KATHMANDU UNIVERSITY

SCHOOL OF ENGINEERING

DEPARTMENT OF GEOMATICS ENGINEERING

MINI PROJECT REPORT

SPATIAL DATABASE MANAGEMENT SYSTEM GEOM 318

Submitted By:

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ACKNOWLEDGEMENT:

I would like to express my sincere gratitude towards the Department of Geomatics Engineering (DOGE). A special appreciation for our SPATIAL DATABASE MANAGEMENT SYSTEM faculty teacher ER. AJAY THAPA sir for his valuable contribution towards providing us with the knowledge and training of software like Postgres, Qgis and many other integrated tools. His supervision has led us to complete our mini project with such efficiency.

Thank you!

ABSTRACT:

This is a mini project report depicting the crucial principles of spatial queries and its application on various software. This project generates the shortest route between the origin(start) and the destination using spatial queries. Different software tools were used such as Postgres, Q, POSTGIS, JAVA. Data such as OSM generated data in both OSM2PO format and .PBF format were also crucial for the execution. The data obtained were used for the determination of shortest route through queries. pgRouting is an extension of the PostGIS/PostgreSQL geospatial database that provides geospatial routing functionality. PostgreSQL, often referred to as Postgres, is a powerful, open-source object-relational database system known for its robustness, feature set, and extensibility. PostGIS is a spatial database extender for PostgreSQL, turning it into a spatial database for geographic information systems (GIS). It adds support for geographic objects, allowing location queries to be run in SQL. SQL (Structured Query Language) is a standard programming language specifically designed for managing and manipulating relational databases. It is widely used for querying, updating, and managing data stored in a database. QGIS (Quantum GIS) is a powerful, free, and open-source geographic information system (GIS) application used for viewing, editing, and analyzing geospatial data. It supports a wide range of vector, raster, and database formats and functionalities, making it a popular choice for both professional and academic use. Spatial data, also known as geospatial data, is information about the physical location and shape of geometric objects. These objects can be points, lines, polygons, and other complex structures representing natural and man-made features on Earth. Spatial data is fundamental to geographic information systems (GIS) and is used in a wide range of applications, from mapping and navigation to environmental monitoring and urban planning

Contents

1 INTRODUCTION

1.1 BACKGROUND

pgRouting is an extension of the PostGIS/PostgreSQL geospatial database that provides geospatial routing functionality. It is designed to work with the PostgreSQL database and the PostGIS spatial extension, enabling complex routing algorithms to be executed directly within the database. (Puyam S. Singh, 2015). Here are some key features and capabilities of pgRouting:

i. **Routing Algorithms**: pgRouting supports a variety of routing algorithms eg.: Dijkstra.
ii. **Integration with postgis:** The spatial capabilities of postgis is integarated with pgrouting.
iii. **Network Analysis:** It can perform network analysis operation such as finding the shortest **route between two points.**

Terminologies:

PostgreSQL: PostgreSQL, often referred to as Postgres, is a powerful, open-source object-relational database system known for its robustness, feature set, and extensibility. (Puyam S. Singh, 2015)

PostGIS: PostGIS is a spatial database extender for PostgreSQL, turning it into a spatial database for geographic information systems (GIS). It adds support for geographic objects, allowing location queries to be run in SQL. (Regina O. Obe, 2017)

QGIS: QGIS (Quantum GIS) is a powerful, free, and open-source geographic information system (GIS) application used for viewing, editing, and analyzing geospatial data. It supports a wide range of vector, raster, and database formats and functionalities, making it a popular choice for both professional and academic use (Muñoz, 2020).

SQL: SQL (Structured Query Language) is a standard programming language specifically designed for managing and manipulating relational databases. It is widely used for querying, updating, and managing data stored in a database (Muñoz, 2020).

Spatial Data: Spatial data, also known as geospatial data, is information about the physical location and shape of geometric objects. These objects can be points, lines, polygons, and other complex structures representing natural and man-made features on Earth. Spatial data is fundamental to geographic information systems (GIS) and is used in a wide range of applications, from mapping and navigation to environmental monitoring and urban planning (Ramesh Janipella, Spatial Data, 2019).

