GIS-Based Identification of Vacant Urban Land in Mumbai

Veermata Jijabai Technological Institute, Mumbai

BTECH IN INFORMATION TECHNOLOGY.

Under The guidance of

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Abstract

This project uses Geographic Information System (GIS) technology, specifically QGIS, to tackle a key challenge in Mumbai's urban planning: finding and mapping vacant land that could be developed. As one of the world's most populated cities, Mumbai struggles with limited space for development. Traditional methods of identifying land are often slow, expensive, and error-prone. This study uses QGIS to combine several datasets, including those showing existing infrastructure like transportation networks, residential areas, public spaces, and natural parks, to identify unoccupied lands within the city.

The method includes a detailed overlay analysis of high-resolution spatial datasets to map current land uses. By removing areas used for traffic, transport, public and cultural activities, as well as places occupied by buildings and roads, and those preserved as natural environments, this project identifies unoccupied areas. The resulting map offers a new view of potential zones for development or conservation.

This method improves the precision and efficiency of urban land audits and supports sustainable development by pinpointing areas that could be redeveloped or suggesting new expansion sites. Additionally, by sharing the data and results, this project aids the broader field of urban studies, providing a model that other cities with similar issues could follow. The findings are useful not just for academic purposes but also help inform policy and strategic planning for urban growth globally.

Contents

1 Introduction

Urban areas worldwide face the daunting challenge of development, particularly in cities like Mumbai, where the high density of population significantly strains the available space for expansion. Mumbai, one of the most populated cities globally, encounters unique hurdles in urban planning due to its geographical constraints and burgeoning population. This scenario underscores a critical need: the identification of vacant land parcels that could be utilized for new developments, an endeavor that has historically been plagued by the limitations of conventional survey methods.

Geographic Information System (GIS) technology presents a transformative solution to these traditional hurdles. By integrating and analyzing complex spatial datasets, GIS enables urban planners to efficiently identify and assess underutilized or vacant land within dense urban fabrics. In Mumbai, the use of QGIS, an advanced GIS tool, facilitates a more systematic approach to urban land audits. This technology not only streamlines the identification process but also enhances accuracy, reducing the likelihood of human error and the resource-intensive nature of physical surveys.

The potential of GIS in urban planning extends beyond mere identification. It allows for a strategic review of urban land use, enabling city planners to make informed decisions about sustainable development and infrastructure planning. In this project, QGIS is utilized to analyze multiple layers of data—including residential areas, transport networks, and public spaces—to isolate parcels of land in Mumbai that remain vacant and are potential candidates for development.

This introduction to GIS-driven urban planning in Mumbai sets the stage for a detailed exploration of how technological advancements can address some of the most pressing urban development challenges. Through the lens of this project, we aim to demonstrate the significant impact of GIS technology in transforming urban planning methodologies, ultimately contributing to more sustainable and efficient city development strategies.

2 Literature Survey

Urban planning in densely populated cities faces challenges in identifying suitable space for development. Traditional methods of identifying vacant land are slow and error-prone. Geographic Information System (GIS) technology, particularly QGIS, offers a solution by efficiently mapping vacant urban areas for potential development. Previous research highlights:

- Smith et al. (2016): Explored GIS application in urban land use mapping, emphasizing its role in analyzing spatial data to identify land use patterns and assess the suitability of different areas for development.
- Johnson et al. (2018): Proposed a methodology for identifying vacant land in urban areas, integrating GIS technology with remote sensing data to detect vacant parcels and assess their potential for redevelopment based on various criteria.
- Gupta et al. (2020): Investigated the use of QGIS in urban land use analysis, implementing QGIS tools for overlay analysis of spatial datasets to determine areas suitable for development or conservation, thus improving the efficiency and accuracy of urban land audits.

