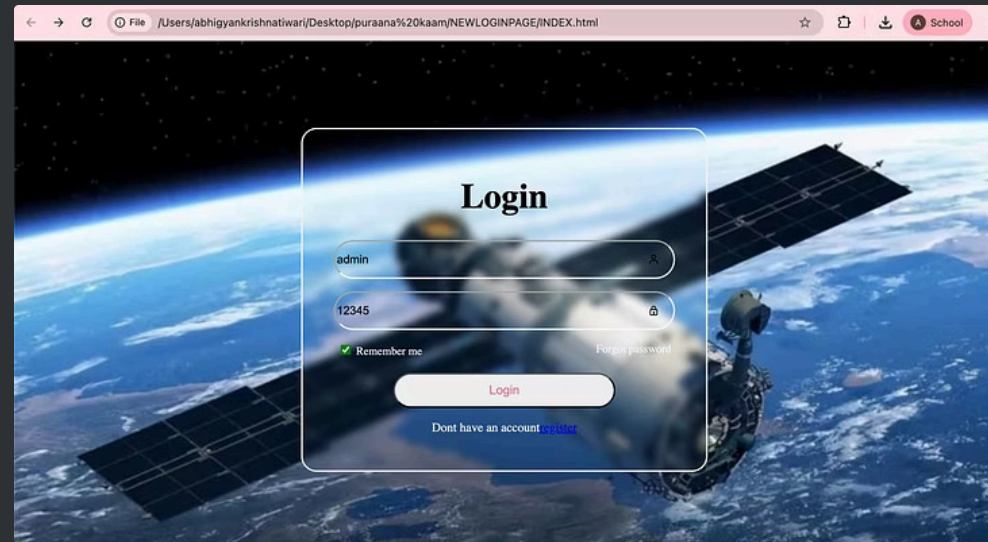


Login Page



This represents our first significant milestone during the internship - the creation of a functional login page that serves as the gateway to our GIS dashboard application.

Development Details

- **Technologies Used:** HTML, CSS, and JavaScript for a responsive and interactive user interface
- **Key Features:** User authentication, form validation, and secure login functionality
- **Design Approach:** Clean, modern interface with intuitive user experience
- **Security Implementation:** Input sanitization and basic authentication protocols

Learning Outcomes

This initial project helped us establish fundamental web development skills and understand the importance of user authentication in web applications. It laid the groundwork for the more complex GIS dashboard that would follow, teaching us essential concepts about frontend development, user interface design, and security considerations.

FIRST PRIMITIVE GIS DASHBOARD

Geographic Information Systems (GIS) are powerful tools that capture, store, analyze, and visualize spatial and geographic data. They enable us to understand patterns, relationships, and trends in our world by combining location data with descriptive information.

What is GIS?

A system designed to capture, store, manipulate, analyze, manage, and present spatial or geographic data

