

# **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.

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# 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**

### **2.1 Land Use Planning in Mumbai**

**Land Use Classification and Survey Methodology for Urban Development Planning in Mumbai:** This study outlines a comprehensive land use classification system implemented for Mumbai's Development Plan 2014-2034, involving extensive field surveys and GIS data categorization of urban land uses.

### **2.2 Equitable Housing in St. Johns**

**Equitable and Affordable Housing Development in St. Johns:** Focusing on GIS and remote sensing, this study maps vacant lots for affordable housing in St. Johns, using site suitability analysis with weighted overlays to integrate socio-economic and physical land data for equitable urban development.

### **2.3 Challenges in Modeling Vacant Lands by Gregory A. Newkirk**

**Determining Vacant Buildable Lands Using Vector and Cadastral Data by Gregory A. Newkirk:** Newkirk addresses the complexities and assumptions in GIS modeling of vacant and buildable lands, emphasizing the need for adaptable methodologies that preserve historical and comparative accuracy.

## **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, parks and land use. 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 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 Analysis

1. **Identify Uncovered Areas:** Vector analysis tools, including union, merge, and buffer, were employed to merge the individual layers into consolidated datasets. Buffer operations were applied to roads (3 meters) and railways (7 meters) to create buffer zones.
2. **Area Calculation:** The area of the background city shape and the merged layer, including buffer zones, were calculated using QGIS tools.
3. **Vacant Space Identification:** The difference between the total area of Mumbai and the area covered by the merged layer, including buffer zones, was computed to identify vacant spaces within the city.

## 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.

## 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.

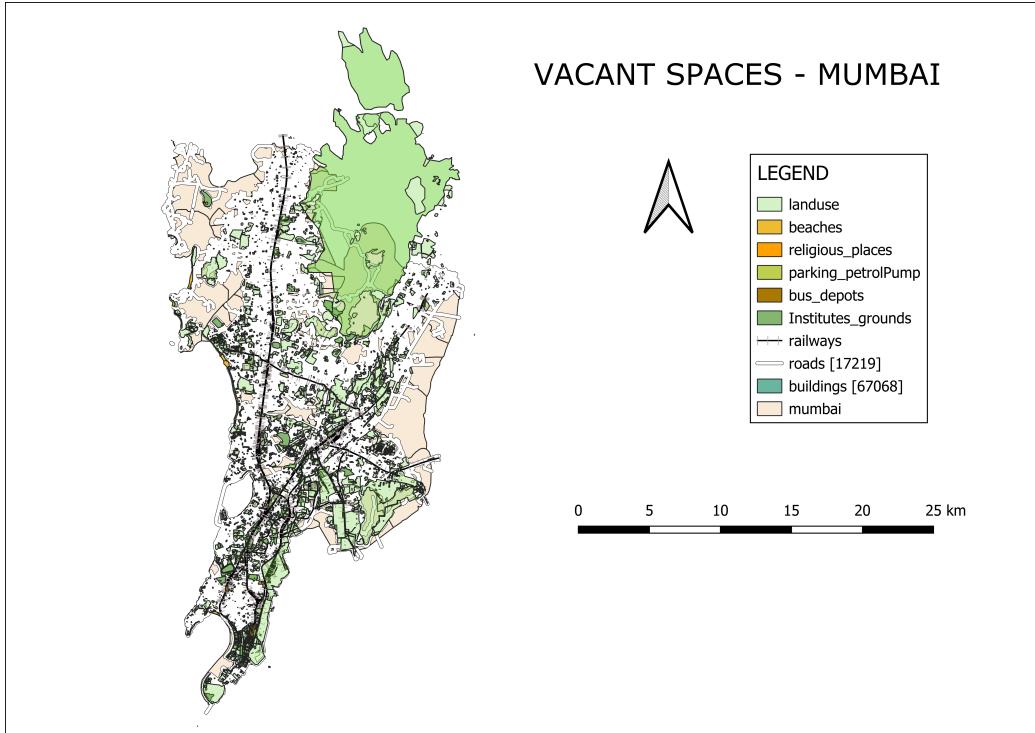


Figure 1: Map highlighting potential vacant spaces in Mumbai.

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](#).

