Software Dev 2025

Technology Stack

FrontEnd

React, Leaflet.js, WebSocket API

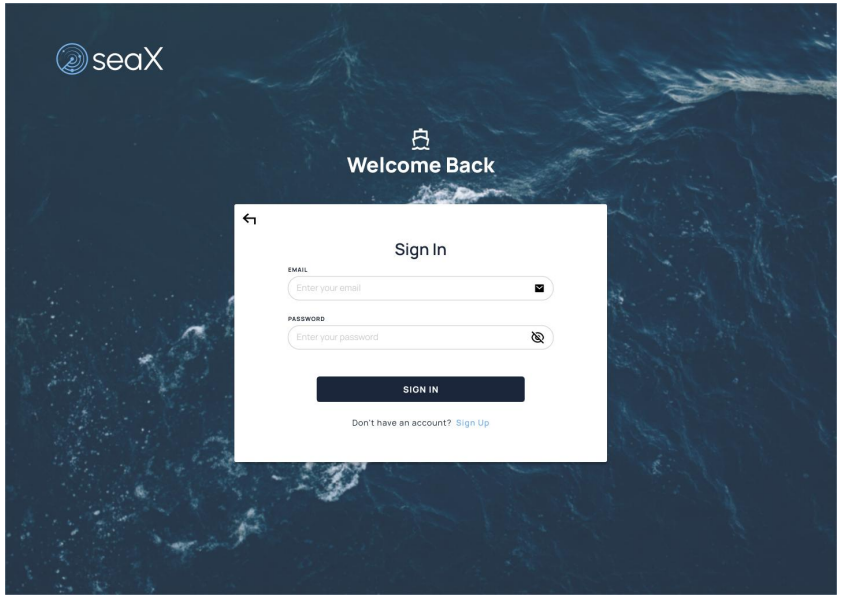
BackEnd

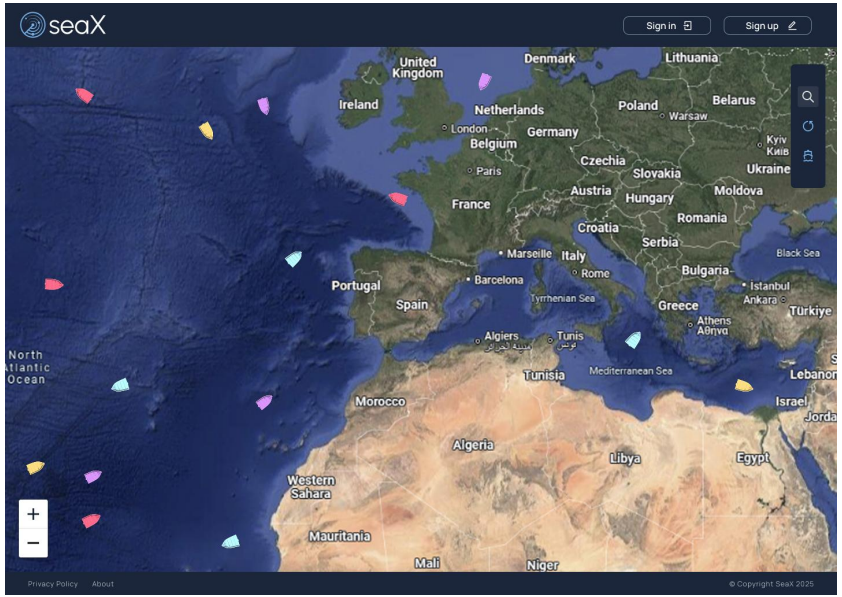
Java-Spring Boot, Apache Kafka, PostgreSQL, PostGIS, Redis