Key Components

- Hardware & Software
- Data (spatial & attribute)
- People & Methods

Applications

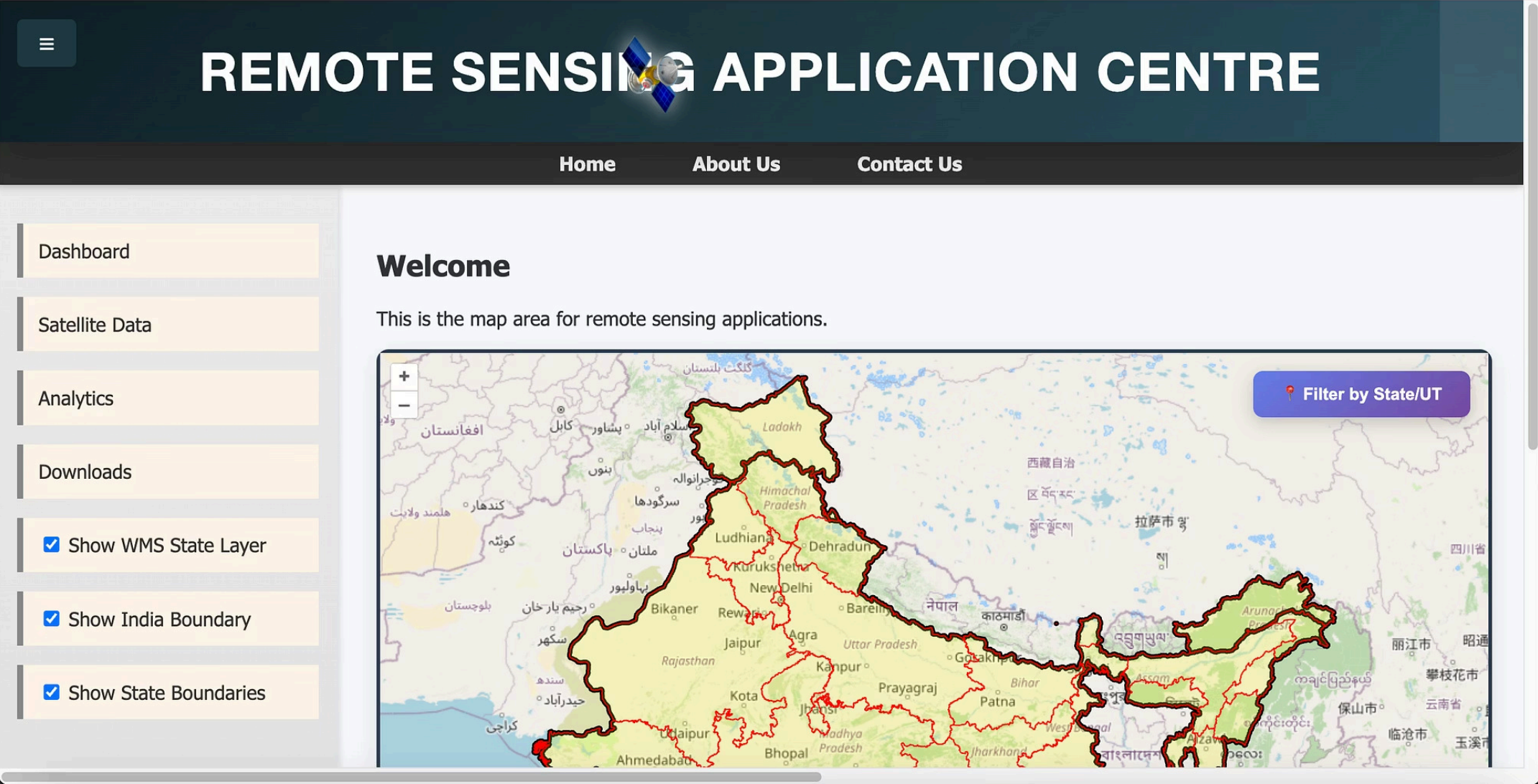
- Urban Planning
- Environmental Monitoring
- Infrastructure Management
- Emergency Response

Our Journey Forward

Building on the foundation established with our login page, we will now create and present our comprehensive GIS dashboard. This dashboard will demonstrate practical applications of GIS technology in road infrastructure management, showcasing how spatial data can be transformed into actionable insights for better decision-making.

Get Ready! We're about to dive into the exciting world of web-based GIS development, where we'll transform complex spatial data into an intuitive, interactive dashboard.

FIRST PRIMITIVE GIS DASHBOARD



Developing a Web-Based GIS Dashboard for Road Infrastructure

Following our successful login page implementation, we progressed to developing a comprehensive web-based GIS dashboard. This project marked a significant advancement in our technical capabilities and understanding of geographic information systems.

Project Implementation

- **Interactive Map Integration:** Implemented a fully functional web map interface with zoom, pan, and navigation capabilities
- **Boundary Visualization:** Successfully integrated JSON files to display state and country boundaries with precise geographic accuracy
- **Data Management:** Utilized JSON format for efficient storage and retrieval of geographic boundary data
- **Web Deployment:** Successfully deployed the application using GitHub for version control and Vercel for hosting