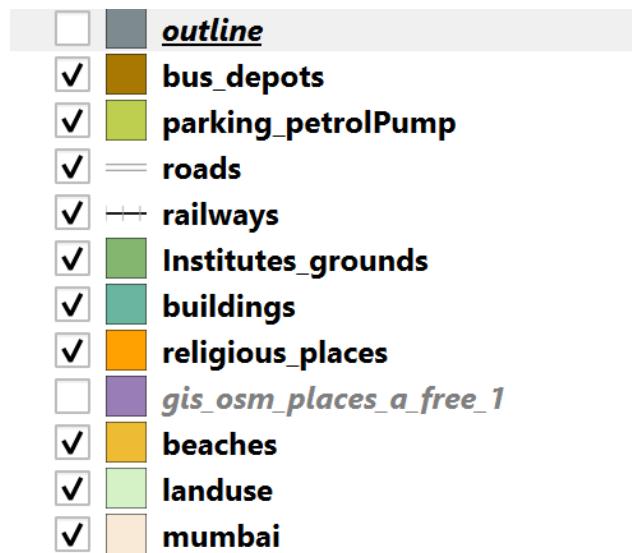


Figure 2: Key of the attributes present in the Map.



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

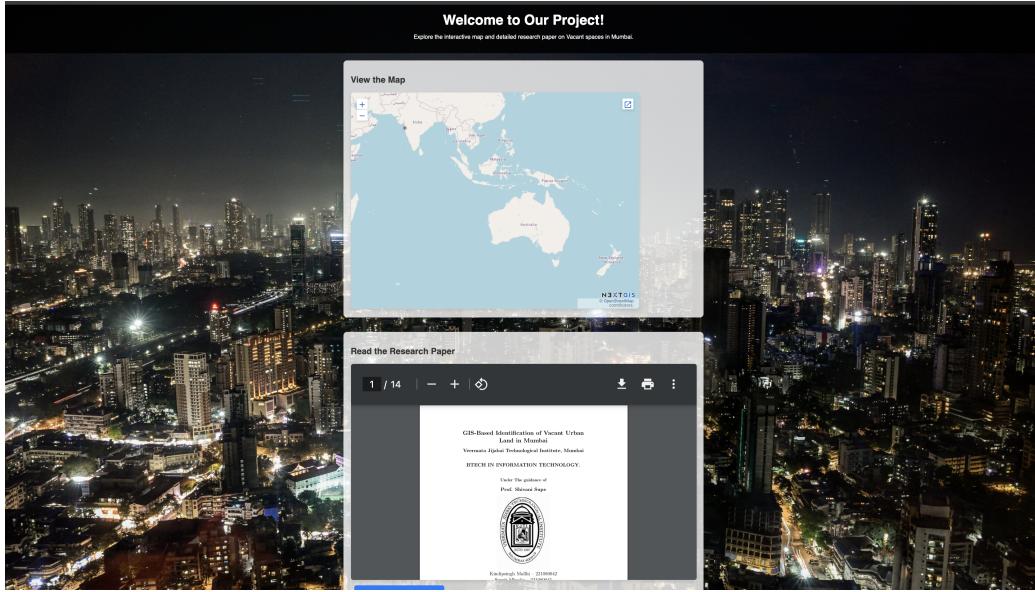


Figure 4: Hosting the map and research paper in the format of a website. To access the source code for the website click [here](#).

