CSE 7101- Capstone Project Review-2

PROJECT TITLE - AI-Driven Smart Ambulance Routing and EMS Triage Dashboard for Disaster/Dispatch Management

Batch Number: CSE-156

ROLL NUMBER	NAME
20211CSE0242	ZOYA ALAM
20221CSE0021	FAIZAN AHMED
20221CSE0541	PAVITRA PRABHUSWAMI HIREMATH

Under the Supervision of,

Mr. Syed Mohsin Abbasi
Assistant Professor
School of Computer Science and Engineering
Presidency University

Name of the Program: Computer Science and Engineering
Name of the HoD: Dr. Asif Mohamed H.B.
Name of the Program Project Coordinator: Dr. Jayavadivel Ravi
Name of the School Project Coordinators: Dr. Sampath A K , Dr. Geetha A

Content

Abstract

1. **Problem:** Inefficient dispatching of emergency services in Bengaluru due to a lack of real-time data and intelligent decision-making tools.

2. **Objective:** To create an AI-powered system to optimize resource allocation by analyzing emergency calls, predicting incident severity, and recommending appropriate response units.

3. **Approach:** A server-rendered web application featuring a live map, real-time fleet tracking, and AI-powered guidance for dispatchers, all built on a robust, modern technology stack.

Literature Survey Summary

Key Reviewed Papers:

1. **Comprehensive Review:** Analyzed **10 relevant research papers** from IEEE Xplore
2. **Key Finding:** Traditional dispatch systems rely heavily on manual decision-making, leading to delays and suboptimal resource allocation.
3. **Opportunity:** Advancements in **Machine Learning**, server-side rendering, and real-time data processing offer significant opportunities for improvement.
4. **Our Focus:** Applying structured **AI flows** for incident classification and using **predictive analytics** for demand forecasting.

Literature Survey - Comprehensive Review & Critical Analysis

Objectives

1. **Develop a high-performance, real-time dispatch dashboard** using Next.js and React.
2. **Implement structured AI-powered incident analysis** using Genkit to automatically analyze caller reports.
3. **Optimize resource allocation** by developing an algorithm to recommend the nearest and most appropriate response unit.
4. **Integrate a persistent, real-time database** using Firebase Firestore for live data synchronization.
5. **Provide intelligent decision support and analytics**, offering AI-generated guidance and displaying KPIs on a dashboard with Recharts.

Existing Methods and Drawbacks

1. **Manual Call Triage:** Subjective and prone to error, leading to misclassification of emergencies.

2. **Client-Side Rendering:** Traditional single-page applications often have slower initial load times, which is not ideal for a critical system.

3. **Static Resource Allocation:** Units are often dispatched based on proximity alone, ignoring specific capabilities needed for the incident.

4. **Lack of Real-Time Data:** Outdated information on fleet status and hospital availability leads to inefficient routing.

5. **Consequences:** Increased response times, suboptimal patient outcomes, and inefficient use of critical resources.

Proposed Method

1. **Frontend & Backend Framework:** The application is built with **Next.js** (App Router) for fast, server-side rendering. The entire codebase is in **TypeScript** for enhanced safety and maintainability.

2. **AI Logic with Genkit:** All AI interactions are managed through **Genkit**, allowing for structured, testable, and observable "flows" for tasks like analyzing reports or generating summaries.

3. **UI and Visualization:** The interface is constructed with **ShadCN UI** for a professional design. The map is powered by **MapLibre GL JS**, and the analytics dashboard features charts from **Recharts**.