Technical Stack

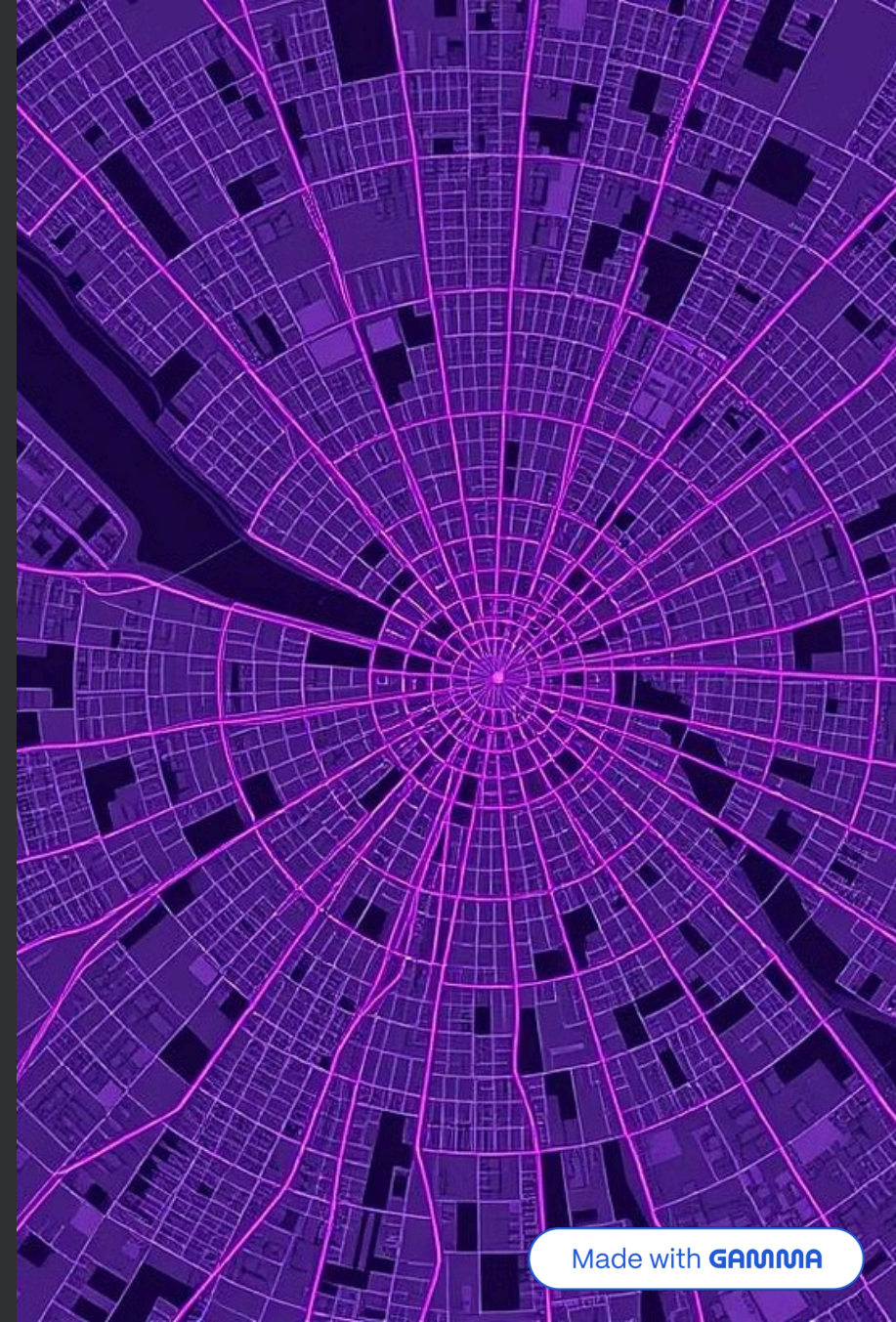
- **Frontend:** HTML, CSS, JavaScript with mapping libraries for interactive visualization
- **Data Format:** JSON files for geographic boundary information
- **Version Control:** GitHub for collaborative development and code management
- **Deployment:** Vercel platform for seamless web hosting and continuous deployment

