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MINISTER OF HIGHER EDUCATION

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER ENGINEERING

COURSE: INTERNET PROGRAMMING AND MOBILE APPLICATIONS

COURSE CODE: CEF 440

********** UNIVERSITY OF BUEA **********

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TASK 2

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INTRODUCTION

Background:

In the context of increasing global awareness about the impacts of natural disasters, there is a pressing need for efficient disaster management systems. These systems are crucial for minimizing the impact of disasters on human life, property, and the environment. Traditional disaster management approaches often rely on fragmented and manual methods of communication and coordination, which can lead to delays and inefficiencies in response times and resource allocation.

Problem Statement:

With the rise in frequency and intensity of natural disasters, such as hurricanes, earthquakes, and floods, coupled with urban densification, the existing disaster management frameworks are often found lacking. They struggle with issues such as real-time data dissemination, efficient incident reporting, and effective coordination of resources, all of which are vital during a crisis.

Project Goal:

The goal of this project is to develop a Mobile-Based Disaster Management System using Unified Modeling Language (UML) to design and visualize the system architecture. This system aims to leverage the ubiquity and capabilities of mobile technology to enhance disaster preparedness, response, and recovery efforts.

Objectives:

Enhance Real-Time Communication: To provide real-time alerts and updates to users during disasters to ensure they are well-informed and can take appropriate actions promptly.

Streamline Incident Reporting: To enable users to report new incidents directly through the mobile app, ensuring quick dissemination of information to relevant authorities and responders.

Improve Resource Allocation: To facilitate better management and allocation of emergency resources by providing detailed, real-time information about resource availability and needs.

Integrate Geographic Information Systems (GIS): To utilize GIS for mapping disaster-affected areas and creating clear, accessible evacuation routes and safe zones.

Approach:

The system will be designed using various UML diagrams to outline the system's functionality, structure, behavior, and interaction with users. These diagrams will include use case diagrams,

sequence diagrams, class diagrams, activity diagrams, component diagrams, and deployment diagrams. Each diagram will contribute to a comprehensive understanding of the system's architecture and operations.

Significance:

This project is significant as it aims to use advanced technology solutions to address critical challenges in disaster management. By improving communication, reporting, and resource management through a mobile application, the system will contribute to more effective disaster response strategies, ultimately leading to reduced disaster impact on communities.

METHODOLOGY

Overview:

The methodology section outlines the systematic approach used to develop the Mobile-Based Disaster Management System. Emphasis is placed on the use of Unified Modeling Language (UML) to create a series of diagrams that represent various aspects of the system. This approach ensures a structured and detailed design phase, which is critical for developing a robust and effective system.

UML Utilization:

UML is a standardized modeling language that provides a way to visualize a system's architectural blueprints in various dimensions, including static structure, dynamic behavior, and user interaction:

Static Structure Representation:

Class Diagrams were used to define the system's classes, their attributes, operations, and the relationships among objects. These diagrams help in understanding the data and functionality the system will manage.

Component Diagrams provided insights into the software components and their dependencies, which is crucial for building the system's modular architecture.

Dynamic Behavior Representation:

Sequence Diagrams illustrated how objects interact with each other in terms of a sequence of messages in particular use cases. This is especially useful for understanding the flow of information and control in the system during incident reporting and alert notifications.

Activity Diagrams showed the flow from one activity to another within the system. These diagrams are useful for depicting the workflow of the application, including decision points, user actions, and concurrent activities.

User Interaction Representation:

Use Case Diagrams captured the interactions between a user and the system, providing a high-level overview of the system's functionality and highlighting the roles of various users and their interaction with the system functionalities.

Design Principles:

The design of the system is guided by several key principles:

Modularity: The system is broken down into interconnected modules that can be developed, tested, maintained, and updated independently.

Scalability: The architecture is designed to handle increasing workloads and to be scalable to accommodate growth in user numbers and data volume without performance losses.

Security: Security measures are integrated into the design to protect data and ensure privacy and integrity.

User-Centric Design: The system interface and interactions are designed with a focus on user experience, ensuring ease of use, accessibility, and effectiveness in emergency situations.

Diagram Development Process:

The process of developing UML diagrams involved iterative refinement:

Drafting: Initial diagrams were created to capture basic ideas and functionalities.