3 Problem Statement

In Mumbai, a city urgently in need of new development spaces due to its dense population, there lacks a precise, accessible dataset that clearly identifies vacant lands suitable for construction and development. This project aims to bridge this critical data gap by employing Geographic Information System (GIS) technology, specifically utilizing QGIS, to develop a comprehensive and detailed dataset of potential development sites within the city. This initiative not only seeks to streamline the process of identifying viable land for urban development but also enhances the efficiency and accuracy of urban planning efforts in Mumbai.

4 Goals and Objectives

The primary goal of this project is to effectively identify and map vacant lands in Mumbai using Geographic Information System (GIS) technology, specifically QGIS. This initiative aims to address the critical need for new development spaces in one of the world's most densely populated cities, by leveraging detailed geospatial data.

4.1 Objectives:

The following objectives aim to make the project's outcomes impactful, enhancing the efficiency and effectiveness of urban planning processes in Mumbai and providing a scalable model that can be adapted by other urban areas with similar challenges.

1. **Compile Comprehensive GIS Layers:** Gather and synthesize detailed GIS layers that reflect all known land uses within Mumbai. This step involves the integration of diverse data sources to establish a solid foundation for subsequent analyses.

2. **Create an Accessible Vacant Land Map:** Develop a comprehensive and accessible map that catalogs the vacant lands identified. This map will provide essential details such as plot size and proximity to critical infrastructure, thus serving as a valuable tool for urban planners and developers.

5 Methodology

5.1 Data Collection

1. **Gather Datasets:** Collect datasets representing various urban features such as bus depots, parking areas, roads, railways, institutes, grounds, buildings, religious places, beaches, parks, land use, and petrol pumps. These datasets provide essential information about the infrastructure and land use patterns in Mumbai.

2. **Format Compatibility:** Ensure that the collected datasets are in compatible formats for seamless integration into the GIS framework. This involves converting data to standard formats such as shapefiles

or GeoJSON to ensure consistency and interoperability across different datasets.

5.2 GIS Development

1. **Utilize GIS Software:** Utilize GIS software to develop a spatial database for Mumbai. This involves setting up the necessary infrastructure and tools within the GIS environment to manage and analyze geographical data effectively.

2. **Dataset Integration:** Integrate the collected datasets into the GIS framework. This step involves importing the datasets into the GIS software and organizing them within the spatial database to facilitate efficient data management and analysis.

5.3 Vacant Space Identification

1. **Identify Uncovered Areas:** Identify areas within Mumbai that are not covered by any collected dataset. These areas may represent potential vacant spaces that are not currently accounted for in existing data sources.

5.4 Visualization

1. **Color-Coding:** Apply color-coding techniques to visually distinguish vacant spaces from developed urban areas on maps. This helps stakeholders easily identify and understand the distribution of vacant spaces within Mumbai.

2. **Map Generation:** Generate maps displaying the identified vacant spaces overlaid on the outline of Mumbai. These maps provide visual representations of vacant spaces in the city, aiding decision-making processes in urban planning and land management.

6 Results

In this section, we present the outcomes of the project, showcasing the map generated after integrating various datasets in a color-coded format.