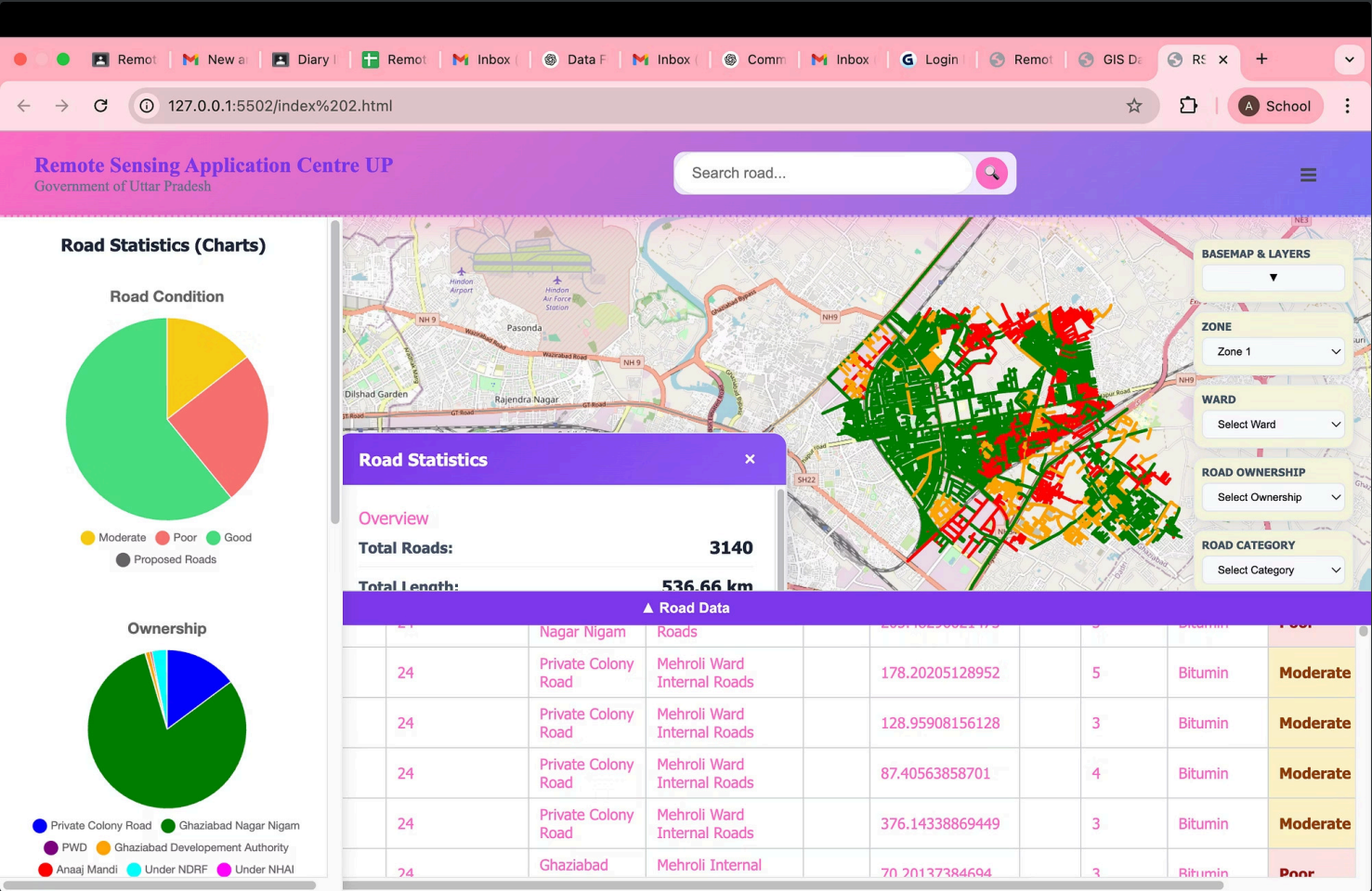
Key Achievements

This project provided invaluable hands-on experience with modern web development workflows, from local development to production deployment. The integration of geographic data visualization with web technologies opened new possibilities for creating interactive, data-driven applications. The successful deployment process taught us essential skills in DevOps practices and web application hosting.

Developing a Web-Based GIS Dashboard for Road Infrastructure

This presentation details my internship project at the Remote Sensing Application Centre, UP (RSAC-UP), focusing on building a comprehensive web-based GIS dashboard for road infrastructure mapping and condition analysis.





Project Objectives

Our GIS dashboard project was designed with specific objectives to create a comprehensive road infrastructure management system. The following features were implemented to achieve these goals:

- ### 1. Dynamic Filter Dropdowns

Interactive dropdown menus that allow users to filter road data by various criteria such as road type, condition status, district, and maintenance priority. These filters enable real-time data refinement and targeted analysis.
- ### 2. Statistics Box

A centralized display panel showing key performance indicators and summary statistics including total road length, road condition distribution, maintenance requirements, and budget allocations for quick dashboard overview.
- ### 3. Road Data Table

A comprehensive tabular view displaying detailed road information including road ID, location, length, surface type, condition rating, last maintenance date, and priority status with sorting and pagination capabilities.
- ### 4. Sidebar with Statistics

A dedicated sidebar panel containing visual charts, graphs, and statistical summaries that provide deeper insights into road network performance, maintenance trends, and infrastructure health metrics.

