International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Facility Ratio Calculator Using Open Street Map and Streamlit

Mohammed Hannan Ahmed[1], Anwaar Ul Haque[2], Mohammed Kamran Uddin[3], Ms.Syeda Azkia Quadri[4]

[1,2,3] Department of IT, Nawab Shah Alam Khan College of Engineering and Technology, Hyderabad, India.
[4]Assistant Professor, (B. Tech, MTech, PhD (CSE)]

A B S T R A C T

In an era of rapid urbanization and population growth, the equitable distribution of public infrastructure such as schools, hospitals, police stations, and other essential services is a critical aspect of sustainable development and urban planning. However, existing assessment methods for facility adequacy are often limited by outdated data, manual surveys, and lack of automation. To address these challenges, this paper presents a novel web-based geospatial tool—Facility Ratio Calculator—that utilizes real-time geographic data from OpenStreetMap (OSM) through the Overpass API, coupled with a user-friendly Stream lit interface for visualization and interaction.

The tool allows users to upload CSV files containing multiple regions with latitude, longitude, and population data. For each location, it fetches up-to-date data on nearby public facilities such as schools, hospitals, post offices, police and fire stations, and pharmacies within a defined radius. It then calculates the facility-to-population ratios, compares them with configurable benchmark standards, and flags areas that are potentially underserved. The output is presented through interactive tables and dynamic map screenshots using Folium and Selenium, offering both quantitative insights and spatial context.

This solution stands out for its real-time analysis capability, scalability, and accessibility to non-technical users. It is especially useful for urban planners, researchers, government bodies, and NGOs seeking actionable intelligence for improving public service distribution

Keywords: Facility Ratio Calculator, Streamlit, Overpass API, CSV Upload, b]Selenium and Folium,

1. Introduction

Access to public infrastructure is one of the foundational pillars of sustainable urban development and social equity. Facilities such as schools, hospitals, police stations, fire stations, post offices, and pharmacies play a vital role in ensuring the well-being, safety, and empowerment of communities. As cities continue to expand and populations grow, the equitable distribution of these services becomes a pressing challenge, especially in developing regions where planning is often constrained by outdated data, limited digital infrastructure, and manual survey methods.

In response to these gaps, this paper introduces the **Facility Ratio Calculator**, a lightweight, browser-based tool designed to automate the analysis of public infrastructure adequacy using **real-time geospatial data**. The application leverages **OpenStreetMap (OSM)**, a community-driven and frequently updated geospatial data platform, and integrates it with the **Overpass API** to fetch detailed information on public amenities. It then calculates the **facility-to-population ratios** for a set of user-provided geographic coordinates and compares them to internationally or locally accepted benchmarks. Areas falling below these thresholds are flagged as **"underserved,"** helping planners and decision-makers identify regions that need attention.

Nomenclature

OSM	OpenStreetMap
API	Application Programming Interface
CSV	Comma-Separated Values
UI	User Interface
GIS	Geographic Information System
HTTP	HyperText Transfer Protocol
HTML	HyperText Markup Language

PNG	Portable Network Graphics
RAM	Random Access Memory
CPU	Central Processing Unit
GUI	Graphical User Interface
ML	Machine learning

1.1 Tables

All three talukas show multiple underserved facility categories, especially **schools and hospitals**, indicating a need for infrastructure planning support.

Table 1 - An example of a table.:

Taluka	Population	Adequate Facilities	Underserved Facilities
Pune	5,000,000	Police Stations	Schools, Hospitals, Pharmacies, Fire, Post Offices
Nashik	2,200,000	Police, Fire Stations	Schools, Hospitals, Pharmacies, Post Offices
Aurangabad	1,500,000	None	All (Schools, Hospitals, Pharmacies, etc.)

1.2 System Analysis and Design

The goal of the system is to analyze and evaluate the availability of public infrastructure facilities relative to population density using real-time data sources. The system enables stakeholders—such as government officials, urban planners, and researchers—to identify underserved areas and plan improvements effectively.