Reviewing: Diagrams were reviewed for accuracy, completeness, and feasibility.

Revising: Necessary adjustments were made based on the review, with particular attention to incorporating feedback and simplifying complex processes.

Tools Used:

UML diagrams were created using software tools such as PlantUML, which facilitated easy diagramming and quick revisions.

USER REQUIREMENTS

Overview:

This section outlines the specific user requirements for the Mobile-Based Disaster Management System, derived from the theoretical use cases and functionalities necessary for effective disaster management. These requirements are categorized into functional and non-functional requirements to provide clarity and structure.

Functional Requirements:

Functional requirements describe what the system should do. They include interactions and tasks the system must perform:

Receive Real-Time Alerts:

Users receive notifications about emergencies and disasters in real-time, customized based on their location and preferences.

Report Incidents:

Users can report emergencies or incidents directly through the app, including details like type of incident, location, and severity.

Access Emergency Resources:

The system provides information about available emergency resources such as shelters, first-aid stations, and evacuation centers.

View Disaster Maps:

Integration with GIS to display maps showing affected areas, safe zones, and evacuation routes.

Community Interaction:

Features to enable users to communicate with other community members, share information, and coordinate community response efforts.

Non-Functional Requirements:

Non-functional requirements define how the system operates, focusing on usability, reliability, performance, and support:

Usability:

The interface must be user-friendly, intuitive, and accessible to individuals with varying levels of technology skills and abilities.

Performance:

The system must perform efficiently under high demand during a disaster, with capabilities to handle high traffic and data loads.

Reliability:

High availability during emergency situations, with minimal downtime and the ability to recover quickly from failures.

Security:

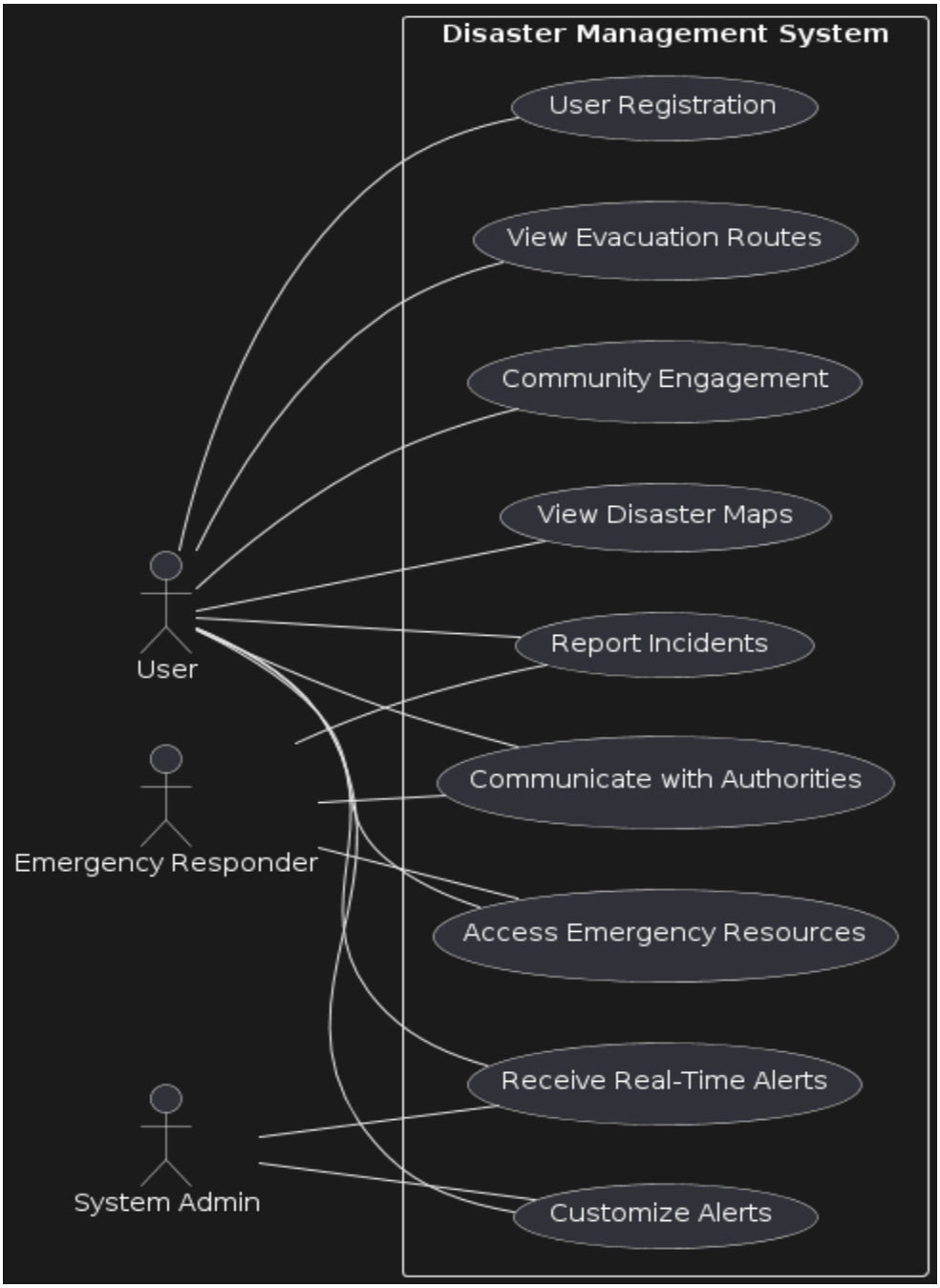
Robust security measures to protect sensitive user data and prevent unauthorized access.