Integration & Functionality

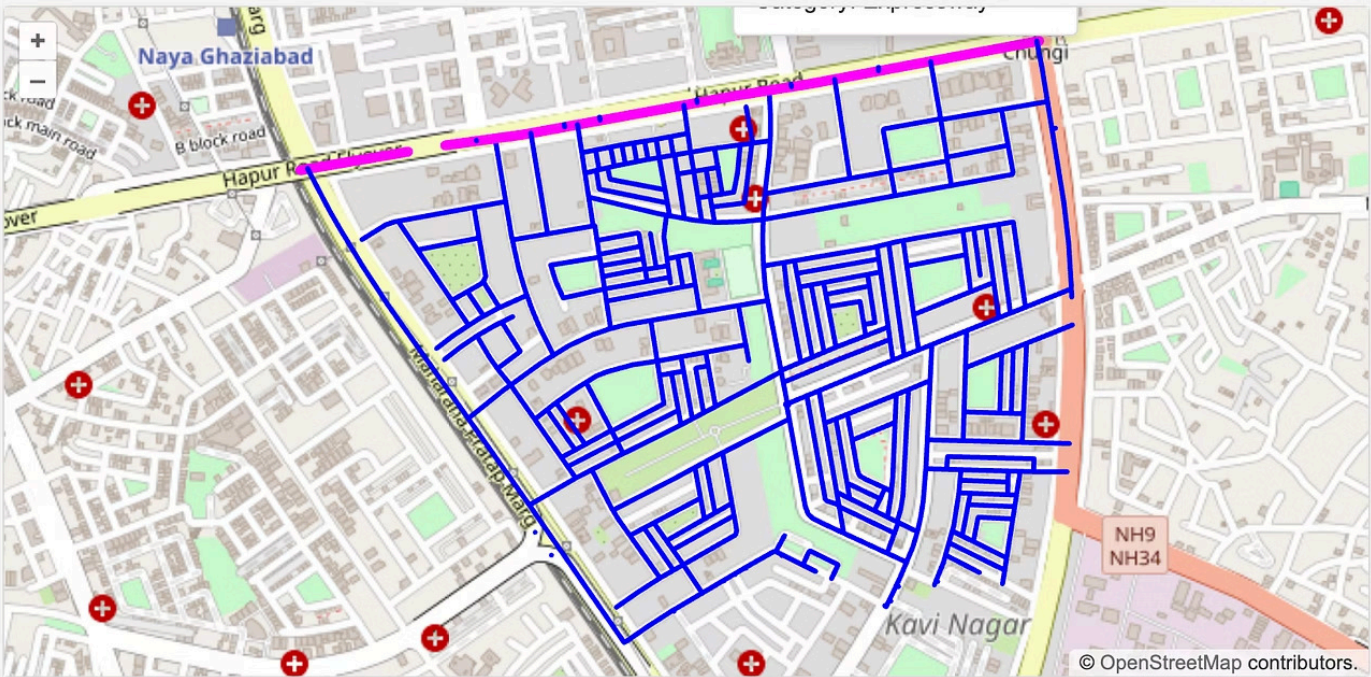
These four core features work together to create a unified dashboard experience where users can filter data, view statistics, analyze detailed records, and gain insights through visual representations. The interactive nature of these components ensures that changes in one feature dynamically update the others, providing a seamless user experience for infrastructure management decisions.

GIS Dashboard with Map

Select Zone: Zone 1

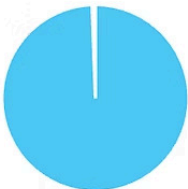
Select Ward: Kavi nagar

Load Roads



Road Attributes

Ownership



Ghaziabad Nagar Nigam PWD

Material



| GID | ID | Road Name | Ownership | Material | Length | Condition | Category | Ward No |
|------|------|---------------------------|-----------------------|----------|--------|-----------|----------|---------|
| 1056 | 1640 | Kavi Nagar Internal Roads | Ghaziabad Nagar Nigam | CC | 130.89 | Good | Local | 91 |
| 1008 | 1592 | Kavi Nagar Internal Roads | Ghaziabad Nagar Nigam | CC | 183.46 | Good | Local | 91 |

Project Objectives

The primary goal was to create a dynamic GIS dashboard, visualizing road networks and providing robust analytical capabilities.

