F1 Circuits Worldwide

Spatial Database Project

CS621 Spatial Databases

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Project Overview

Database Design

Spatial database using PostGIS for PostgreSQL to store and analyze F1 race circuits with precise geographic coordinates.

Technologies Used

- PostgreSQL with PostGIS extension
- QGIS for visualization
- SQL spatial functions (ST_Distance, ST_DWithin, ST_MakePoint)

Data Coverage

50+ circuits • 30 countries • 6 continents • 1950-2024 • Status: Active, Historic, Inactive

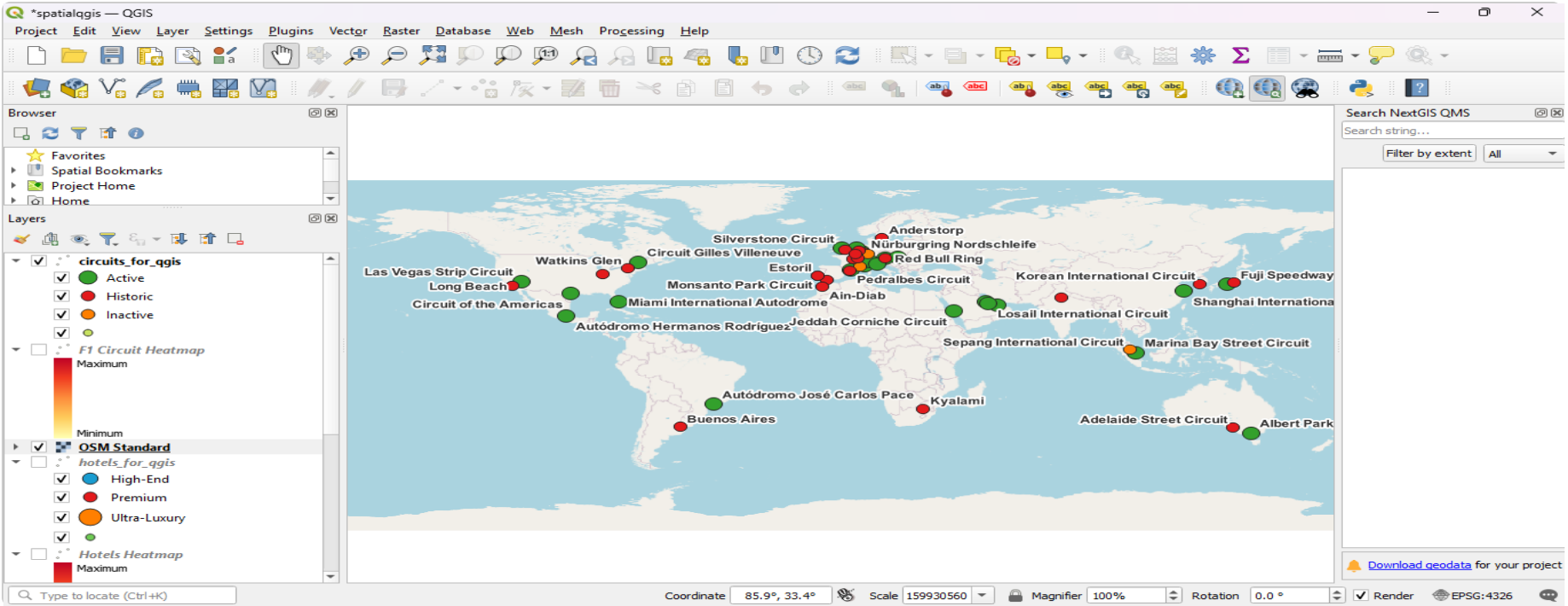
Database Schema

f1_circuits Table Structure

```sql
-- Create main F1 circuits table with spatial data
CREATE TABLE f1_circuits (
    circuit_id SERIAL PRIMARY KEY,
    circuit_name VARCHAR(200) NOT NULL,
    city VARCHAR(100),
    country VARCHAR(100),
    length_km NUMERIC(5,3) CHECK (length_km > 0),
    first_gp_year INTEGER CHECK (first_gp_year >= 1950 AND first_gp_year <= 2030),
    last_gp_year INTEGER CHECK (last_gp_year >= 1950 AND last_gp_year <= 2030),
    total_gps INTEGER CHECK (total_gps >= 0),
    circuit_type VARCHAR(50),
    status VARCHAR(20),
    geom GEOMETRY(Point, 4326),
    created_date TIMESTAMP DEFAULT CURRENT_TIMESTAMP
);
```