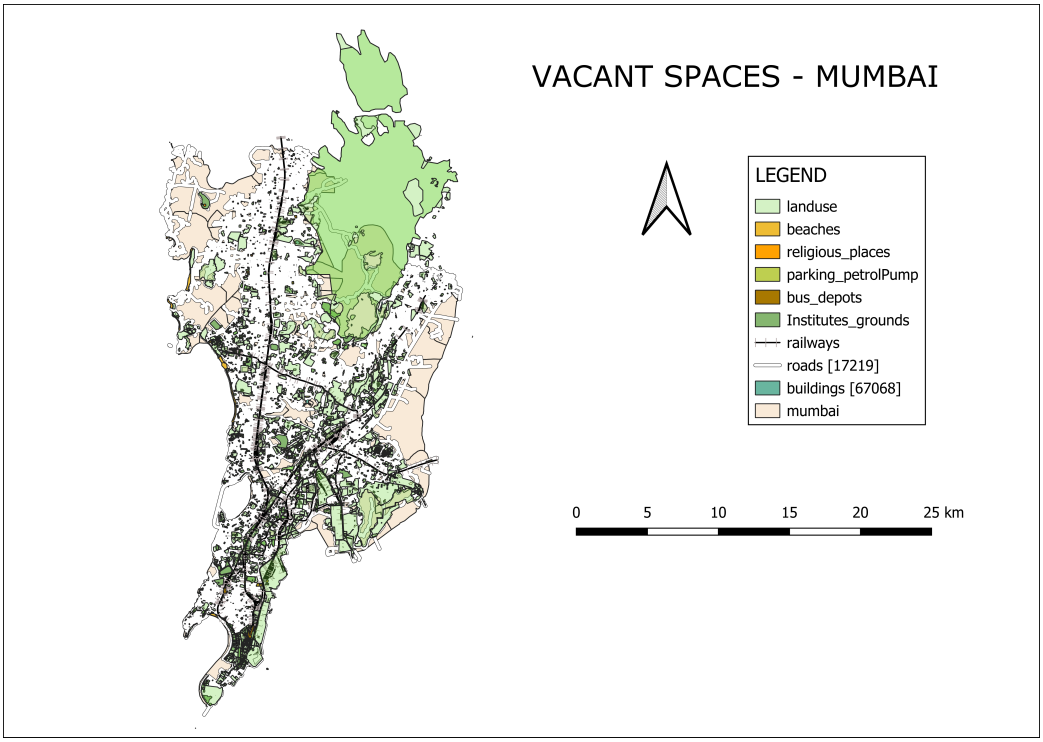

Figure 1: Map highlighting potential vacant spaces in Mumbai.

Through the implementation of the proposed methodology leveraging QGIS technology, this project aims to provide tangible outcomes that contribute to urban planning efforts in Mumbai. By identifying and mapping vacant urban areas for potential development, the project sought to offer a comprehensive view of available land resources within the city. The resulting map, derived from overlay analysis of spatial datasets, highlighted areas suitable for redevelopment or conservation in a labelled manner, thereby improving the precision and efficiency of urban planning.Ultimately, the findings from this project have the potential to inform policy and strategic planning for urban growth in Mumbai. To access the map in NextGIS platform click here.

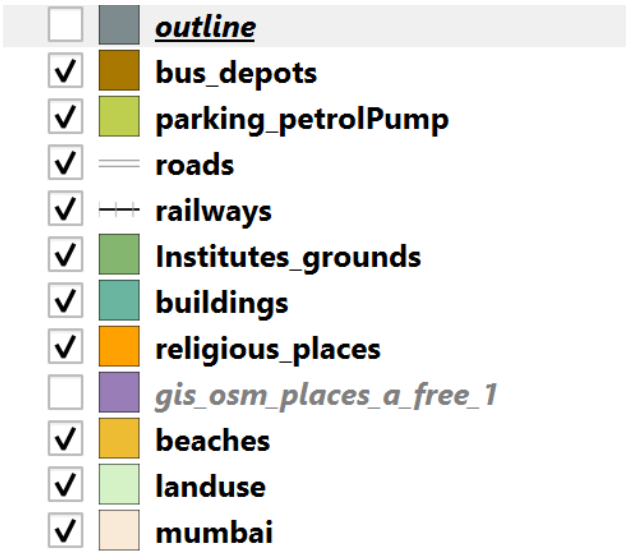

Figure 2: Key of the attributes present in the Map.

Figure 3: Colour coded display of vacant land in Mumbai.