Scalability:

The architecture should support scaling to accommodate a growing number of users and data without degradation in performance

UML MODELS

Use Case Diagram:



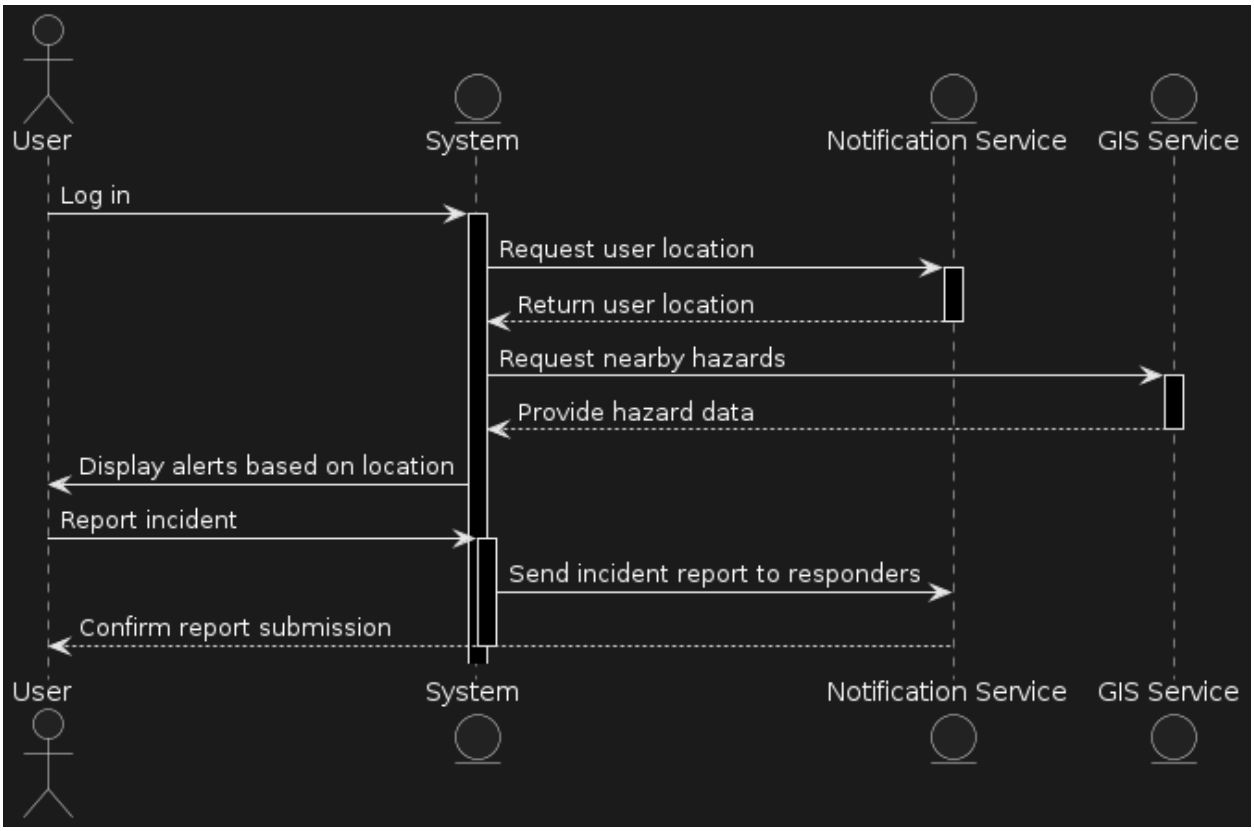
These interactions are defined between three main actors:

User: Engages with most of the system functionalities.

Emergency Responder: Involved in incident reporting, accessing emergency resources, and communication.

System Admin: Manages alert settings and oversees the system operations.

Sequence Diagrams:



Sequence Steps:

User Logs In: The user initiates the process by logging into the system.

System Requests User Location: The system requests the user's location from the Notification Service.

Notification Service Returns Location: The Notification Service provides the user's current location to the system.

System Requests Nearby Hazards from GIS: The system then queries the GIS Service for any nearby hazards based on the user's location.

GIS Provides Hazard Data: The GIS Service returns data about nearby hazards.

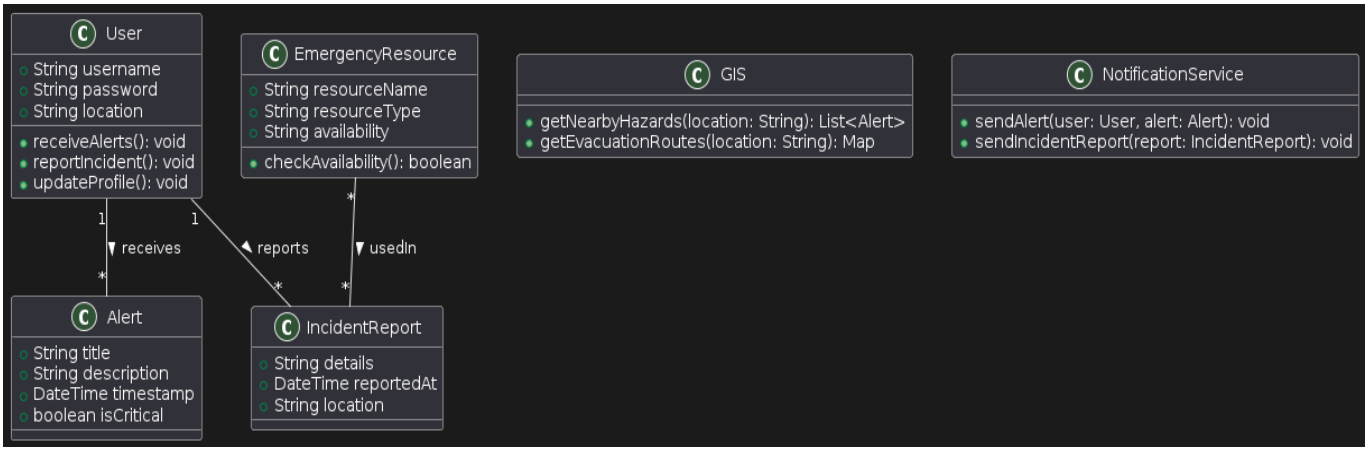
System Displays Alerts: The system displays relevant alerts to the user based on the provided location and hazard data.

User Reports an Incident: The user reports an incident through the system.

System Sends Incident Report to Responders: The system forwards the incident report to emergency responders via the Notification Service.

Notification Service Confirms Report Submission: The Notification Service confirms to the user that the incident report has been successfully submitted.

Class Diagrams:



Classes and Relationships:

User:

Attributes: username, password, location

Operations: receiveAlerts(), reportIncident(), updateProfile()

Relationships: Receives alerts and reports incidents**.**

Alert:

Attributes: title, description, timestamp, isCritical

Used to notify users about emergencies and disasters.