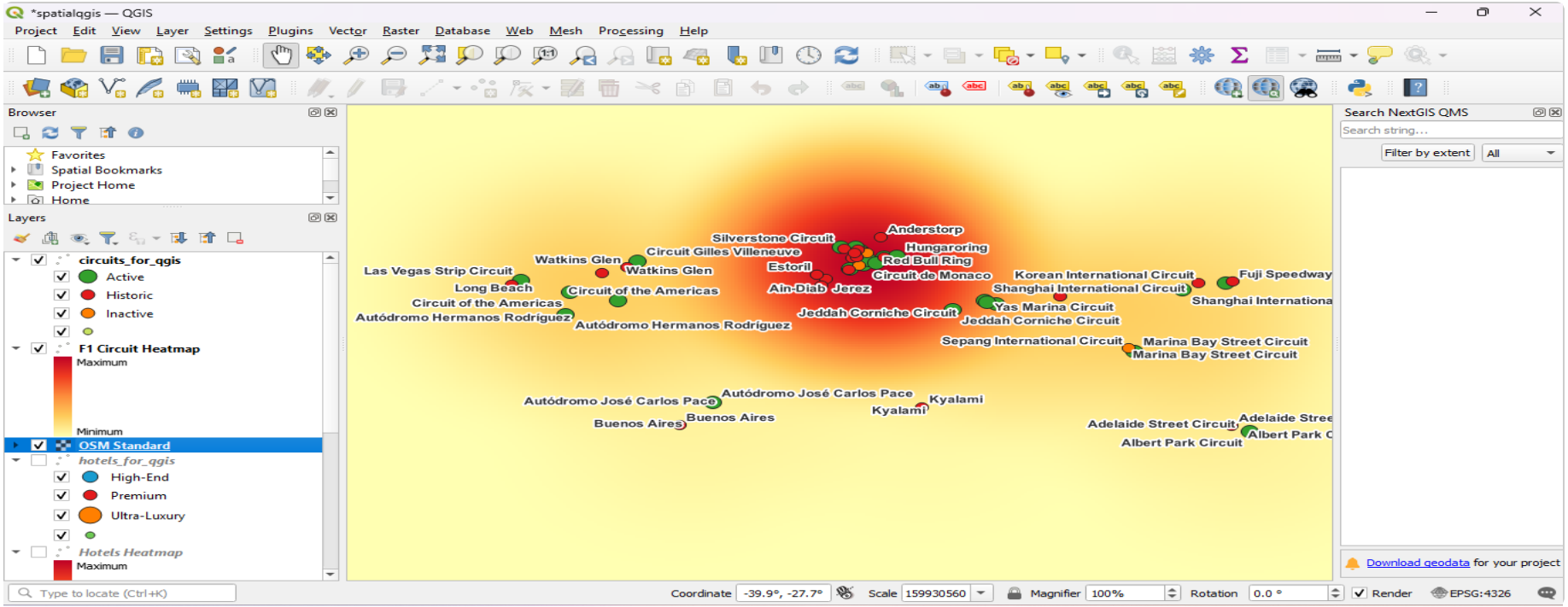
Global Circuit Distribution

QGIS visualization showing all F1 circuits on world map with OSM base layer



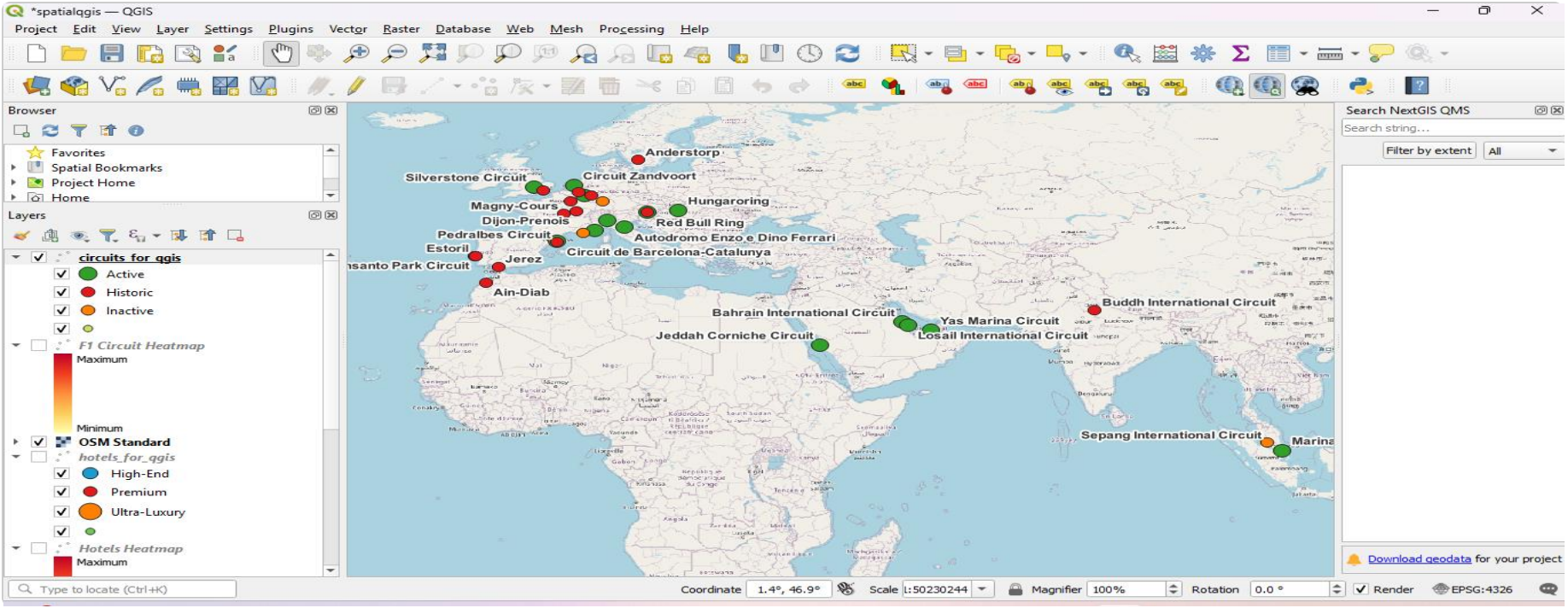
Circuit Density Analysis

Heatmap visualization showing circuit clustering and high-density racing regions



Regional Circuit Analysis

Detailed view of European, Middle Eastern, African, and Asian circuits



Key Spatial Queries

1. Circuit Clustering Analysis (200km radius)

```
SELECT c1.circuit_name, c1.country, COUNT(c2.circuit_id) - 1 AS nearby_circuits
 FROM f1_circuits c1 LEFT JOIN f1_circuits c2
 ON ST_DWithin(c1.geom::geography, c2.geom::geography, 200000)
 GROUP BY c1.circuit_id ORDER BY nearby_circuits DESC;
```

Identifies circuit density patterns within 200km radius

Data Output | Messages | Notifications

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	circuit_name character varying (200)	city character varying (100)	country character varying (100)	status character varying (20)	nearby_circuits_within_200km bigint	density_category text
1	Circuit de Spa-Francorcha...	Spa	Belgium	Active	2	Medium Density
2	Nürburgring Nordschleife	Nürburg	Germany	Historic	2	Medium Density
3	Zolder	Zolder	Belgium	Historic	2	Medium Density
4	Circuit Zandvoort	Zandvoort	Netherlands	Active	0	Isolated
5	Circuit de Barcelona-Catalu...	Barcelona	Spain	Active	0	Isolated
6	Circuit de Monaco	Monte Carlo	Monaco	Active	0	Isolated
7	Silverstone Circuit	Silverstone	United Kingdom	Active	0	Isolated
8	Red Bull Ring	Spielberg	Austria	Active	0	Isolated
9	Bahrain International Circuit	Sakhir	Bahrain	Active	0	Isolated
10	Losail International Circuit	Lusail	Qatar	Active	0	Isolated
11	Hockenheimring	Hockenheim	Germany	Inactive	0	Isolated
12	Circuit Paul Ricard	Le Castellet	France	Inactive	0	Isolated