1 Dynamic Visualization

Develop a GIS dashboard for interactive road network visualization.

2 Data Integration

Fetch and display spatial road data using APIs and PostGIS.

3 Enhanced Interactivity

Enable road classification, filtering, and detailed popups for data points.

4 Visual Analytics

Provide charts and tables for insightful data interpretation.

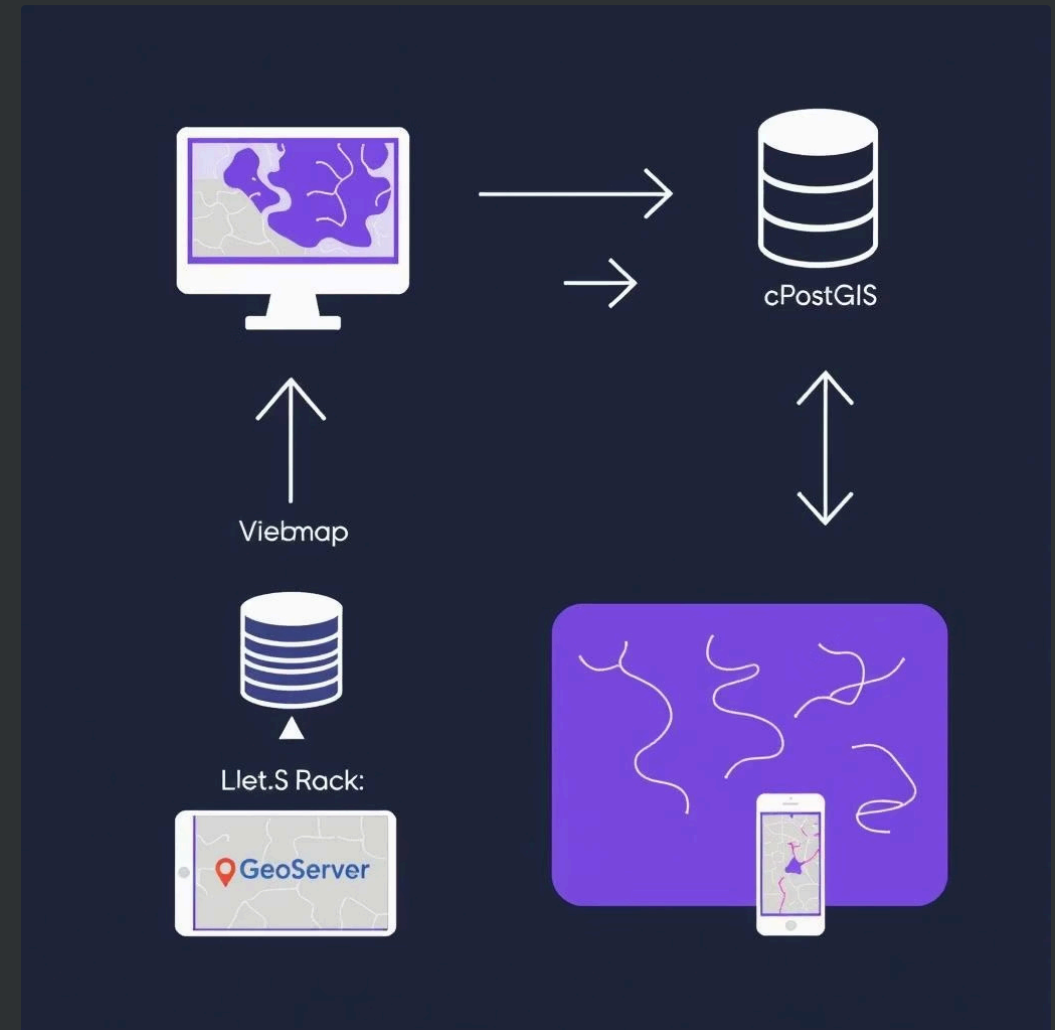
5 User Experience

Offer features like search, data export, dark mode, and overall improved interactivity.

Project Description: From Concept to Dashboard

The project evolved from basic web design to a full-fledged GIS dashboard. Initially, foundational HTML/CSS structures were implemented with responsive design. OpenLayers was integrated to embed interactive maps.

