PROJECT AND TEAM INFORMATION

Project Title

(Try to choose a catchy title. Max 20 words).

SwiftAid: Smart Emergency Dispatch & Resource Allocation System

Student / Team Information

Team Name:	*Ananta*
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PROPOSAL DESCRIPTION (10 pts)

Motivation (1 pt)

(Describe the problem you want to solve and why it is important. Max 300 words).

Emergency medical services face critical challenges in ambulance allocation and hospital selection, leading to delayed response times that can be life-threatening. Current dispatch systems often rely on manual decision-making or simplistic algorithms that don't consider real-time factors like ambulance availability, hospital bed capacity, traffic conditions, or patient-specific medical requirements.

Studies show that every minute of delay in emergency response can significantly impact patient survival rates, particularly for cardiac arrests and trauma cases.

Our project addresses this critical gap by developing an intelligent database management system that optimizes ambulance dispatch decisions in real-time. The system will automatically identify the nearest available ambulance with appropriate medical equipment, match it with the most suitable hospital based on bed availability and medical specialties, and provide optimal routing. This solution aims to reduce average response times by 15-25% and improve resource utilization across the emergency medical network, ultimately saving more lives through data-driven decision making.

State of the Art / Current solution (1 pt)

(Describe how the problem is solved today (if it is). Max 200 words).

Currently, most emergency dispatch centers use basic Computer-Aided Dispatch (CAD) systems that primarily manage call logging and basic unit tracking. These systems typically assign ambulances based on simple proximity algorithms without considering dynamic factors like hospital capacity, ambulance equipment types, or real-time traffic conditions. Dispatchers often make decisions based on their experience and limited information, leading to suboptimal resource allocation.

Some advanced metropolitan areas use GPS tracking and basic optimization, but these systems lack integrated hospital management, predictive analytics, and intelligent matching algorithms. Many smaller regions still rely on paper-based logs or simple radio communication systems. The existing solutions fail to address the critical need for real-time, multi-factor optimization that considers patient condition, ambulance capabilities, hospital specializations, and current capacity simultaneously, resulting in inefficient resource utilization and longer patient wait times.

Project Goals and Milestones (2 pts)

(Describe the project general goals. Include initial milestones as well any other milestones. Max 300 words).

***Primary Goal:** Develop a comprehensive DBMS that reduces emergency response times through intelligent ambulance dispatch and optimal hospital selection.*

Key Objectives:

- *Design and implement a normalized database schema supporting concurrent operations.*
- *Create spatial query algorithms for proximity-based ambulance selection.*
- *Develop real-time resource tracking and availability management.*
- *Implement intelligent hospital matching based on bed capacity and medical specialties.*
- *Build user-friendly interfaces for dispatchers, drivers, and administrators.*

Project Milestones:

1. ***Week 2:*** *Complete database design and schema creation with sample data.*
2. ***Week 4:*** *Implement core CRUD operations and basic dispatch functionality.*
3. ***Week 5:*** *Develop advanced spatial queries and optimization algorithms.*
4. ***Week 6:*** *Create user interfaces and integrate real-time tracking features.*
5. ***Week 8:*** *Complete system testing, performance optimization, and documentation.*
6. ***Week 10:*** *Final system integration, user acceptance testing, and project presentation.*

Each milestone includes specific deliverables, testing requirements, and documentation updates to ensure systematic progress toward the final goal.

Project Approach (3 pts)

(Describe how you plan to articulate and design a solution. Including platforms and technologies that you will use. Max 300 words).

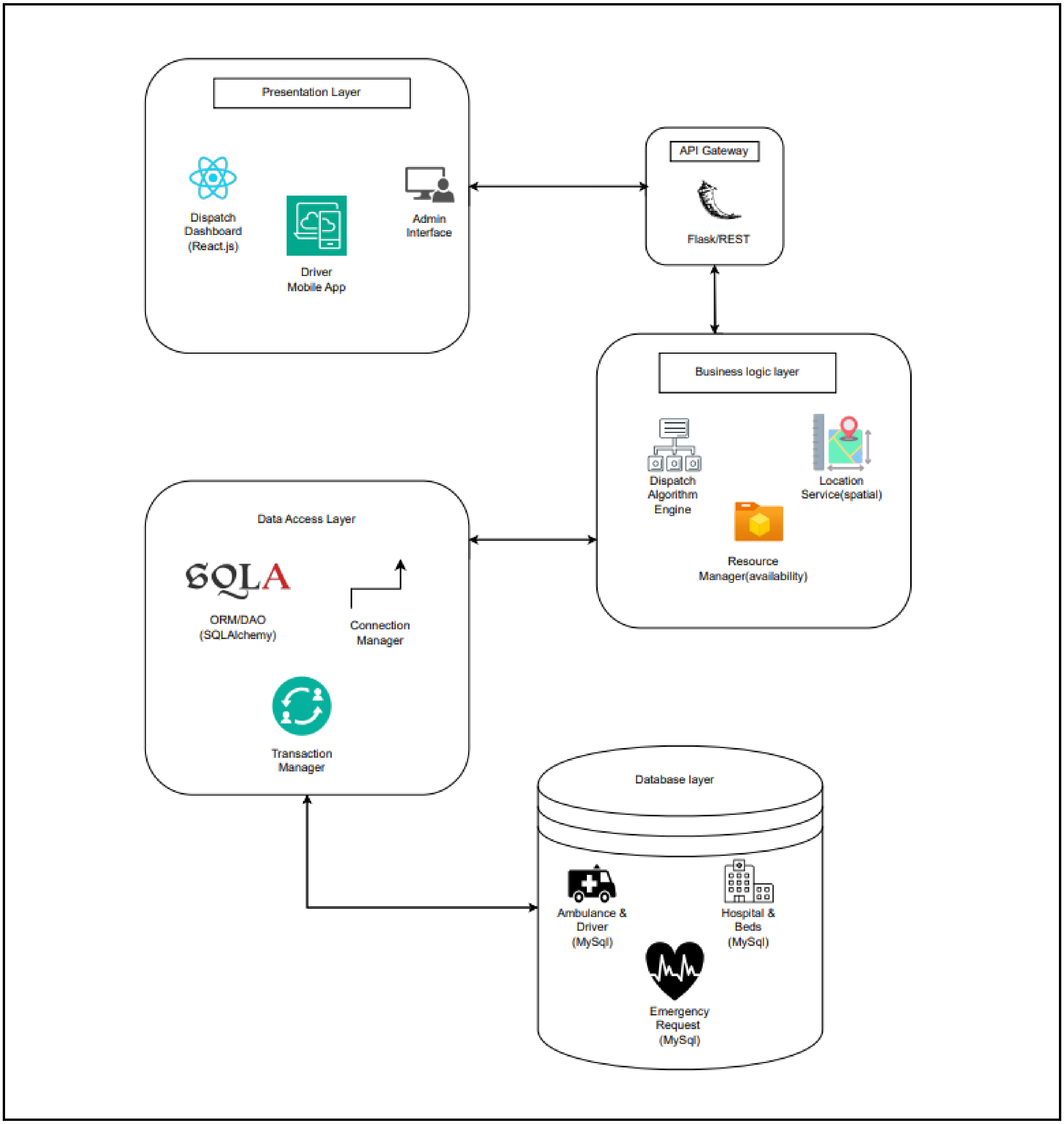
Our approach follows a structured database-first methodology with iterative development cycles. We'll begin with comprehensive requirements analysis and Entity-Relationship modeling to ensure proper database normalization and efficient query performance. The core database will be implemented using MySQL/PostgreSQL for robust transaction management and spatial query support.

