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Geo Web Map

A full-stack GIS web application for managing, visualizing, and analyzing spatial data using PostGIS, Node.js, and Leaflet.js.

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Abstract

Geo Web Map is a full-stack GIS web application integrating PostgreSQL/PostGIS spatial database, Node.js/Express backend, and Leaflet.js frontend for interactive geospatial data management and visualization. It supports:

- CRUD on geospatial features
- Spatial filtering and attribute-based queries
- Dynamic styling and shortest-path routing via pgRouting
- Geometry editing

Ideal for academic, research, or professional GIS applications.

Introduction

- Full-stack GIS web app for managing, visualizing, analyzing spatial data.
- Uses PostgreSQL/PostGIS for spatial storage and queries.
- Node.js backend for API and business logic.
- Leaflet.js frontend for dynamic map visualization.
- Features include:
  - CRUD operations (points, lines, polygons)
  - Attribute and spatial filtering
  - Routing via pgRouting
  - Dynamic styling and map legends

Features

Interactive Map Visualization:

- Render points, lines, polygons dynamically
- Zoom, pan, inspect attributes

CRUD Operations:

- Create, read, update, delete spatial features
- Drag-and-drop editing of geometries

Filtering and Spatial Queries:

- Attribute and spatial filters
- Find nearest features, intersecting geometries

More Features

- Routing and network analysis (shortest paths via Dijkstra and pg Routing)
- Dynamic styling map legends
- UI-based filters (text input, dropdown selectors)
- Geometry editing (move points, reshape lines/polygons)

Getting Started

Prerequisites:

- Node.js (v14+), PostgreSQL (v13+)
- PostGIS and pgRouting extensions

Installation Highlights:

- Clone repo, set up database with PostGIS and pgRouting
- Install backend dependencies and start server
- Install frontend dependencies and start client

Core API Endpoints

Method	Endpoint	Description
GET	/features	Retrieve all spatial features
POST	/features	Add new feature
PUT	/features/:id	Update feature
DELETE	/features/:id	Delete feature
GET	/route	Compute shortest path route
GET	/nearest	Find nearest features

Technologies Used

Frontend	Leaflet.js, HTML, CSS, JS
Backend	Node.js, Express.js
Database	PostgreSQL + PostGIS + pgRouting
Visualization	Leaflet.js
Dev Tools	pgAdmin4, VS Code
Version Control	Git & GitHub

Development Workflow

- **Phase 1: Requirements Analysis** – Identify user needs, GIS use cases
- **Phase 2: Spatial Database Design** – Create spatial tables using PostGIS
- **Phase 3: API Development** – Build RESTful endpoints using Node.js/Express
- **Phase 4: Frontend Implementation** – Render and edit maps using Leaflet.js
- **Phase 5: Feature Integration** – Add filtering, routing, styling, editing
- **Phase 6: Testing & Debugging** – Unit tests, spatial validation, cross-browser checks
- **Phase 7: Documentation** – Create README.md, API docs, UML diagrams
- **Phase 8: Final Deployment** – Host frontend and backend on local or cloud server

Testing Strategy

- **Unit Tests:** API endpoints for CRUD and routing
- **Manual Testing:** Draw/edit features, inspect data
- **Data Validation:** PostGIS geometry checks
- **Browser Testing:** Chrome, Firefox, mobile responsiveness

Limitations and Future Work

Limitations:

- No authentication layer (currently public)
- Routing limited to static network dataset
- Basic UI (could be more polished)

Future Enhancements:

- Add user login and role-based permissions
- Realtime data support with WebSockets
- Mobile-friendly layout improvements
- Export/Import GeoJSON support