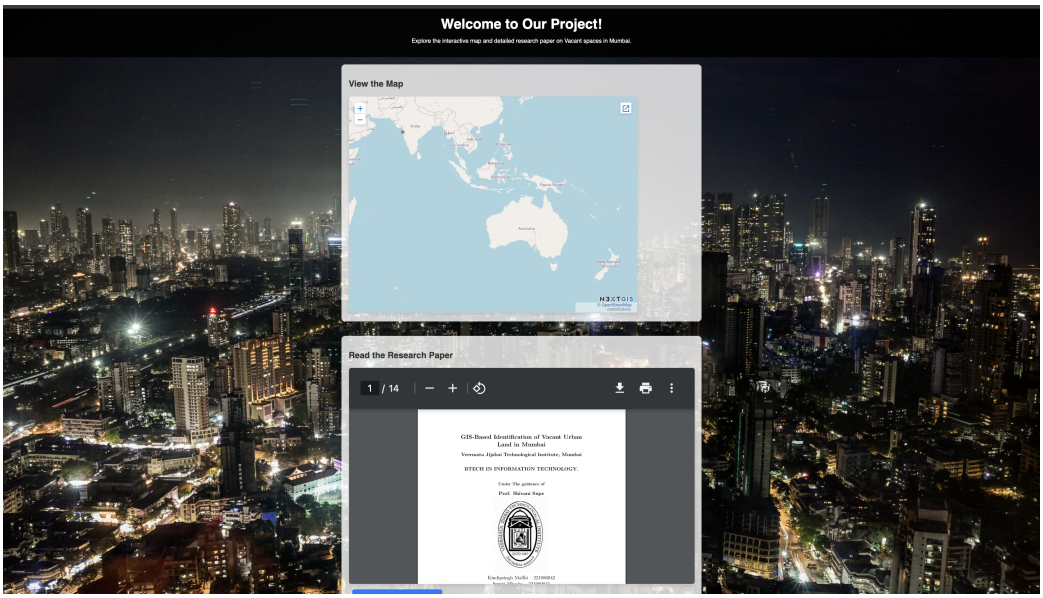

Figure 4: Hosting the map and research paper on a website for public access. To access the source code for the website click here.

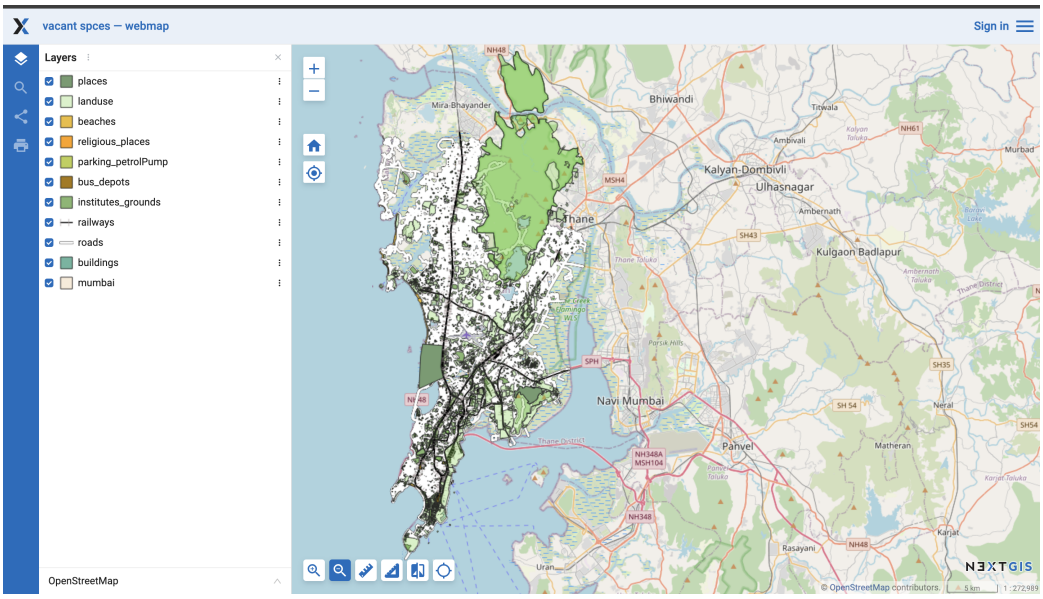

Figure 5: Display of map using NextGIS.