1.2. 1 Existing system

In current practice, evaluating the adequacy of public infrastructure (such as schools, hospitals, police stations, etc.) is primarily done through manual surveys, static census reports, and GIS tools like ArcGIS or QGIS. These systems are often:

- ***Data-limited: Rely on outdated or manually updated databases.***
- ***Non-automated: Users must manually collect and verify facility locations.***
- ***Technically demanding: Require GIS expertise and software installation.***
- ***Not scalable: Cannot easily assess multiple regions in batch.***

1.2.2 proposed system

The **Facility Ratio Calculator** provides an automated, real-time, and scalable system to evaluate infrastructure adequacy using live data from **OpenStreetMap (OSM)** and presents results through an interactive **Streamlit web interface**.

Key Features:

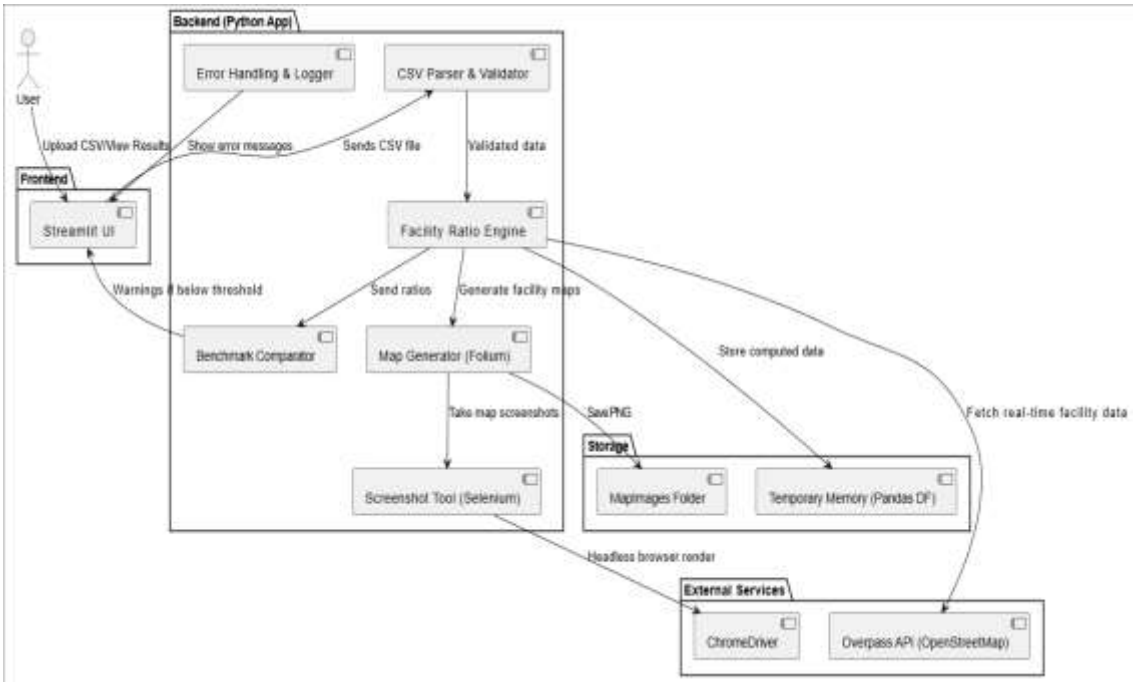
- Real-time facility data using **Overpass API**
- **Automated ratio calculation** per location
- User-friendly **web interface** (no GIS knowledge required)
- Dynamic tables and **interactive maps**
- **Screenshot generation** of maps for reports

Advantages Over Existing System:

Feature	Existing System	Proposed System
Data Source	Manual / Census	Real-time via OpenStreetMap
Automation	✕ Manual	☑ Fully automated

Feature	Existing System	Proposed System
Technical Skill Requirement	High (GIS knowledge)	Low (Web-based interface)
Batch Analysis	✗ Not supported	✅ Supported
Visualization	Static maps	Interactive + Auto-screenshots
Alerts/Warnings	✗ Absent	✅ Provided

1.2.3 Architecture



1.3 Methodology

This project follows a step-by-step process to analyze how well public facilities serve a population using real-time map data.