DevOps

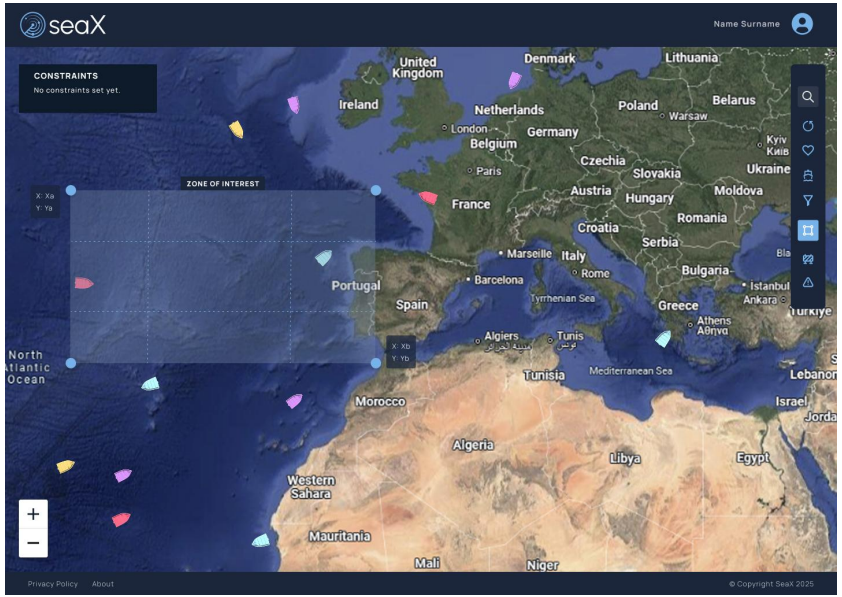
GitHub actions, Docker

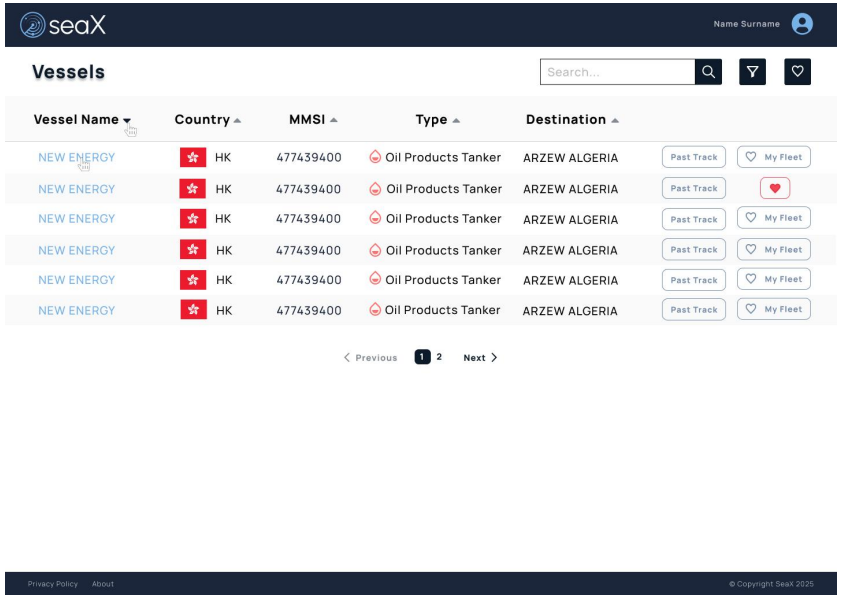
Login page, Guest Home page



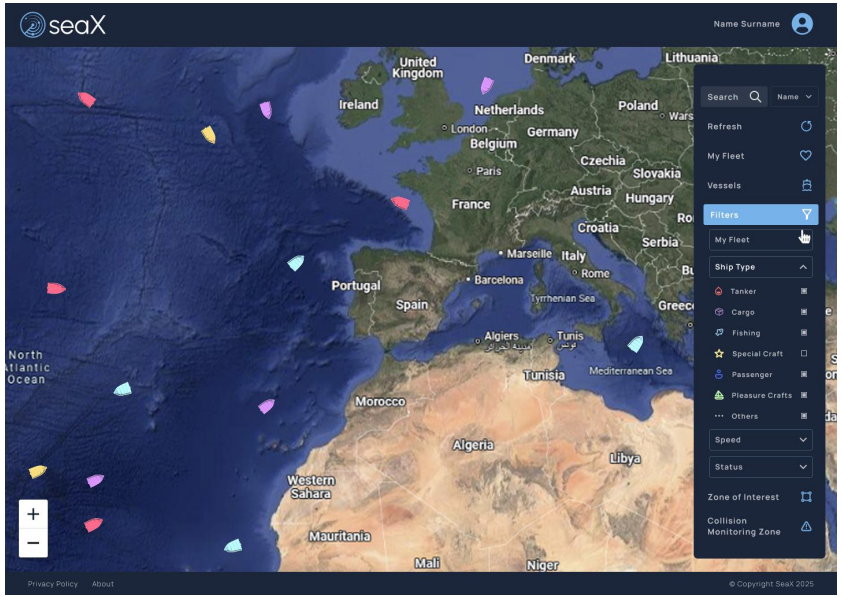


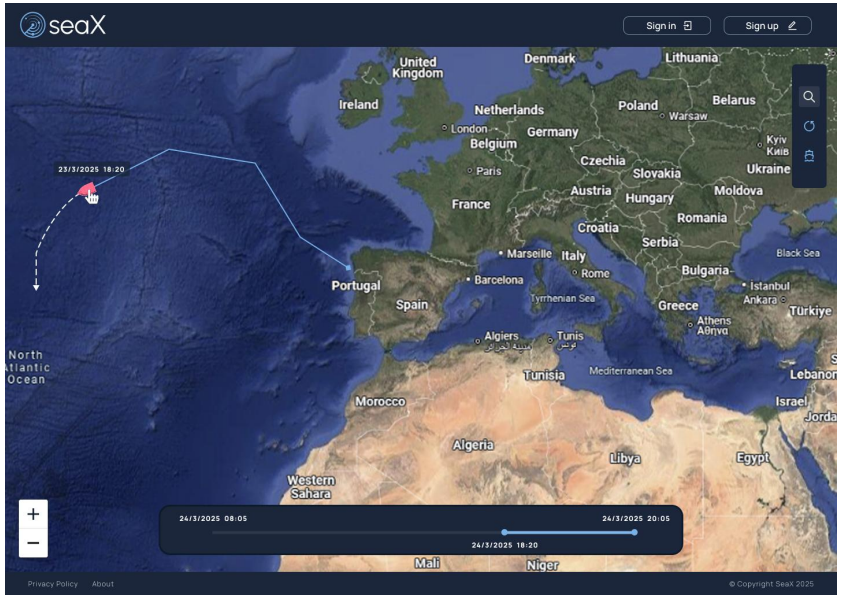
Zone of Interest





Filters, History





Front End - Implementation

User Management

- Forms for registration, login, password reset
- Profile view for editing / deleting
- UI elements hidden/shown based on user role fetched from backend.

Front End - Implementation

Real-Time Ship Tracking

- Map component displaying ship icons.
- WebSocket connection to receive real-time position updates.
- Popup to show detailed ship info when a ship is clicked.
- Filtering controls (dropdowns, sliders) for speed, type, status.
- "My Fleet" view (fetches saved ships for the user).

Historical Data & Search

- Search bar (by Name, MMSI).
- Results list/table, sortable.
- Option to view historical track (last 12h) for a selected ship on the map.
- Clicking a search result highlights/centers the ship on the map.