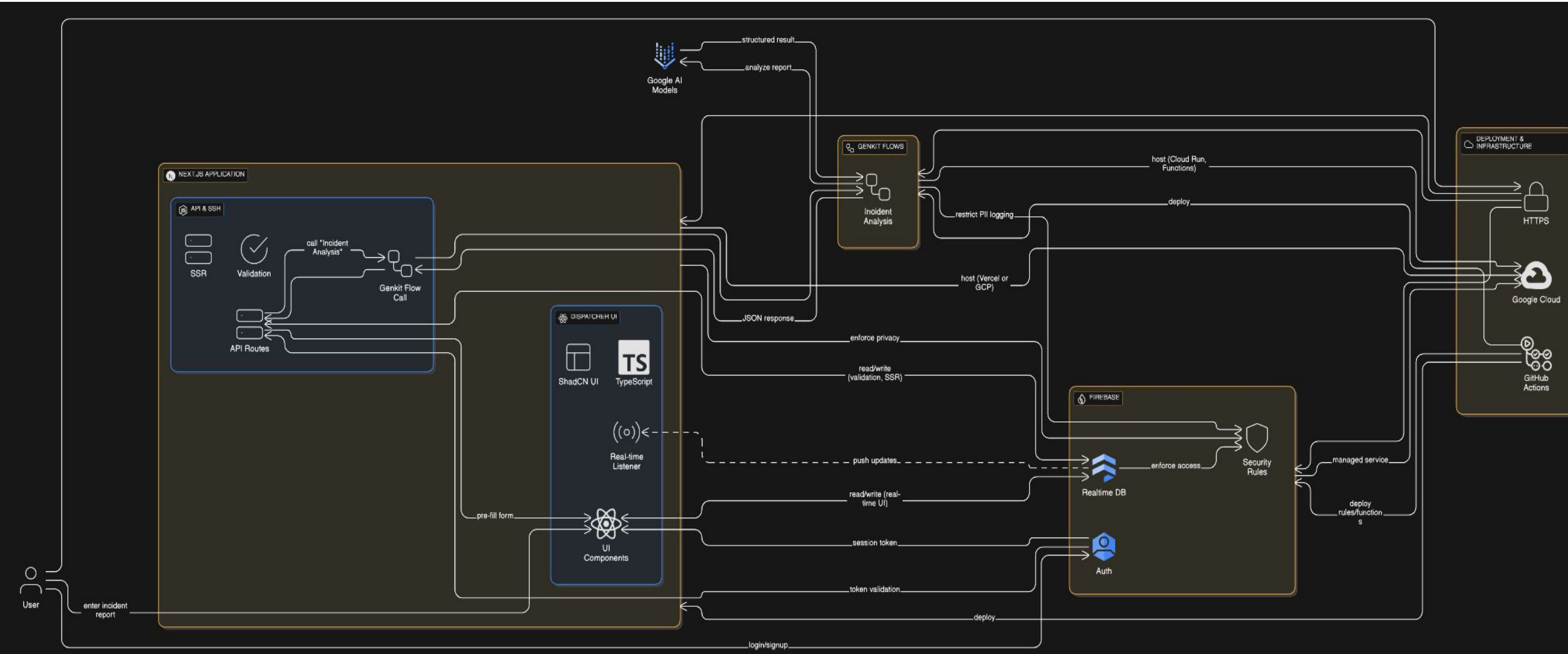
Feasibility Study

1. **Technology:** The proposed stack (Next.js, TypeScript, Genkit, Firebase) is modern, well-documented, and widely adopted, ensuring a strong foundation.

2. **Cost:** The use of open-source libraries and scalable cloud services (Firebase, Google AI Platform) makes the project highly cost-effective.

3. **Resources:** The project can be developed by a team with skills in modern web development (React/Next.js), TypeScript, and AI API integration.

System Architecture Diagram



Modules

1. **Map & Visualization Module:** Renders the interactive MapLibre GL JS map and all real-time visual elements.
2. **Incident Management Module:** Handles the creation, updating, and resolution of incidents.
3. **Fleet Management Module:** Tracks the real-time status and location of all response units.
4. **Firebase Integration Module:** Manages all communication with the Firestore database.
5. **Genkit AI Module:** Contains all the defined Genkit flows for classification, protocol generation, and reporting.
6. **Analytics Module:** Displays historical data and KPIs on a dashboard using Recharts.