IncidentReport:

Attributes: details, reportedAt, location

Used for documenting incidents reported by users.

EmergencyResource:

Attributes: resourceName, resourceType, availability

Operations: checkAvailability()

Related to incident reports and used to manage emergency resources.

GIS (Geographic Information System):

Operations: getNearbyHazards(location), getEvacuationRoutes(location)

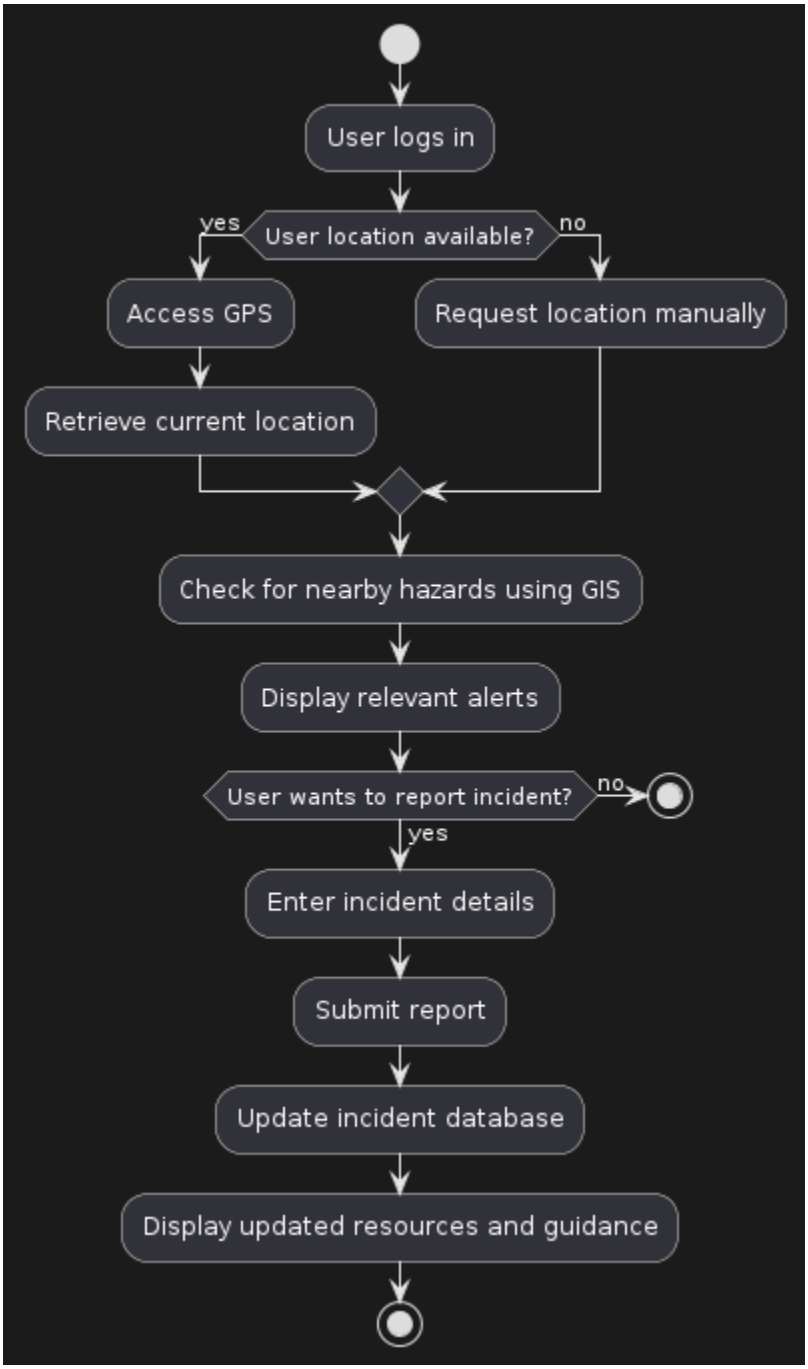
Provides geographical data to support alerting and evacuation procedures.

NotificationService:

Operations: sendAlert(user, alert), sendIncidentReport(report)

Manages the distribution of alerts and incident reports to users and responders.