Front End - Implementation

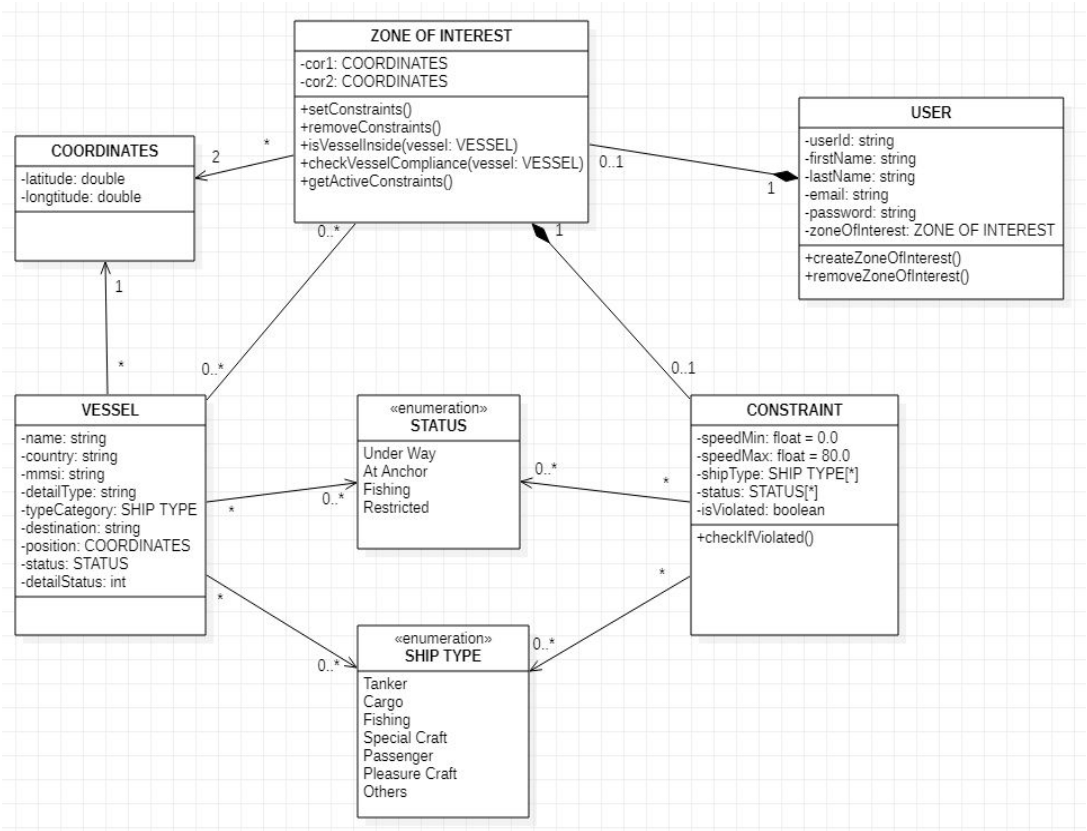
Zones of Interest & Alerts

- Map interface to draw polygonal zones (google.maps.drawing.DrawingManager).
- Form to define rules for the zone (e.g., Max Speed: 10 knots, Allowed Types: Cargo, Tanker, Status: Anchored).