Network Analysis: Network analysis of spatial data involves examining the relationships and interactions between spatial entities within a geographic space. This type of analysis is crucial in various fields, such as transportation planning, urban development, environmental management, and public safety. It often requires integrating geographic information systems (GIS) with network analysis tools to derive meaningful insights from spatial networks (Smiraglia, 2001).

1.2 OBJECTIVES

Primary Objective:

The primary objective of this project is:

i. To find out the shortest distance between the origin and destination.
i. To analyze the spatial queries for the shortest route determination.

Secondary Objective:

The secondary objective of the project includes:

i. To become familiar with the Postgres, Postgis, Qgis tools.
ii. To be able to work with OSM data.

2 METHODOLOGIES

The methodologies involved for performing pgrouting are as follows:

1. Installation:
   - To perform pgrouting we need to first install Postgres and Postgis in our devices.

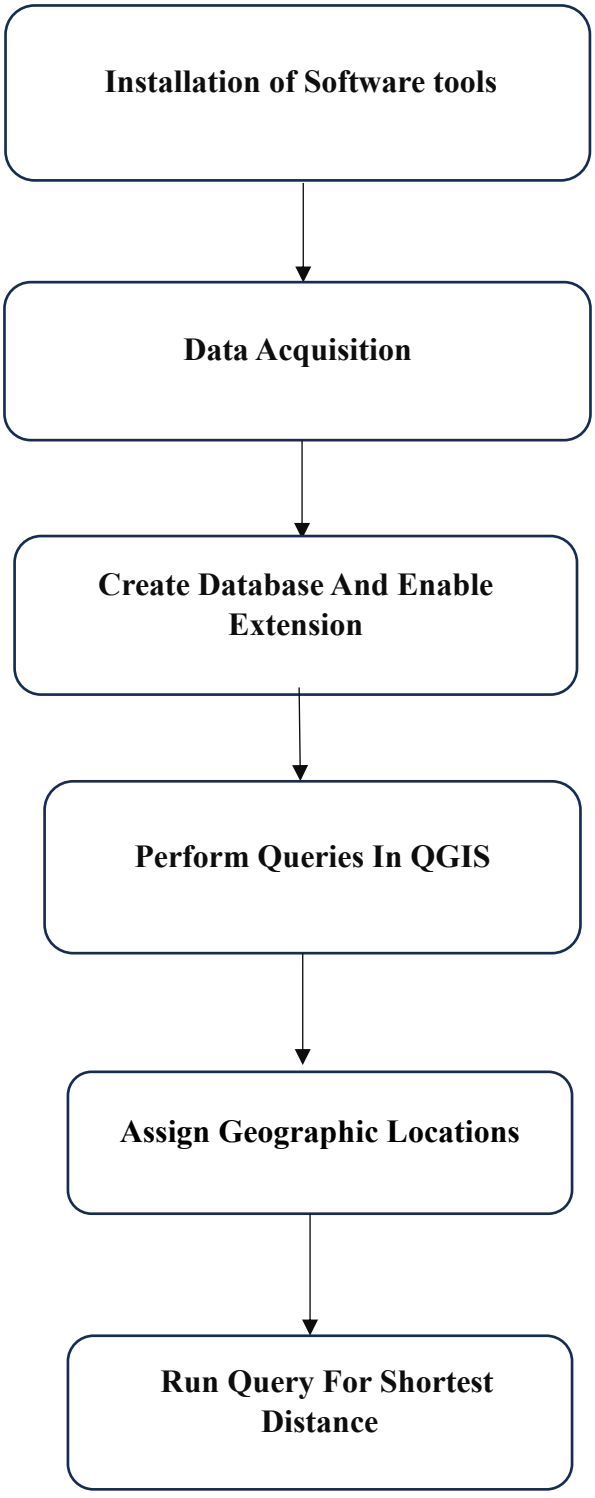
i. Installation of PostgreSQL: https://www.postgresql.org/download/
ii. PostGIS: https://postgis.net/documentation/getting_started/install_windows/
iii. QGIS: https://www.qgis.org/en/site/forusers/download.html
iv. JAVA: https://www.java.com/en/download/