Activity Diagrams:



Steps in the Diagram:

User logs in: The user accesses the system by logging in.

Check User Location: The system checks if the user's location is available.

If yes: The system accesses the GPS to retrieve the current location.

If no: The user is requested to manually enter their location.

Check for Nearby Hazards: The system uses GIS to check for nearby hazards based on the retrieved location.

Display Relevant Alerts: Based on the hazard data, relevant alerts are displayed to the user.

User Decides to Report Incident:

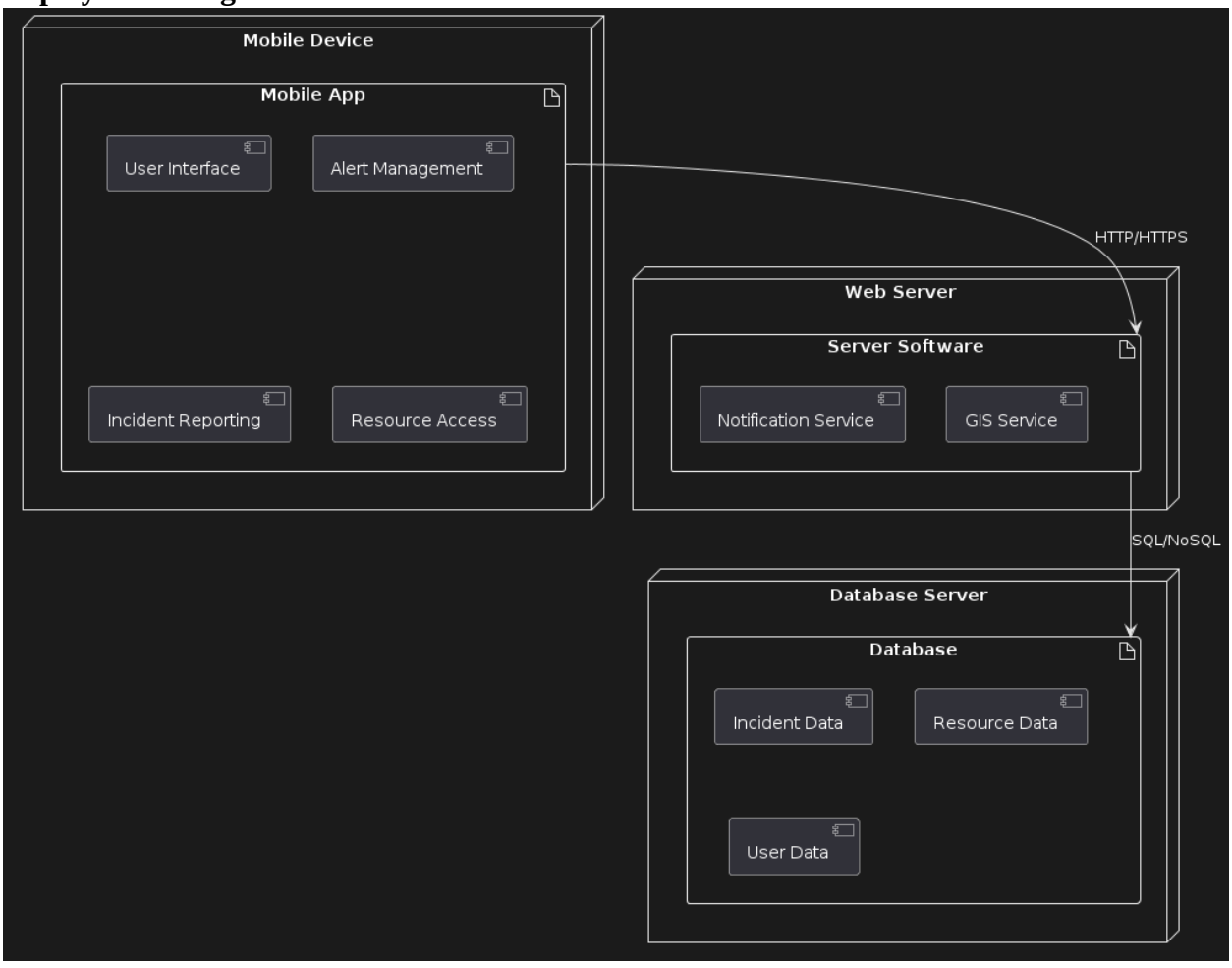
If yes: The user enters incident details and submits the report. The system then sends a notification to Emergency Responders to confirm the report submission.