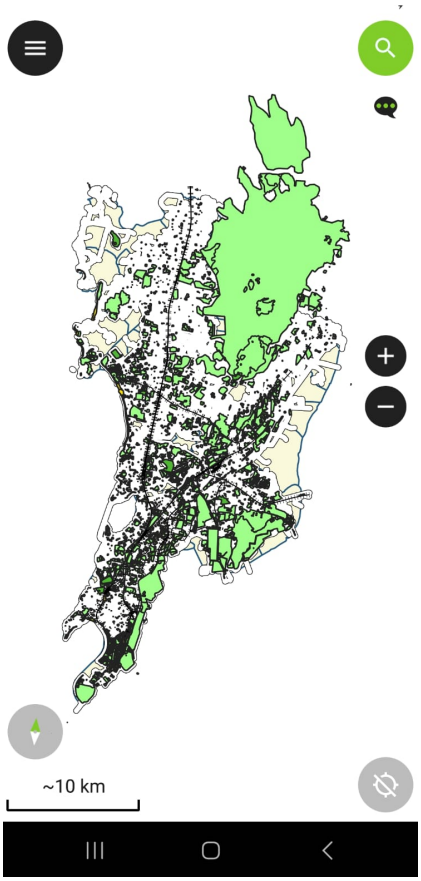

Figure 6: Hosting the map on QField, a mobile application for QGIS.

7 Conclusion

This project highlights the crucial role of Geographic Information System (GIS) technology, particularly QGIS software, in addressing urban planning challenges in Mumbai. By analyzing diverse spatial datasets, we identified potential vacant land parcels, providing insights for sustainable development.

Through GIS, we comprehensively understood Mumbai's urban landscape, including infrastructure, transportation, residential clusters, and natural reserves.

The generated maps serve as decision-support tools for urban planners, aiding redevelopment and natural area conservation. This project sets the stage for future research in urban planning and GIS, with adaptable methodologies for other cities facing similar challenges.

In conclusion, GIS technology offers a transformative approach to mapping vacant land in Mumbai, shaping more informed and sustainable urban planning decisions.

8 Future Scope

1. **Coordinate Collection and Database Development:** Extend the project by collecting precise geographic coordinates for identified vacant land parcels and develop a comprehensive database. This database can store detailed information about each vacant parcel, including its size, zoning status, ownership, and proximity to critical infrastructure.

2. **Integration of Additional Datasets:** Expand the scope of the project by integrating more datasets depicting land use patterns. These datasets could include information on commercial and industrial areas, green spaces, and land ownership records. By incorporating these datasets, we can further refine and narrow down the identification of vacant areas within the city.

3. **Deployment in Web Applications:** Explore the integration of the developed database into web applications catering to various stakeholders. For example, the database could be integrated into real estate websites to provide valuable information to potential investors and developers. Similarly, urban planning authorities could utilize the database

to streamline decision-making processes related to land use and development.

4. **Expansion to Larger Regions:** Scale up the project to cover larger geographical regions beyond Mumbai. By applying the developed methodologies and tools to broader areas, we can address urban planning challenges in other cities and regions facing similar issues of land scarcity and development pressure.

By pursuing these avenues of development, the project can evolve into a robust platform for informed decision-making, stakeholder collaboration, and sustainable urban development in Mumbai and beyond.

9 References

Datasets Used:

- Buildings in India: link here
- Land Use in India: link here
- Natural Objects: link here
- Places: link here
- Roads and Railways: link here
- Traffic and Transport: link here
- Water and Waterways: link here

Research Paper Referred to:

- Urban Design Research Institute Research Paper: link here