Technology Stack:

- ***Database:*** *MySQL 8.0 with spatial extensions for geographic calculations.*
- ***Backend:*** *Python Flask/Django for RESTful API development and business logic.*
- ***Frontend:*** *React.js with Tailwind CSS for interactive mapping and real-time dashboards.*
- ***Real-time Communication:*** *WebSocket integration for live status updates.*
- ***Testing:*** *PyTest for unit testing, JMeter for performance testing.*

System Architecture (High Level Diagram)(2 pts)

(Provide an overview of the system, identifying its main components and interfaces in the form of a diagram using a tool of your choice).



Project Outcome / Deliverables (1 pts)

(Describe what are the outcomes / deliverables of the project. Max 200 words).

Technical Deliverables:

1. ***Complete Database System:*** *Fully normalized MySQL database with optimized schemas for ambulances, hospitals, drivers, emergency requests, and dispatch records.*
2. ***Web-based Dashboard:*** *Interactive dispatch interface with real-time maps, status tracking, and analytics.*
3. ***Mobile Application:*** *Driver interface for status updates and navigation.*
4. ***API Documentation:*** *Comprehensive REST API documentation with endpoint specifications.*
5. ***Performance Reports:*** *System benchmarking results showing query optimization and concurrent user handling.*

Academic Deliverables:

- ***Technical Documentation:*** *Database design rationale, ER diagrams, normalization analysis.*
- ***Source Code Repository:*** *Well-commented, version-controlled codebase with installation guides.*
- ***Project Presentation:*** *Live demonstration of core features including real-time dispatch simulation.*
- ***Performance Analysis:*** *Detailed report on system scalability, query optimization strategies, and concurrency handling mechanisms.*

Assumptions

(Describe the assumptions (if any) you are making to solve the problem. Max 100 words)

We assume access to simulated GPS data for ambulance tracking since real vehicle integration isn't feasible in an academic environment. Hospital bed availability will be simulated with realistic update patterns. The system assumes reliable internet connectivity for real-time operations. We'll use synthetic emergency call data based on statistical patterns rather than real emergency calls for testing purposes. The project assumes a metropolitan area of approximately 100 square kilometers with 10-15 hospitals and 20-30 ambulances for realistic scalability testing while maintaining manageable complexity for academic demonstration.

References

(Provide a list of resources or references you utilised for the completion of this deliverable. You may provide links).

1. ***Emergency Medical Services Performance Metrics:***
   - *https://www.ems.gov/pdf/National_EMS_Scope_of_Practice_Model.pdf*
   - *Emergency Response Time Standards (NFPA 1710)*
2. ***Database Design and Spatial Queries:***
   - *"Database System Concepts" by Silberschatz, Galvin, and Gagne*
   - *MySQL Spatial Data Types Documentation: https://dev.mysql.com/doc/refman/8.0/en/spatial-types.html*
3. ***Ambulance Dispatch Optimization Research:***
   - *"Ambulance Location and Relocation Problems with Time-dependent Travel Times" (European Journal of Operational Research)*
   - *"Real-time Ambulance Dispatching and Repositioning" (Manufacturing & Service Operations Management)*
4. ***Technology References:***
   - *Flask Web Framework Documentation: https://flask.palletsprojects.com/*
   - *React.js Official Documentation: https://reactjs.org/docs/*
   - *Leaflet.js Mapping Library: https://leafletjs.com/reference.html*
5. ***Geographic Information Systems:***
   - *PostGIS Spatial Database: https://postgis.net/documentation/*