2. Data Acquisition:
   - Different spatial data acquisition are to be done before conducting the process:

i. OSM2PO: https://osm2po.de/releases/
ii. OSM data in .PBF format: https://download.geofabrik.de/asia.html

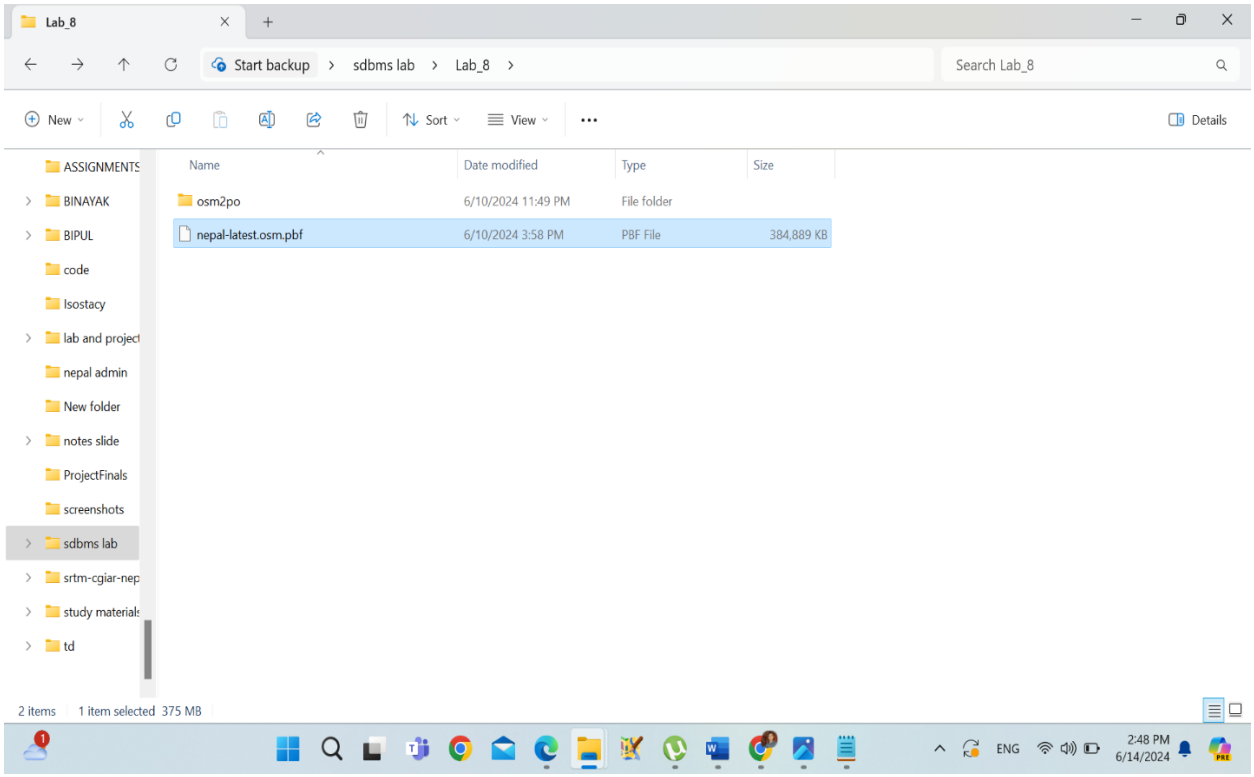
3. Create a Database and Enable extension
4. Perform spatial queries.
5. In QGIS, DB manager write a query to assign the location for the origin and destination.
6. Perform the query for the origin location.
7. Perform the query for the destination location.
8. Finally perform the overall query to find out the shortest path between the origin and destination (Puyam S. Singh, 2015) (Smiraglia, 2001).