Technology Stack

1. **Language:** TypeScript
2. **Framework:** Next.js (App Router), React
3. **UI Components:** ShadCN UI, Radix UI
4. **Styling:** Tailwind CSS
5. **Generative AI:** Genkit, Google AI Platform
6. **Mapping:** MapLibre GL JS
7. **Charts & Analytics:** Recharts
8. **Database:** (Firestore)
9. **Development:** Visual Studio Code, Git, Firebase Studio

Timeline of the Project (Gantt Chart)

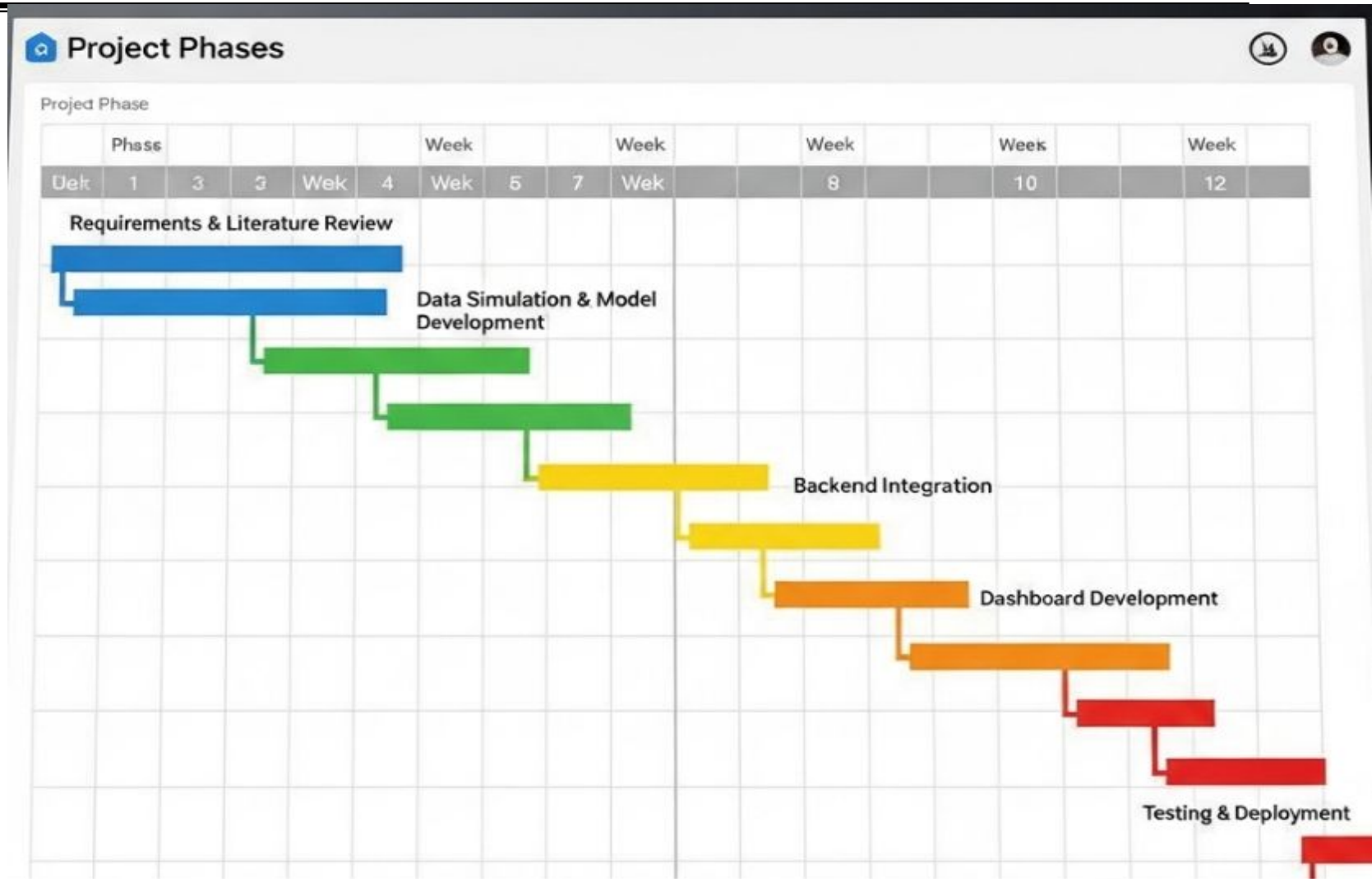
Phase 1 (Weeks 1-2): Focus on requirements gathering and literature review.