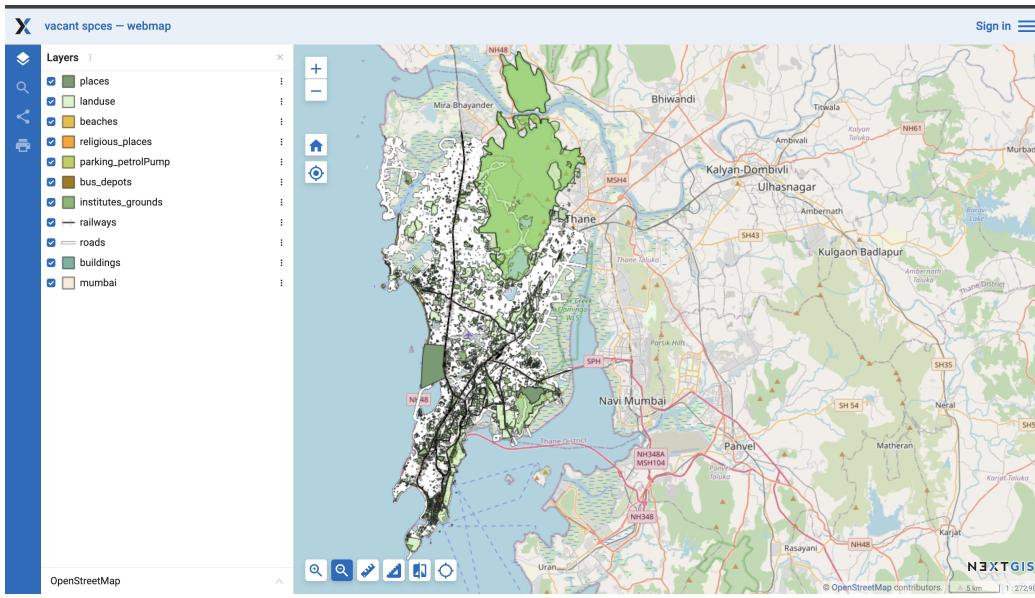


Figure 5: Display of map using NextGIS.

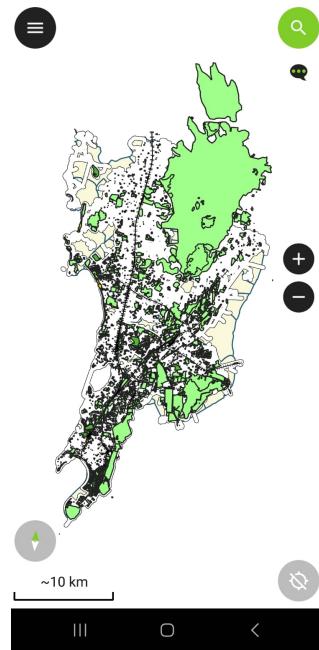


Figure 6: Hosting the map on QField, a mobile application for QGIS.

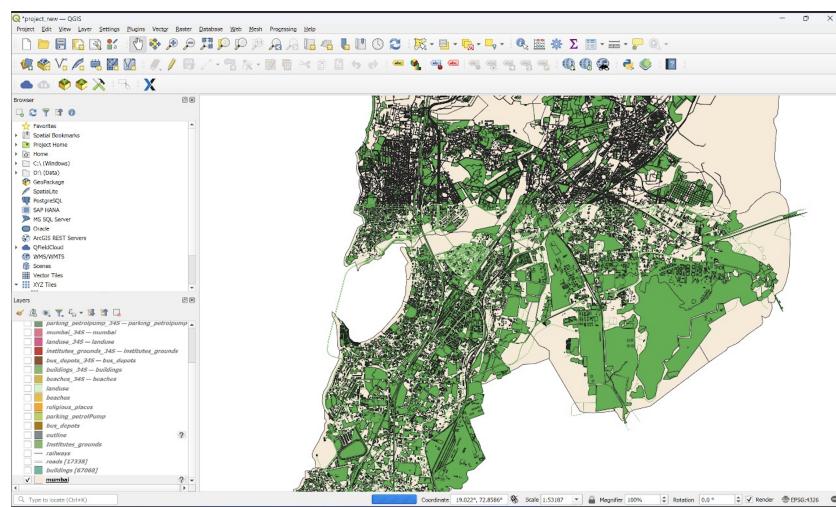


Figure 7: Combining All individual layers into one dataset.

## 6.1 Results Cumulated:

- **Total Area of Mumbai:** 433,833,318 square meters.
- **Area of Merged Layer:** 420,725,742 square meters.
- **Vacant Spaces:** 13,107,576 square meters.
- **Percentage of Vacant Land:** 3.021% of the total area.

## 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 Papers Referred to:**

- Urban Design Research Institute Research Paper: link here
- Vacant Land Plotting of St Johns, Portland: link here
- Assessing Vacant and Buildable Lands: A GIS Approach to Urban Planning Challenges by Gregory A. Newkirk: link here