Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

CS7CS3 Advanced Software Engineering Group Project, Project Name: Response to City Disaster

GROUP 16

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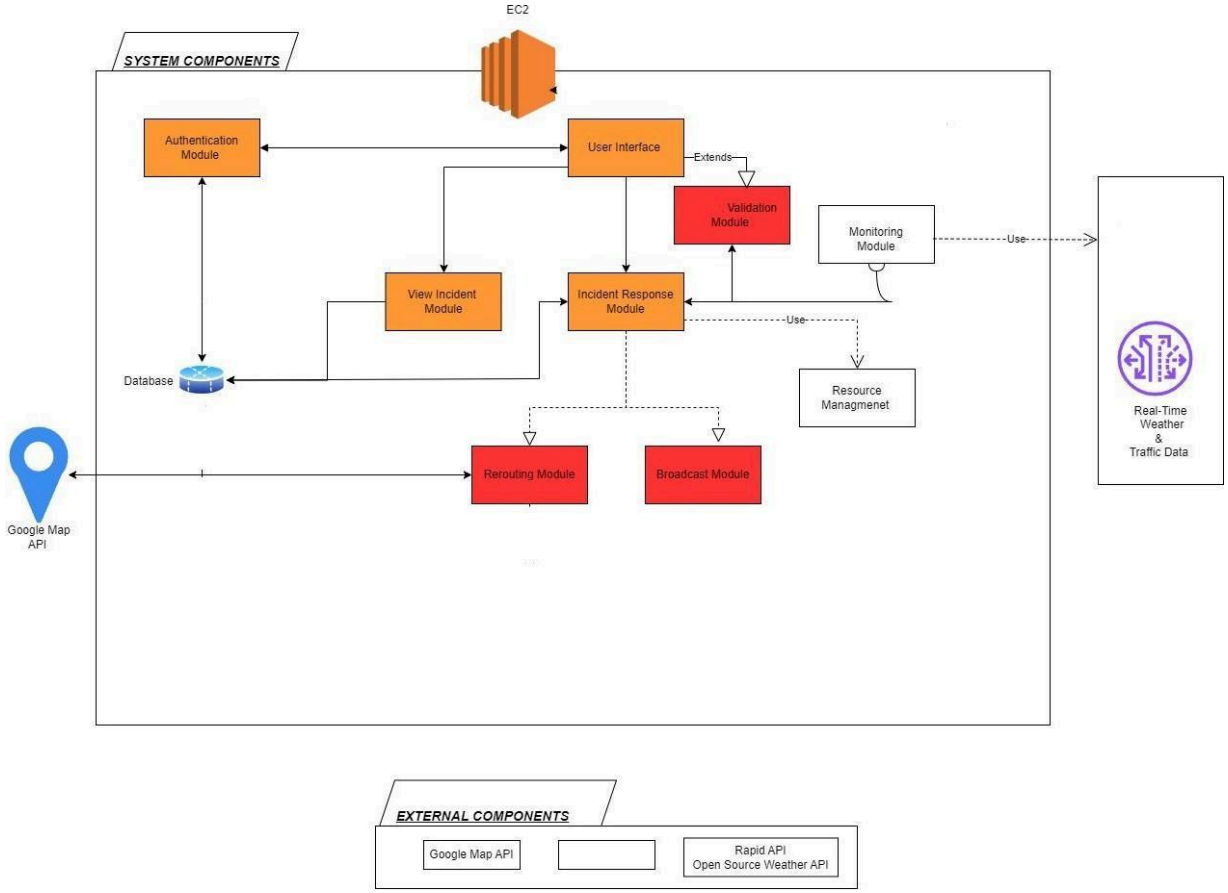
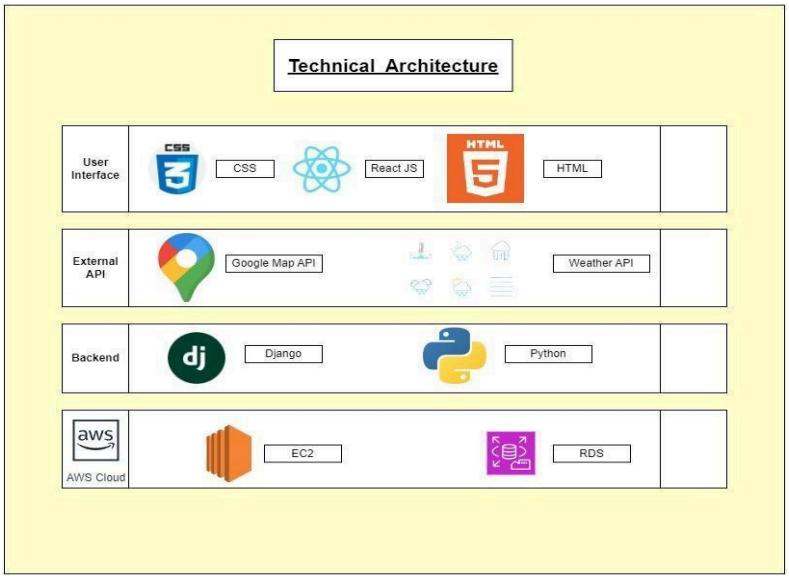
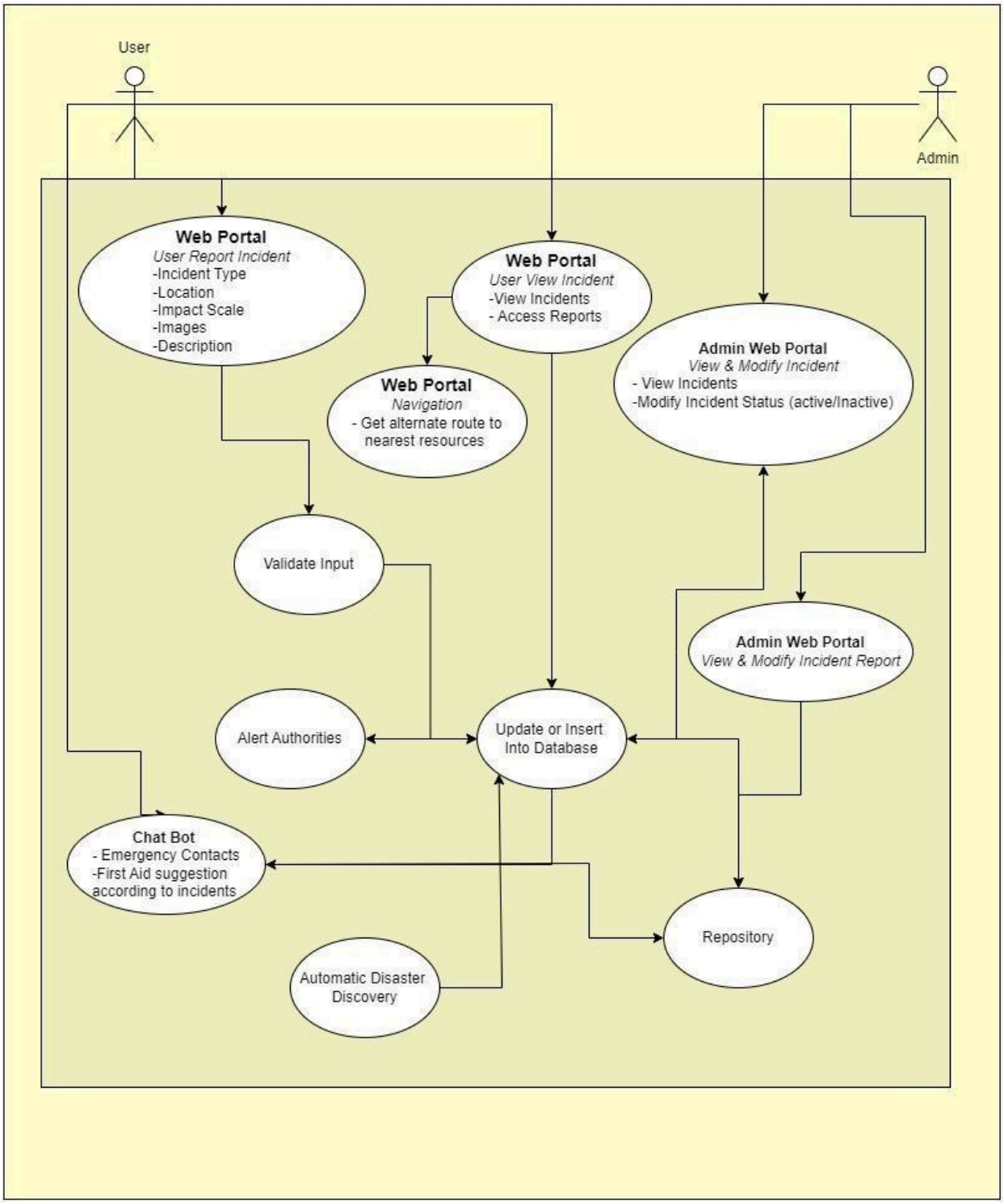
1.1 FUNCTIONAL ARCHITECTURE