13	Magny-Cours	Nevers	France	Historic	0	Isolated
14	Brands Hatch	Kent	United Kingdom	Historic	0	Isolated
15	Estoril	Estoril	Portugal	Historic	0	Isolated
16	Österreichring	Spielberg	Austria	Historic	0	Isolated
17	Dijon-Prenois	Dijon	France	Historic	0	Isolated

2. Active circuits by region

```sql
-- Active circuits by region
SELECT
    CASE
        WHEN country IN ('United Kingdom', 'Italy', 'Germany', 'France', 'Spain', 'Belgium', 'Austria
        WHEN country IN ('USA', 'Canada', 'Mexico', 'Brazil', 'Argentina') THEN 'Americas'
        WHEN country IN ('Japan', 'China', 'Singapore', 'Malaysia', 'South Korea', 'India') THEN 'As
        WHEN country IN ('Bahrain', 'UAE', 'Saudi Arabia', 'Qatar') THEN 'Middle East'
        WHEN country IN ('Australia') THEN 'Oceania'
        WHEN country IN ('South Africa', 'Morocco') THEN 'Africa'
        ELSE 'Other'
    END as region,
    COUNT(*) as circuit_count,
    COUNT(CASE WHEN status = 'Active' THEN 1 END) as active_count,
    ROUND(AVG(length_km)::numeric, 3) as avg_length_km
FROM f1_circuits
```

Data Output | Messages | Notifications

SQL

	region text	circuit_count bigint	active_count bigint	avg_length_km numeric
1	Europe	23	9	5.761
2	Americas	10	6	4.717
3	Asia	7	3	5.292
4	Middle Ea...	4	4	5.562
5	Oceania	2	1	4.529
6	Africa	2	0	6.070

Conclusion

Project Achievements

- Implemented PostGIS spatial database for 50+ F1 circuits
- Analyzed geographic data across 30 countries
- Created spatial queries for distance and clustering analysis
- Visualized data using QGIS with multiple layers

Key Findings

Europe has highest circuit density. Middle East and Asia show growth. Average length: 5.2 km

Future Work

Add elevation data, temporal analysis, weather correlations