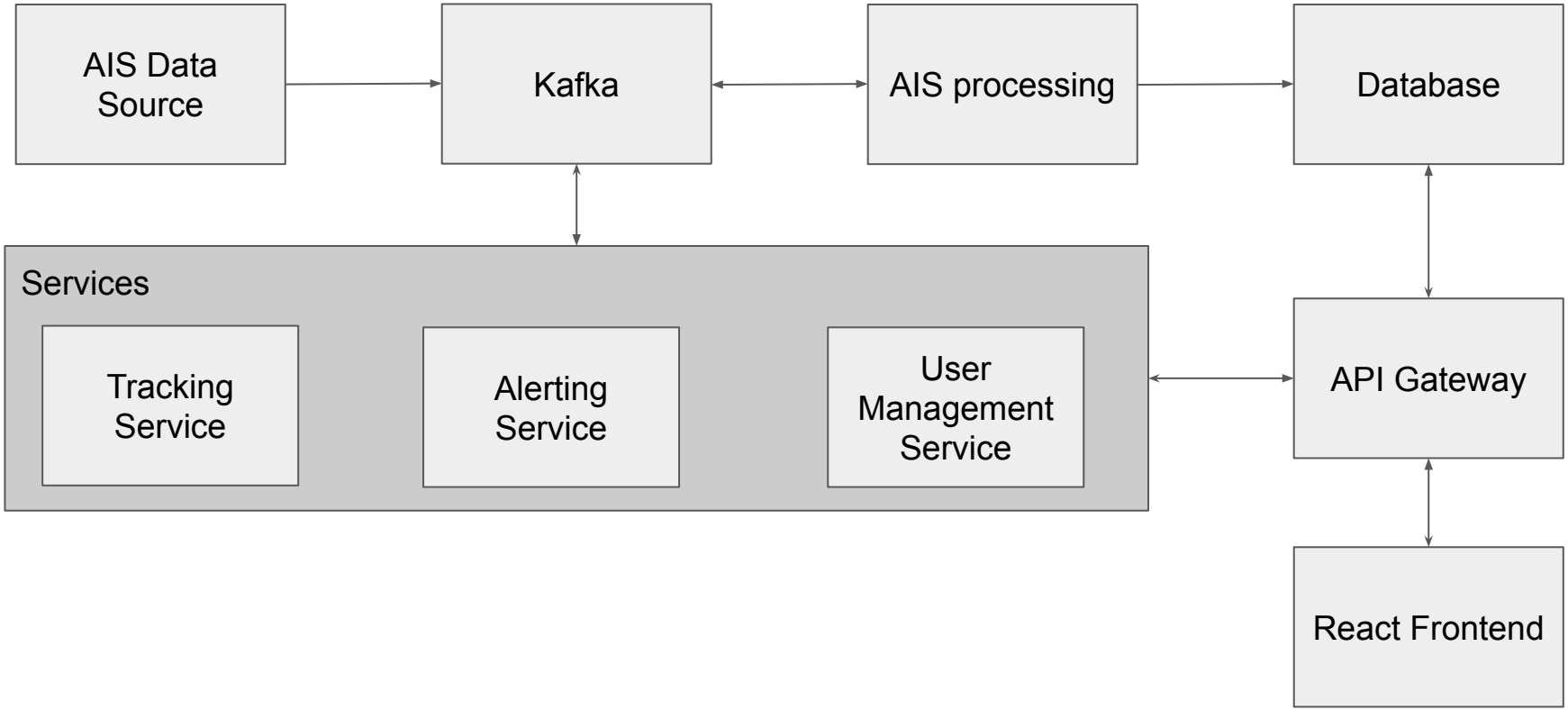
Collision Monitor Zones

- Similar interface to Zones of Interest for drawing zones.

Class Diagram - Zones of Interest



Backend High-Level Architecture Overview



AIS Data Processing and Storage

Ingestion

AIS Feed, Kafka messages, ais.raw

Backend Processing

@KafkaListener, data validation, java object mapping

Database Storage

- PostgreSQL,TimescaleDB
- Tables: ship_positions, ship_static_data, ship_voyage_data

Backend - Ship Tracking

REST API endpoints

/api/ships/current , /api/ships/details/{mmsi}, /api/ships/fleet

Websocket

- /ws/tracking
- Push real-time ship position updates
- Consume (ship.position.updated topic) from @KafkaListener
- Broadcast general updates or client subscriptions

Backend - Historical Data & Search

REST API endpoints

/api/ships/search?query=... , /api/ships/history/{mmsi}?hours=...

Database

- ship_static_data: name, mmsi
- ship_positions: compound index: (mmsi, timestamp)

TimescaleDB

Timestamp in the ship_positions hypertable

Backend - Zones of Interest & Alerts

REST API endpoints

/api/zones/interest , POST-GET-DELETE

Database

- zones_of_interest (id, user_id, name, geom GEOMETRY())
- PostGIS spatial index (geom column)

Rule Engine Logic

- Consume kafka ship.position.updated
- On rule violations generate alerts

Backend - Collision Monitor Zones

REST API endpoints

/api/zones/collision , POST-GET-DELETE

Database

- Collision_monitor_zones (id, user_id, name, geom GEOMETRY())
- PostGIS spatial index (geom column)

Collision Detection

- Consume kafka ship.position.updated
- Collision detection logic
- Publish message to kafka , alert.collisions

Modifications over previous plans

Database

PostgreSQL with TimescaleDB

API Gateway

Centralize concerns like routing, authentication and frontend interaction

Thank you for your time!