1.2 TECHNICAL ARCHITECTURE



1.3 SYSTEM USECASE DIAGRAM



Code-based Solutions to Generalizable, Complex Computer Science Problems

Problem 1: Real-Time route adjustment in response to emergency events

Description of problem:
Developing an algorithm and system that takes real-time inputs from various data sources (e.g., official reports, weather services, traffic data) to dynamically adjust vehicular routes in response to natural disasters.
Challenges:
1. Integration of multiple, possibly heterogeneous, data sources.
2. Ensuring low latency in data processing to provide real-time route adjustments.
3. Providing accurate and safe alternative routes that are efficient and keep users away from danger.

Generalizability:
This problem isn't just limited to natural disasters but can be generalized to any large-scale events that impact traffic, such as big sporting events, large concerts, or political rallies. Furthermore, the core idea of dynamically adjusting to real-time data can be applied in various domains, like stock trading, health monitoring systems, or energy grid management.

Proposed Solution:
Technology:
a. Architecture:
i. We'll store important information using AWS for easy access and historical record-keeping.
ii. AWS Step Functions will help us organize the various steps our system needs to perform.

b. Data Integration:
i. We'll use AWS Glue to make sure data from different sources fits together properly.

c. **Scalability**:
i. To ensure that data is always accessible and responds quickly, we'll use Amazon RDS.

d. Route Accuracy and Safety:
i. Google Maps API will assist us in planning precise routes, offering real-time traffic information, and guiding drivers effectively.

ii. Amazon Location Service will help us analyze locations to find the safest and most efficient alternative routes.

Problem 2: Chat bot for immediate assistance to users through automated response

Algorithm Development:

Developing an algorithm to implement a chat bot which assists users in emergency situations by developing

1. **Intent Recognition:** To classify user requests into different categories such as medical emergencies, natural disasters, etc.

2. **Dialogue Management:** To maintain a coherent conversation flow and assist users efficiently.
Data Collection: displaying real-time data from various sources such as weather stations, disaster API's etc.

Building up the database using websites such as for references,

- https://www.disasterassist.gov.au/home
- https://gdacs.org/

3. Algorithms and Libraries:

Utilization of Natural Language Processing (NLP) libraries that assist with transforming text to keyword, which will help in processing the users input and providing response.

Problem 3: Automatic Disaster Detection System

Algorithm Development:

Data Collection: Gathering real-time data from various sources such as weather station data through API calls from both private and government Meteorological department resources (MetEireaan)

The challenge is to develop an algorithm and system that dynamically helps in acknowledging any disasters that occurred or have been active in a specific area and fetches inputs in real-time based on various data sources, including official reports, weather services, and potentially other parameters like temperature, humidity, precipitation, air quality. The goal was to design an algorithm that detects the most highlighted natural disaster that occurs in the city according to the Ireland terrain.

Challenges:

Integration of Multiple Data Sources:

Combining data from diverse sources such as official reports, weather services, and traffic. This

integration is important in handling insights from weather forecasts and emergency reports.

Handling Large-Scale Data:

During widespread disasters, the system must handle a massive influx of data efficiently to provide effective route adjustments without bottlenecks or delays.

Providing Accurate and Safe Alternative Routes:

The system needs to analyze data accurately to identify safe alternative routes that minimize risks for drivers and avoid danger zones.

Generalizability:

This problem extends beyond natural disasters and can be generalized to any large-scale events that impact traffic, such as concerts, sports events, or political rallies.

The concept of dynamically adjusting routes based on real-time data can be applied across various domains, including stock trading, health monitoring systems, and energy grid management.

Proposed Solution:

Technology:

Architecture:

Designing architecture that can handle real-time data processing and route optimization efficiently.
Scalability:
Deploying the system on cloud infrastructure to leverage scalability features like auto-scaling and elasticity.

Algorithm and System Development:

- Developing an algorithm for real-time data processing event recognition. This allows the

system to recognize the emergency conditions quickly, which facilitates immediate response.

- Implementing a predictive algorithm, the system forecasts any potential disasters by analyzing the trend or patterns exhibited in the weather data fetched. This would be considered a pre-planned action, which enhances to a mitigating approach to potential impacts.
- Dynamic update of the disaster threshold parameters according to the seasonal region-based logic to alleviate the coherence of the system to omit any indefinite fetching of the data and display of false activity/event.

Continuous Improvement:

- Dynamically updating algorithms and models based on new data and insights to help enhance route optimization and responsiveness to emergency events