We processed shapefiles in QGIS, converting them to GeoJSON for map rendering. These vector layers were then uploaded to PostGIS and served via GeoServer as WMS links, with styling managed by SLD files.



Key features developed include interactive sidebars, dynamic dropdowns, and information popups. A significant challenge involving roads intersecting multiple wards was resolved using **ST_Transform** and **ST_Intersection** functions to debug SRID mismatches and ensure accurate length calculations, critically enhancing data precision.

System Design & Architecture

The system employed a standard client-server architecture, ensuring a robust and scalable framework for geospatial data visualization.

| Component | Technologies Used | Role |
|------------|---|--|
| Frontend | HTML, CSS, JavaScript, OpenLayers | User interface and map rendering |
| Backend | Springboot (JAVA) | Data fetching, processing, and API endpoints |
| Database | PostgreSQL with PostGIS | Spatial data storage and management |
| Map Server | GeoServer | Serving spatial layers (WMS) to the frontend |
| Deployment | Vercel (frontend), Local Server (backend) | Hosting and testing environments |

The interaction flow involved loading base layers, API calls for filters, and dynamic UI updates, ensuring a seamless user experience.

Key Software & Technologies



QGIS

Open-source GIS software for spatial data processing, analysis, and shapefile conversion to GeoJSON format



PostgreSQL

Robust relational database system with PostGIS extension for spatial data storage and management



pgAdmin

Web-based administration tool for PostgreSQL database management and query execution



JavaScript

Client-side scripting language for interactive map functionality and dynamic user interface elements



HTML

Markup language for structuring web pages and creating the foundation of the dashboard interface



CSS

Stylesheet language for designing responsive layouts and visual styling of the web application

Key Features Implemented

The dashboard incorporates several features designed to enhance data visualization, interaction, and user utility for road infrastructure management.

1

Interactive Map Interface

Fully styled web interface with an OpenLayers map and WMS layers.

2

Dynamic Filtering

Sidebar with dropdowns for zone, ward, ownership, and condition.

3

Data Table & Visualization

Sortable, highlightable table with filter support; dynamic pie and bar charts.

4

Enhanced Search & Export

Search bar with autocomplete for road names; export to CSV and PNG.

5

Spatial Data Accuracy

Ward-wise road length correction using **ST_Intersection** and multi-ward representation.

Technical Learnings

This project provided extensive hands-on experience across a diverse set of geospatial and web development technologies, significantly enhancing my technical skillset.



Spatial Databases

Working with PostGIS and resolving SRID inconsistencies.



SQL

Writing queries involving ST_Intersection and ST_Transform.



GIS Software

Creating and styling vector layers in QGIS.



Map Servers

Understanding GeoServer's WMS data serving.



API Integration

Using Fetch API, handling CORS, and Postman testing.



Responsive UI

Developing adaptable interfaces with HTML, CSS, and DOM manipulation.

Challenges & Solutions

Throughout the project, several technical hurdles were encountered, each requiring specific solutions to ensure data integrity and system functionality.

1

CORS Issues

Challenge: Cross-Origin Resource Sharing errors during API calls.

Solution: Configured backend headers according to CORS policies and used Postman for debugging.

2

SRID Mismatch

Challenge: Inconsistent Spatial Reference IDs in spatial queries.

Solution: Applied **ST_Transform** to standardize geometries to a common SRID.

3

Accurate Multi-Ward Lengths

Challenge: Displaying correct road lengths across multiple wards.

Solution: Utilized **ST_Intersection** to split roads by ward boundaries for precise length calculations.

4

Real-time Filter Rendering

Challenge: Synchronizing data from multiple APIs for real-time filtering.

Solution: Implemented asynchronous JavaScript logic to merge and display data from two distinct APIs seamlessly.

Outcomes & Impact

The successful completion of this project resulted in a robust GIS dashboard with significant practical applications for municipal infrastructure management.

Accurate Visualization

Provided precise ward-wise infrastructure visualization for informed decision-making.