If no: The activity ends.

Update Incident Database: After submitting the incident report, the system updates the incident database.

Display Updated Resources and Guidance: Finally, the system displays updated resources and guidance to the user.

Deployment Diagram:



Key Components of the Diagram:

Mobile Device:
Mobile App: Contains various components including:

User Interface: The front-end through which users interact with the app.

Alert Management: Manages the reception and display of alerts to the user.

Incident Reporting: Handles the creation and submission of incident reports by users.

Resource Access: Provides information about emergency resources available to the user.

Web Server:
Server Software: Includes components that handle back-end services such as:

Notification Service: Manages the sending of alerts and notifications to users.

GIS Service: Provides geospatial data processing services for mapping and routing.

Database Server:
Database: Stores various types of data, managed by different components:

Incident Data: Stores information related to incidents reported by users.

Resource Data: Maintains data about resources available during disasters.

User Data: Holds user profile information.

Communication between Components:

Mobile App to Server Software: Communication happens over HTTPS protocols, allowing for data exchange and requests between the mobile application and server services.

Server Software to Database: we used NoSQL queries to access and update data stored on the database server.

Analysis of Requirements for the Mobile-Based Disaster Management System

Overview:
This section provides a thorough analysis of the functional and non-functional requirements defined earlier in the report. It examines the feasibility, risks, and priorities associated with these

requirements to ensure they are both realistic and aligned with the overall objectives of the Mobile-Based Disaster Management System.

MoSCoW Analysis of Requirements for the Mobile-Based Disaster Management System

1. Must Have

These are the critical requirements that the system cannot function without. They are essential for the system's basic operations and must be included in the first version of the software.

Receive Real-Time Alerts: Users must receive immediate notifications about disasters relevant to their locations to ensure timely responses**.**

Report Incidents: Users must be able to report new incidents, providing crucial on-the-ground data to disaster response teams and other system users.

User Registration and Login: Essential for tracking user preferences and delivering personalized alerts.

View Disaster Maps: Critical for providing users with navigational help and situational awareness during disasters.

2. Should Have

These requirements are important but not critical for the launch. They enhance user experience and system functionality and should be included as soon as the must-have features are stable.

Access Emergency Resources: Users should be able to access information about emergency resources, though the system can function at a basic level without this feature.

Community Engagement Tools: Features like forums or chat rooms for users to communicate and share information during disasters.

Customize Alerts: Allow users to customize the types of alerts they receive, enhancing user experience and system usability.

3. Could Have

These are desirable features that could be included if time and resources permit. They are not necessary for the initial roll-outs but can be added to enhance the system in future updates**.**

View Evacuation Routes: Providing detailed evacuation routes can be an extension of the basic map functionalities.

Multi-language Support: Enhancing the system to support multiple languages could broaden the user base and inclusivity.

4. Won't Have (for now)
These features are not planned for development in the current project scope, either due to complexity, cost, or current irrelevance.

In-depth Customization of User Profiles: Beyond basic alert customization, more detailed user profile customizations such as UI themes or advanced settings**.**

Integration with Non-Essential Third-Party Services: While potentially useful, integrating non-essential services could divert focus from core functionalities.

CONCLUSION

Summary of Project Goals and Objectives:
The Mobile-Based Disaster Management System aims to revolutionize how emergencies are managed by leveraging mobile technology to enhance real-time communication, incident reporting, resource management, and community engagement. This system is designed to provide critical support during disasters, ensuring timely and effective responses that could save lives and minimize property damage

Feasibility and Viability:
The feasibility study has shown that while there are challenges, the project is technically and economically viable. The technology stack required to build and support the system is well-established.

Closing Thoughts:
This project represents a significant step forward in the use of technology for disaster management. By addressing the challenges and embracing the opportunities presented by mobile technology, the system promises to enhance the effectiveness of disaster response operations and improve safety outcomes for communities worldwide. The commitment to adapting to environmental changes will be key to the project's success and long-term sustainability**.**

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