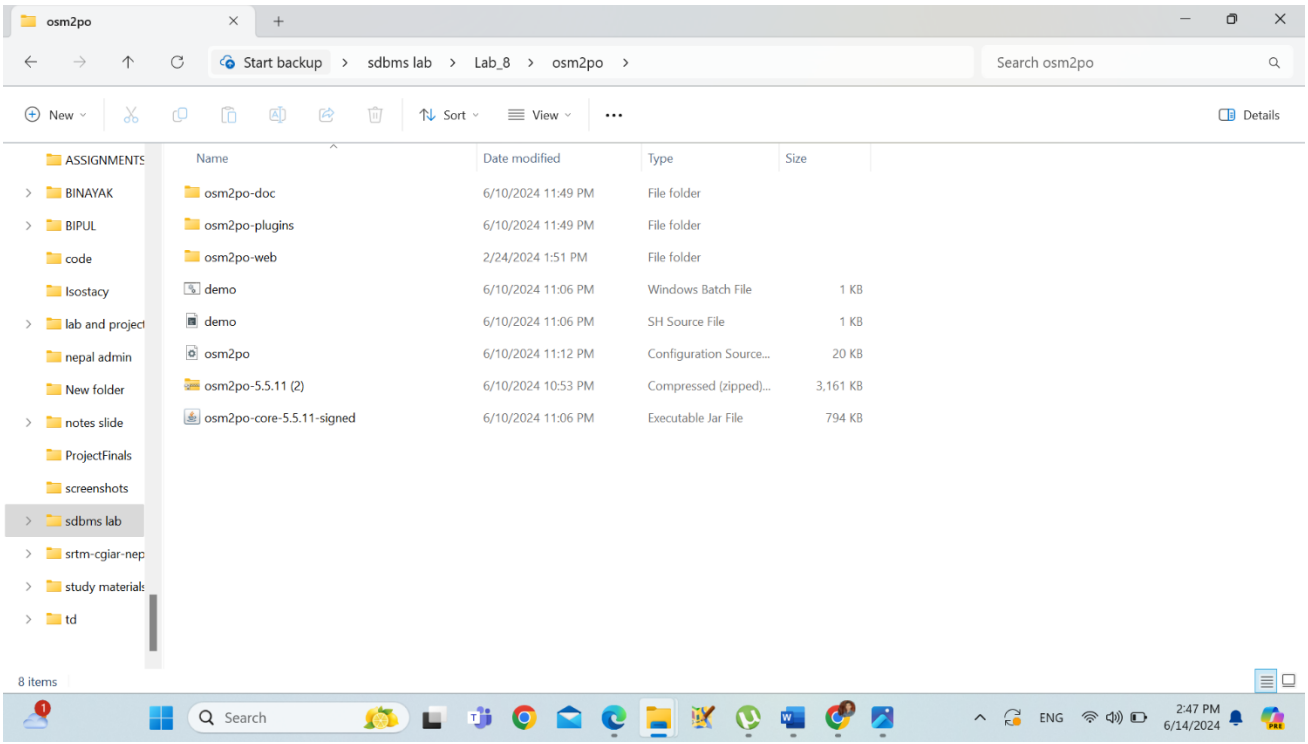
FLOW DIAGRAM:



3 PERFORMED OPERATIONS:

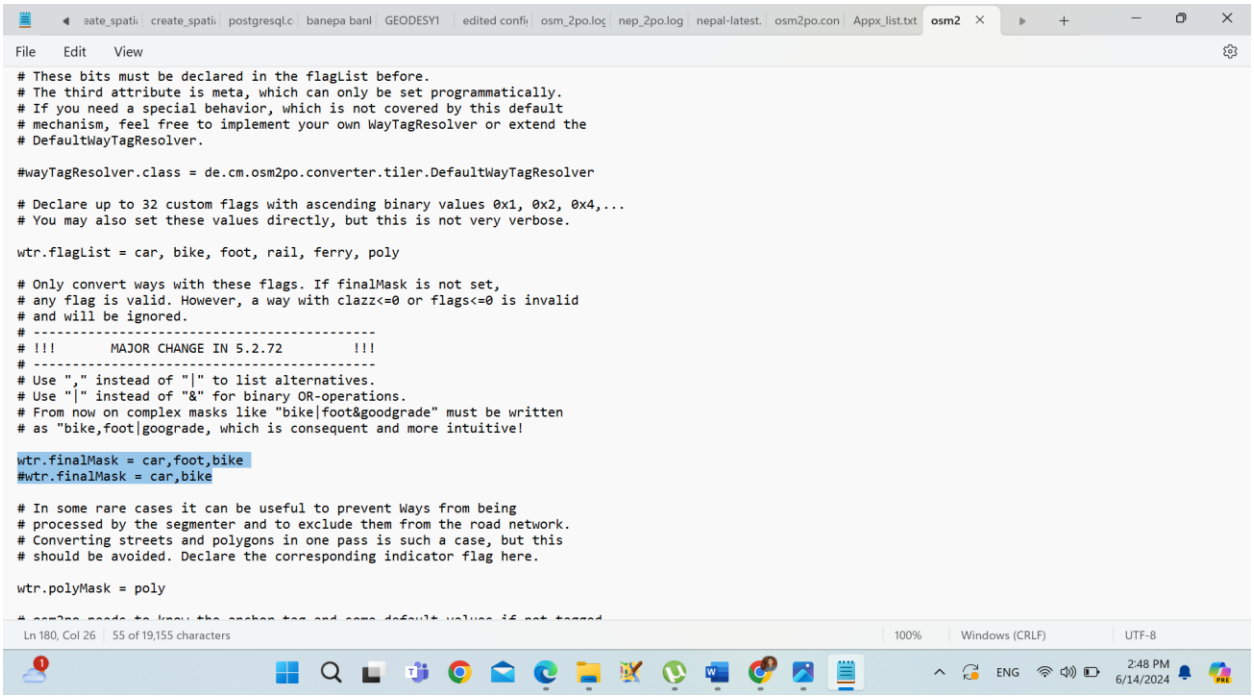
3.1 DATA ACQUISITIONS:

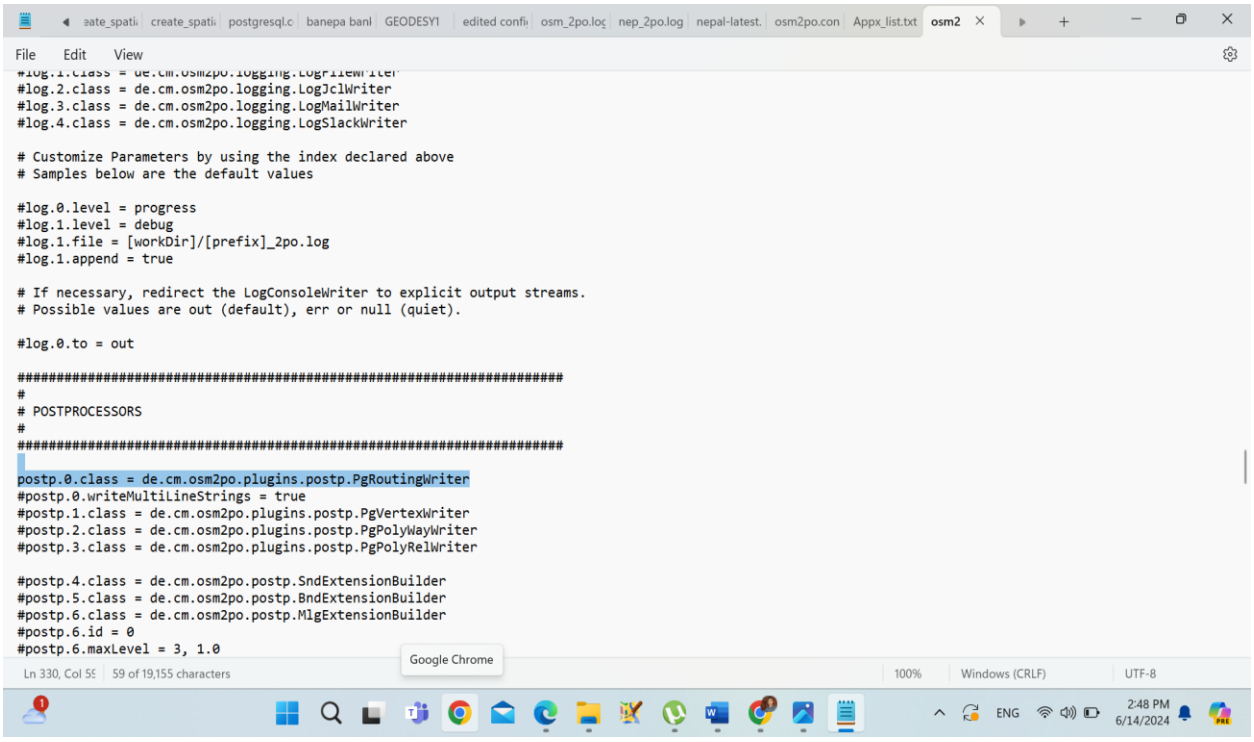




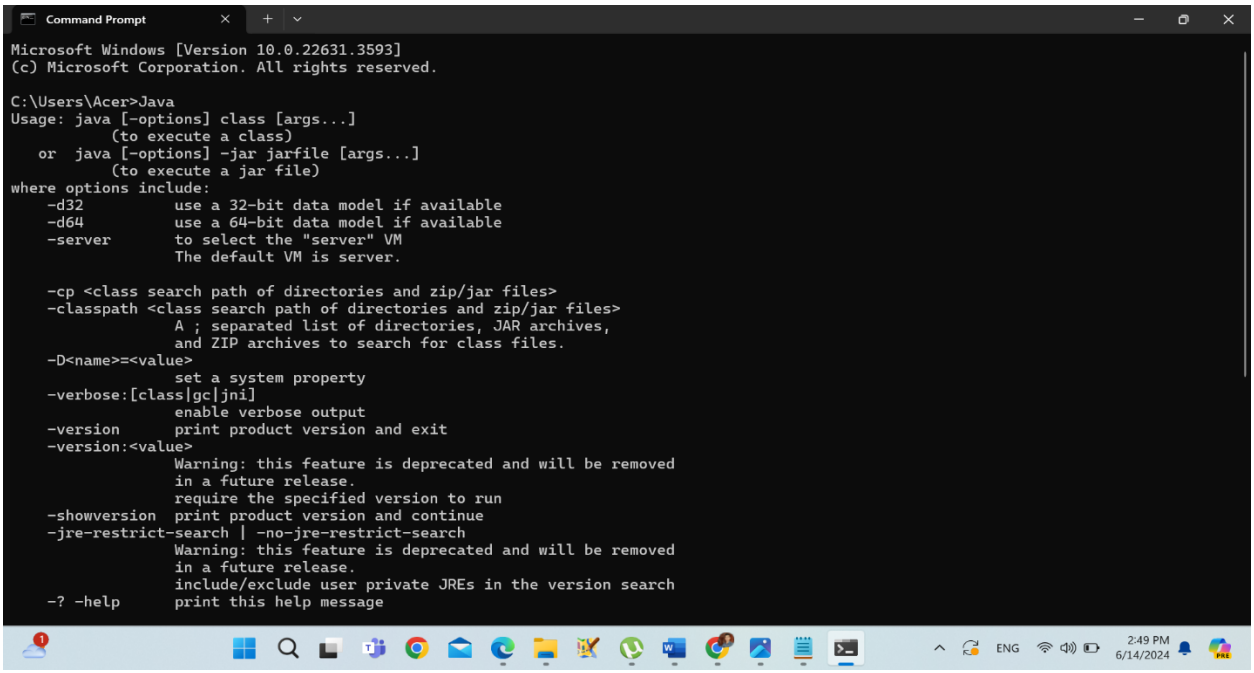
Editing the configuration file in the notepad:

Opened the configuration file from OSM2P0 in the note pad and the edited the line 179 and 330 as mentioned**.**