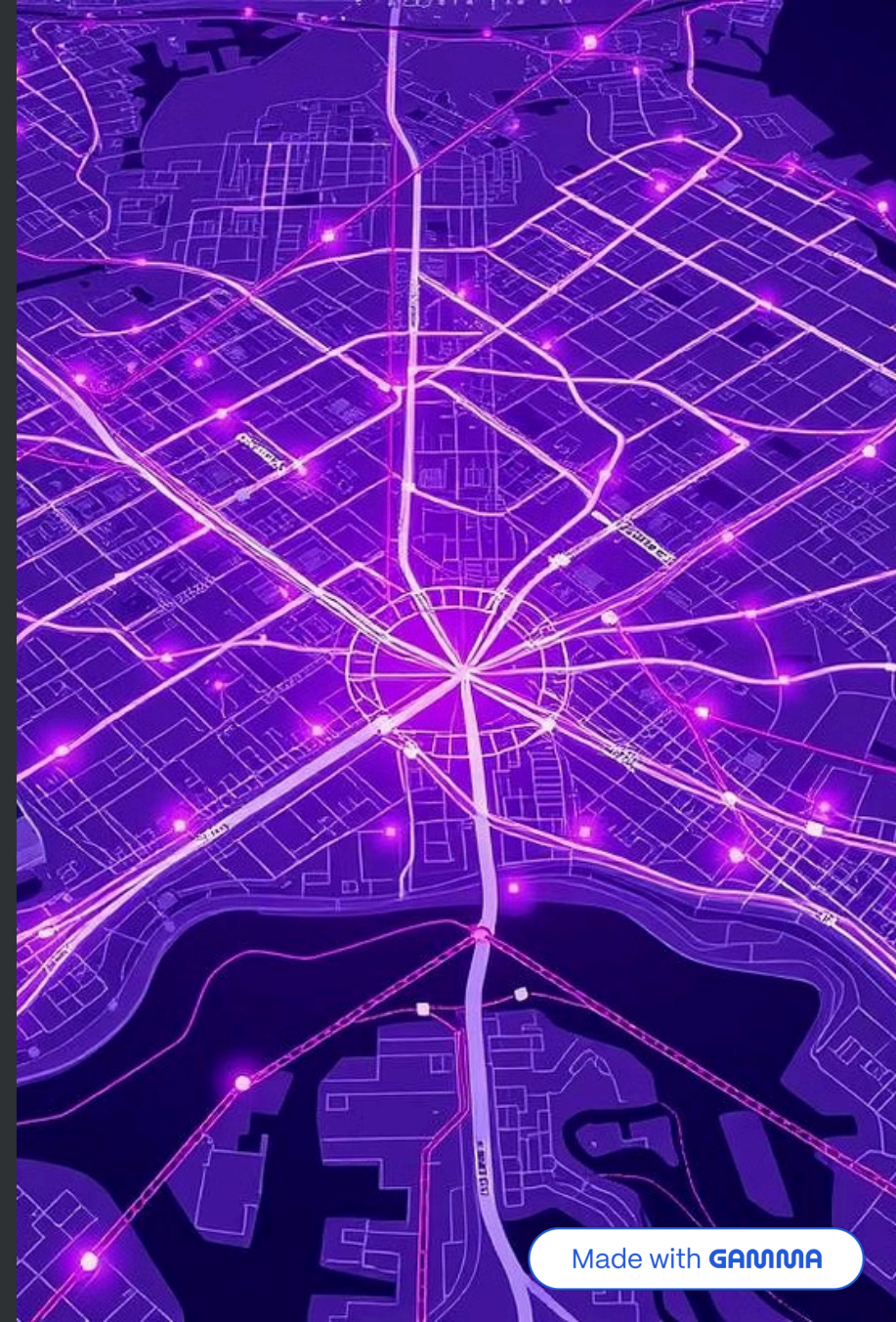
User-Centric Design

Developed an intuitive user interface, accessible to government officers and general users.

Future Scope

The dashboard's capabilities can be significantly expanded with advanced features and integration with broader urban utility management systems.

- **AI Integration:** Incorporate machine learning models for automated damage detection using satellite imagery.
- **Time-Series Analysis:** Integrate historical data to monitor changes in road conditions and infrastructure over time.
- **Security Enhancements:** Implement advanced authentication, authorization, and user role-based dashboards for secure access.
- **Utility Expansion:** Extend the dashboard's scope to include other municipal utilities such as drainage, water supply networks, and encroachment mapping.



Conclusion

This internship at RSAC-UP was pivotal for our technical and professional growth. I gained confidence in frontend development, spatial databases, and web-based dashboard design. The experience underscored the importance of collaboration, problem-solving, and design thinking in creating impactful public service technology, transforming foundational HTML skills into real-world GIS problem-solving abilities.