UML Diagram

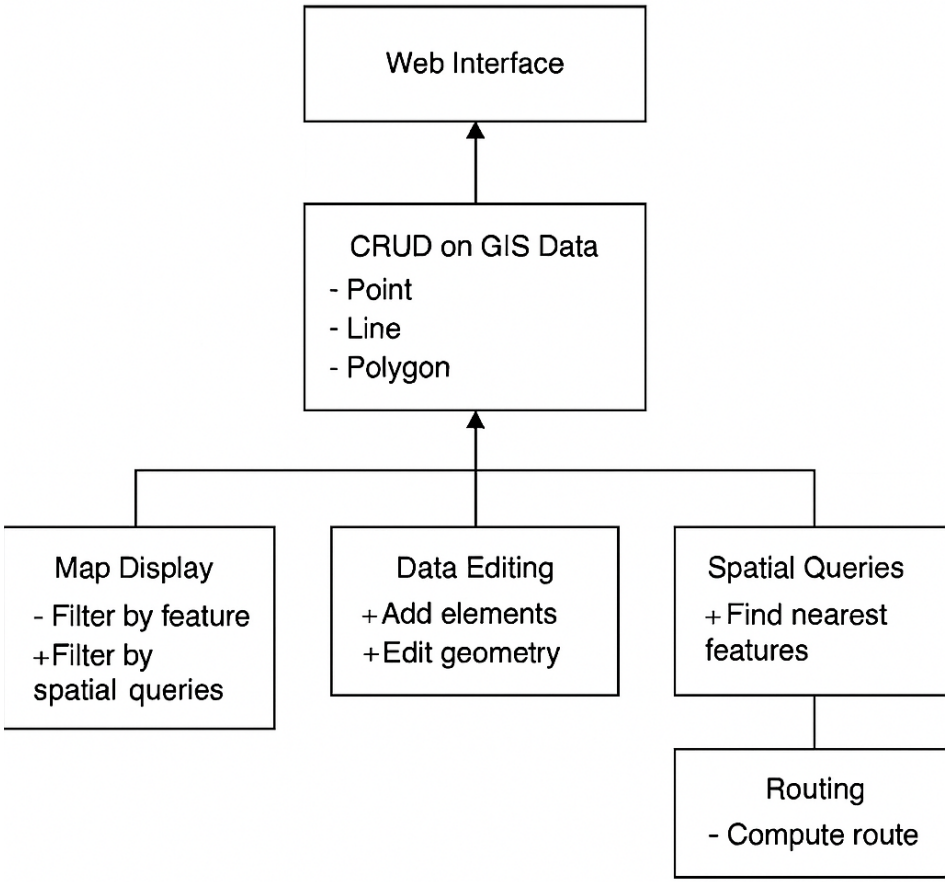

Figure: UML Diagram

UML Use Case Diagram

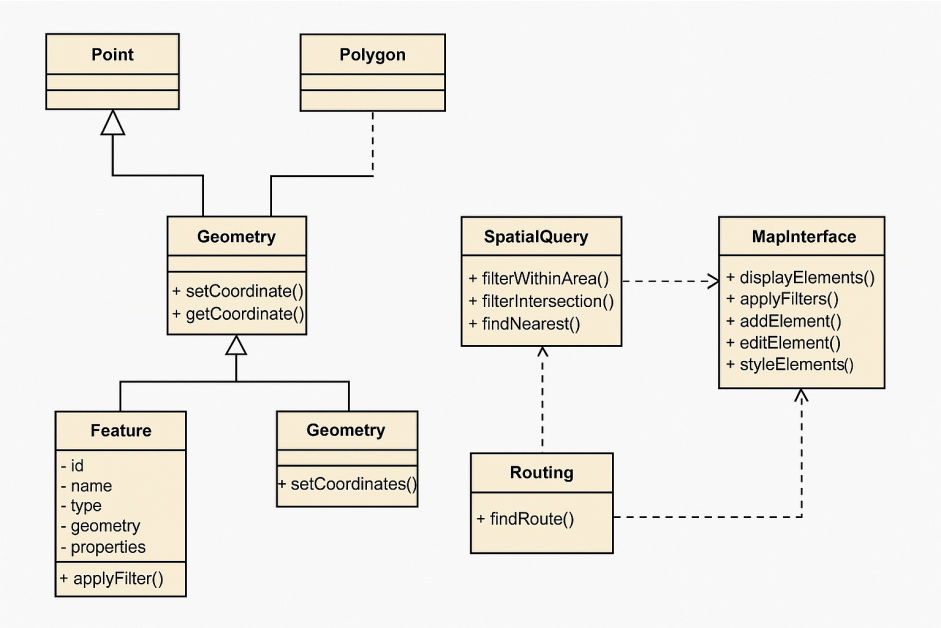

Figure: UML Class Diagram

Conclusion

- Geo Web Map integrates spatial database, backend API, and frontend mapping tools.
- Supports full CRUD, spatial filtering, editing, and routing.
- Suitable for academic and professional GIS applications.
- Modular architecture allows future enhancements.

Acknowledgements

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