Phase 2 (Weeks 3-5): Involves data simulation and model development.

Phase 3 (Weeks 6-8): Dedicated to backend integration.

Phase 4 (Weeks 9-10): Centered on dashboard development.

Phase 5 (Weeks 11-12): Concludes with testing and deployment.



Github Link

Github Link

"The GitHub repository provides public access to our project's source code, documentation, and data simulation scripts. You'll find implementations of the AI/ML models for hospital recommendation

and ambulance routing, along with setup instructions to run the system. We welcome community contributions and feedback.

GitHub Link: https://github.com/FURIOUSCHAMP007/CAPSTONE-PROJECT

References (IEEE Paper format)

[1] S. Shalini, C. Nandini, G. S. R., M. Yasaswini, N. Jain, and A. P., "Greenvoy: A Survey on Smart Ambulance Routing through Green AI and Edge Intelligence," *Int. J. Sci., Eng. Technol.*, vol. 13, no. 3, pp. 227-234, 2025. [Online]. Available: https://www.ijset.in/wp-content/uploads/IJSET_V13_issue3_227.pdf

[2] A. R. Nair, R. R. Patil, and M. R. Deshmukh, "Smart Ambulance Route Optimization System," *Int. Res. J. Eng. Technol.*, vol. 12, no. 4, pp. 417-422, Apr. 2025. [Online]. Available: https://www.irjet.net/archives/V12/i4/IRJET-V12I417.pdf

[3] J. W. Escobar, M. Á. Ortiz-Barrios, and J. C. Paz-Roa, "Ambulance route optimization in a mobile ambulance dispatch system using deep neural network (DNN)," *Sci. Rep.*, vol. 15, no. 1, 2025. [Online]. Available: https://www.nature.com/articles/s41598-025-95048-0

[4] D. Olivia, G. Attigeri, and A. Saxena, "Optimization model for mass casualty management using QoS-aware routing protocol and casualty triage prediction," *Int. J. Inf. Technol.*, vol. 16, pp. 1234-1247, Oct. 2024. [Online]. Available: https://link.springer.com/article/10.1007/s41870-024-02052-0

[5] Y. T. Tan et al., "Pediatric Emergency Medicine Didactics and Simulation: JumpSTART Secondary Triage for Mass Casualty Incidents," *Cureus*, vol. 15, no. 6, p. e39208, Jun. 2023. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10322648/

References (IEEE Paper format)

[6] T. V. Dinh et al., “Evaluation of Triage System Accuracy in Mass Casualty Incidents: A Systematic Review and Meta-analysis,” *Prehosp. Disaster Med.*, vol. 38, no. 4, pp. 393-404, Aug. 2023. [Online]. Available: https://pubmed.ncbi.nlm.nih.gov/35660101/

[7] A. G. C. de Sá, R. L. M. de Souza, A. G. C. P. de Souza, and M. P. Vellasco, “Explainable Machine Learning for ICU Readmission Prediction,” *arXiv preprint arXiv:2309.13781*, Sep. 2023. [Online]. Available: https://arxiv.org/abs/2309.13781

[8] A. M. S. Alsalem et al., “Integrating AI in Emergency Medicine: A Systematic Review in Enhancing Ambulance Dispatch and Triage Systems,” *Indo Am. J. Pharm. Sci.*, vol. 11, no. 12, pp. 112-125, Dec. 2024. [Online]. Available: https://www.iajps.com/wp-content/uploads/2024/12/05.IAJPS05122024.pdf

[9] Y.-Y. Xu et al., “Emergency Medical Service Dispatch Recommendation System Using Simulation Based on Bed Availability,” *BMC Health Serv. Res.*, vol. 24, p. 12006, 2024. [Online]. Available: https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-024-12006-8

[10] J. C. Paz-Roa, J. W. Escobar, and M. Á. Ortiz-Barrios, “A Novel Machine Learning Approach for Spatiotemporal Prediction of Emergency Medical Services Demand,” *J. Emerg. Serv. Anal.*, Jan. 2025. [Online]. Available: https://pmc.ncbi.nlm.nih.gov/articles/PMC11786830/


Thank
You!