Step	Description
1	**Upload CSV**: User uploads location data (Name, Latitude, Longitude, Population)
2	**Fetch Facility Data**: System queries OpenStreetMap via Overpass API
3	**Count Facilities**: Number of nearby schools, hospitals, etc., is calculated
4	**Calculate Ratios**: Facility count is divided by population
5	**Compare with Benchmarks**: Ratios are checked against standard thresholds
6	**Generate Results**: Tables, warnings, maps, and screenshots are displayed

1.4 Results

Taluka	Population	Underserved Facilities	Adequate Facilities
Pune	5,000,000	Schools, Hospitals, Pharmacies, Fire, Post	Police Stations

Taluka	Population	Underserved Facilities	Adequate Facilities
Nashik	2,200,000	Schools, Hospitals, Pharmacies, Post Offices	Police, Fire Stations
Aurangabad	1,500,000	All (Schools, Hospitals, Pharmacies, etc.)	None

1. 4.1 Key observations

- **All regions** show infrastructure gaps in at least 3 facility types.
- **Pune** performs relatively better but still lacks key services like hospitals.
- **Aurangabad** is the most underserved region among the three.

1.5 conclusion

The Facility Ratio Calculator successfully demonstrates how open-source tools and real-time geographic data can be leveraged to evaluate public infrastructure adequacy in a scalable, automated, and user-friendly manner. By integrating OpenStreetMap through the Overpass API with a Streamlit-based interface, the system enables fast and effective analysis of essential services—such as schools, hospitals, police stations, and more—relative to population distribution.

Through ratio calculations and benchmark comparisons, the system accurately identifies underserved regions and provides visual outputs like interactive tables and facility maps. This not only simplifies complex geospatial analysis but also makes the insights accessible to non-technical users such as urban planners, researchers, and government officials.

1.6 Future scope

The Facility Ratio Calculator offers a strong foundation for real-time infrastructure analysis, and there are several promising directions to expand its capabilities:

1. ***Additional Facility Types***

Support can be extended to include more public services such as:

- Water supply points
- Public toilets
- ATMs and banks
- Community centers

2. ***Integration with Government Datasets***

Linking with national databases like the Census of India, Health Ministry, or Smart City APIs can enhance the accuracy and policy relevance of results.

3. ***Predictive Analysis using AI/ML***

Machine learning models could be trained on historical data to:

- Predict future infrastructure demand
- Recommend optimal facility placement
- Identify trends in urban development

4. ***Mobile App Integration***

Developing a mobile version of the tool would improve field accessibility for planners, surveyors, and local authorities.

5. ***Shapefile/GeoJSON Input Support***

Allowing users to upload polygon boundaries (e.g., districts, wards) would enable more advanced spatial analysis.

6. ***Cloud Deployment***

Hosting the tool on platforms like Streamlit Cloud, AWS, or Heroku will allow wider access, multi-user collaboration, and real-time deployment for large-scale projects.

7. Multilingual Interface

Adding regional language support will make the system more inclusive and accessible to local governments and communities.

8. AI-Based Recommendations (Advanced)

In future versions, incorporate **machine learning algorithms** to:

- Predict future facility needs
- Recommend optimal locations for new facilities
- Analyze trends in underserved areas

References

1 Zhang, Y., Wu, P., & Shi, X. (2021). *GIS-Based Assessment of Public Service Accessibility in Urban India*. Journal of Urban Planning and Development, 147(3), 04021040.

2 Singh, A., Kumar, V., & Sinha, P. (2022). *OpenStreetMap and Overpass API for Health Infrastructure Mapping in Rural India*. International Journal of Geoinformatics, 18(2), 75–84.

3 Ahmed, M., Okoth, L., & Muthoni, P. (2020). *Mapping Educational Facilities using Open Data in Kenya: A Case Study Using Leaflet and Census APIs*. Proceedings of GeoICT Conference.

4 OpenStreetMap Wiki. (2024). *Overpass API*. Retrieved from https://wiki.openstreetmap.org/wiki/Overpass_API

5 Streamlit Documentation. (2024). *Streamlit Docs*. Retrieved from https://docs.streamlit.io

6 Folium Documentation. (2024). *Python Data. Folium Mapping Library*. Retrieved from https://python- visualization.github.io/folium

7World Health Organization (WHO). (2010). *Global Health Observatory: Hospital Beds per 10,000 People*. Retrieved from https://www.who.int/data/gho

8 Government of India. (2021). *Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines*. Ministry of Housing and Urban Affairs.

9 National Crime Records Bureau (NCRB). (2023). *Data on Police Stations per Population*. Retrieved from https://ncrb.gov.in

10 SeleniumHQ. (2024). *Selenium with Python Documentation*. Retrieved from https://selenium.dev/documentation/