Clustering high-density unserved populations and pathfinding to Metro Bus routes for a new feeder service in Islamabad

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1. Introduction

A significant portion of Islamabad's population lacks access to affordable public transit. This project aims to:

- Identify high-density underserved populations and POIs
- Connect population clusters to nearby POIs and metro stations using optimal paths
- Map candidate feeder routes and stations to existing metro infrastructure for spatial consistency

2. Problem Statement

How can we improve transit access for underserved high-density areas in Islamabad by:

- Identifying unserved population clusters and key POIs?
- Connecting them to the metro network?
- Proposing efficient, spatially-aligned feeder routes?

3. Data

Data Description and Preprocessing

POIs (hospitals, education, markets) and road networks were extracted using OSMnx.

Population clusters were taken from 1km aggregated data via WorldPop.

Metro routes were retrieved using CityLines API; station coordinates were manually marked using Google Maps.

Preprocessing Steps

POIs were filtered to lie within 10 km of the metro route and outside a 1 km buffer.

Suitable Routes for feeder bus were identified.

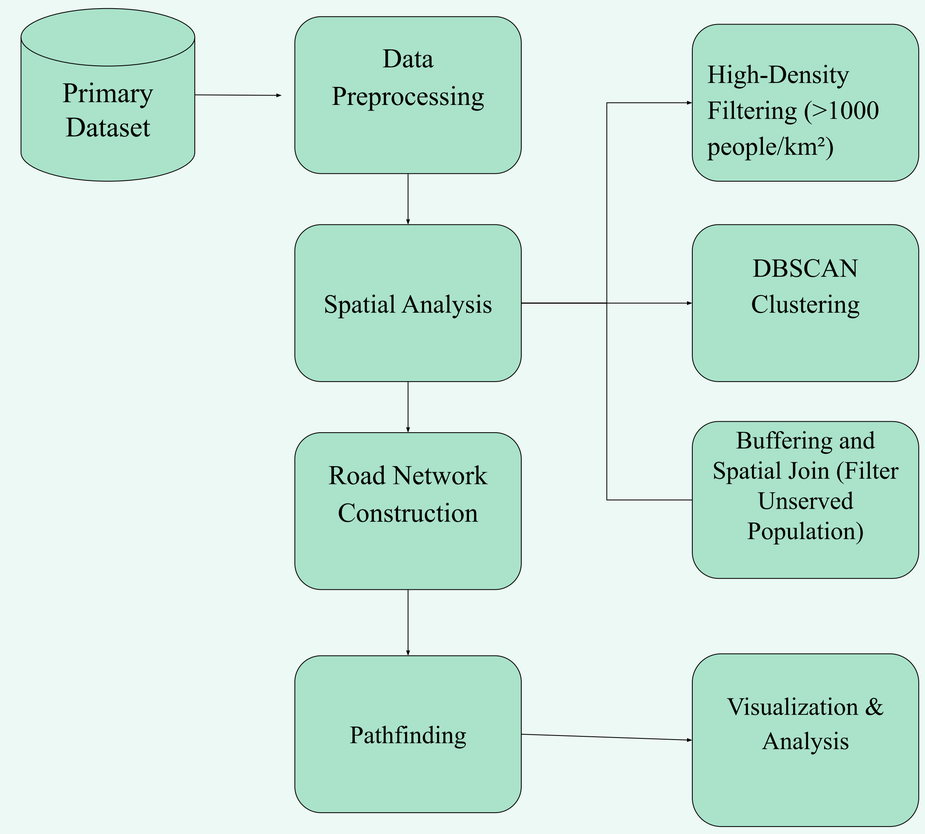
Population clusters were filtered to include only those within 15 km of the metro but outside the 1 km buffer.

Metro stations were snapped precisely onto the metro line.

Cleaned and removed unnecessary or invalid geometries for accurate analysis.

Fig. 1: Key POIs, Metro Bus route and Preferable Road network for buses
Fig 2 :Unserved Population and POIs within 20km of Metro Bus Route

4. Methodology



5. Results & Discussion

Total Number of Routes: 2 routes (approximately 33.37 km) were generated, connecting high-density population clusters to metro stations via feeder roads and underserved POIs.

POI Distribution:

Hospitals: 9 facilities were included, ensuring access to healthcare for unserved populations.

Education: 11 institutions (e.g., schools, universities) were connected, supporting educational accessibility.

Markets: 21 markets were incorporated, addressing commercial needs.

Population Served: 41 POIs were integrated into routes. The routes connect clusters with significant unserved populations (estimated at ~25,000 people across clusters, based on prior clustering with DBSCAN, eps=1500m, min_samples=2, and population >1000 people/km^2).

Cluster Coverage: The two routes originate from centroids of high-density clusters, ensuring that densely populated unserved areas are prioritized.

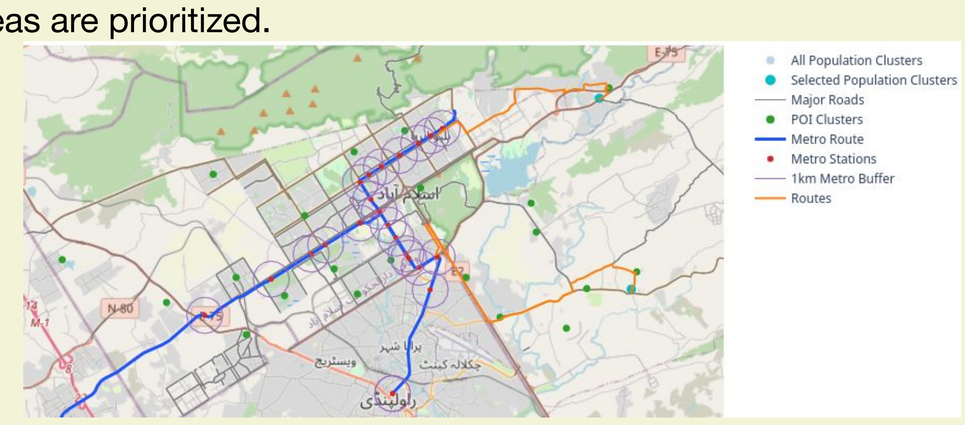


Fig. : Final routes are shown in yellow color

Acknowledgments: Please add acknowledgements here.