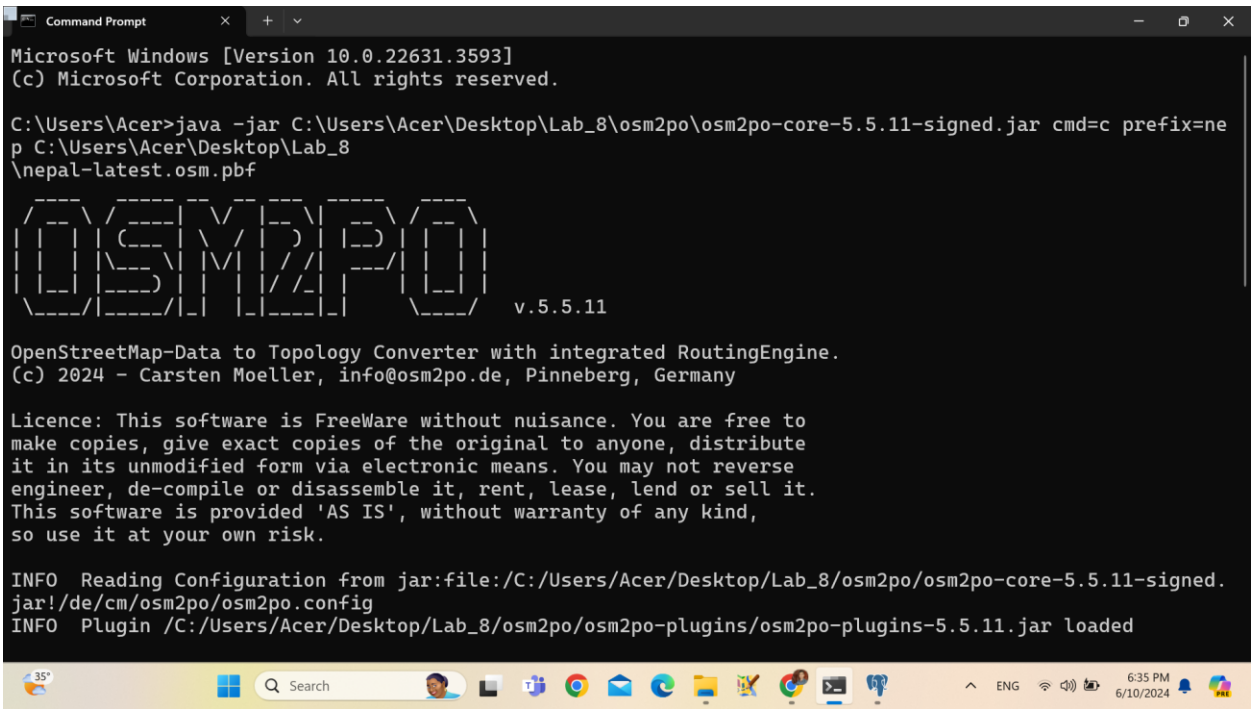


Checking if java is installed or not:

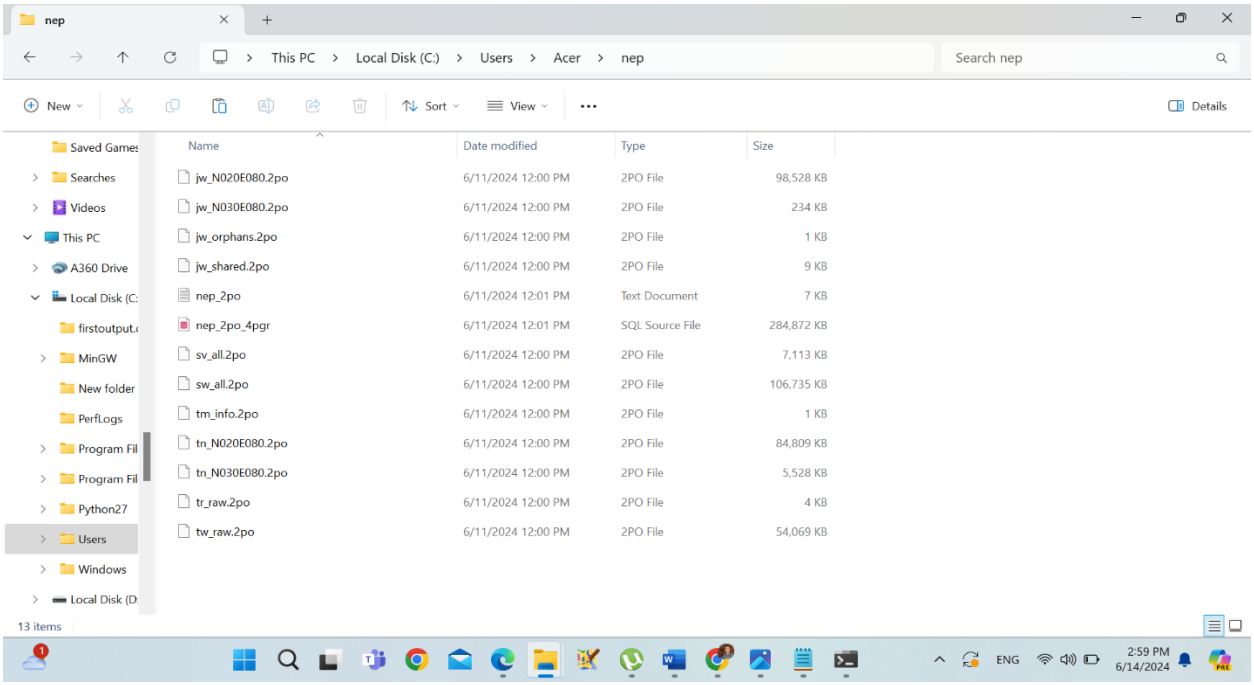


This shows java is completely installed.

Pre-processing of OSM data in OSM2PO:

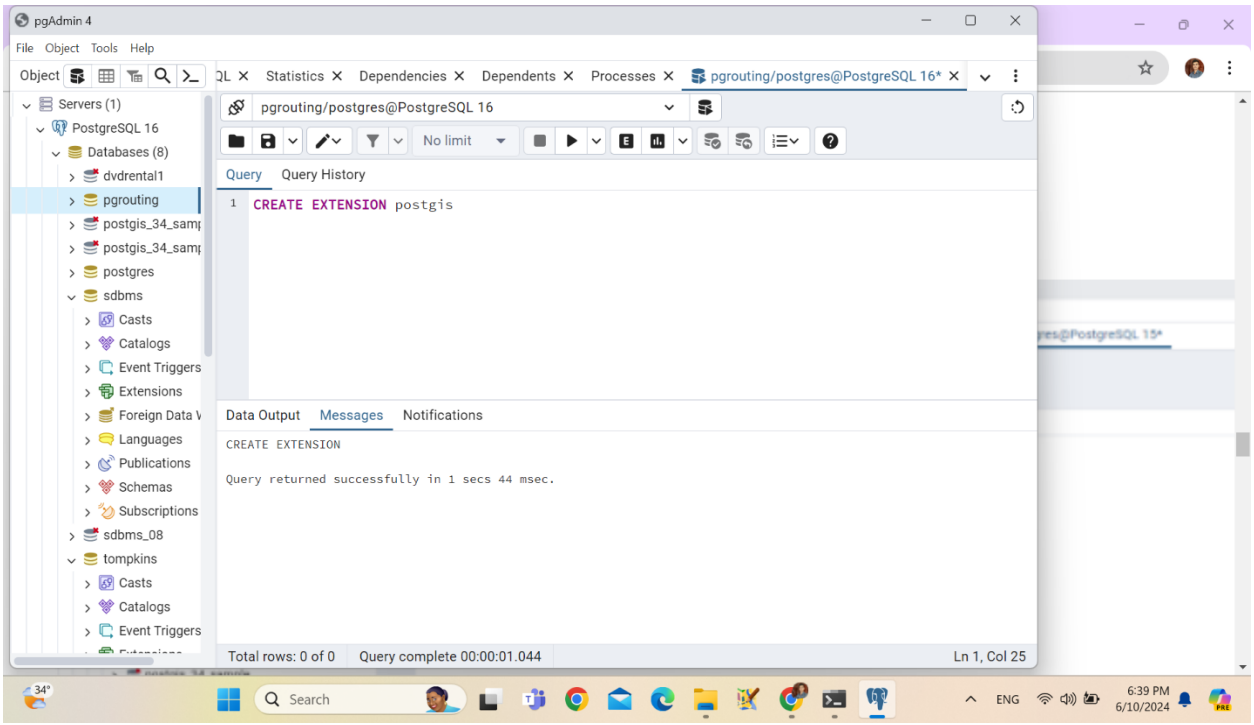


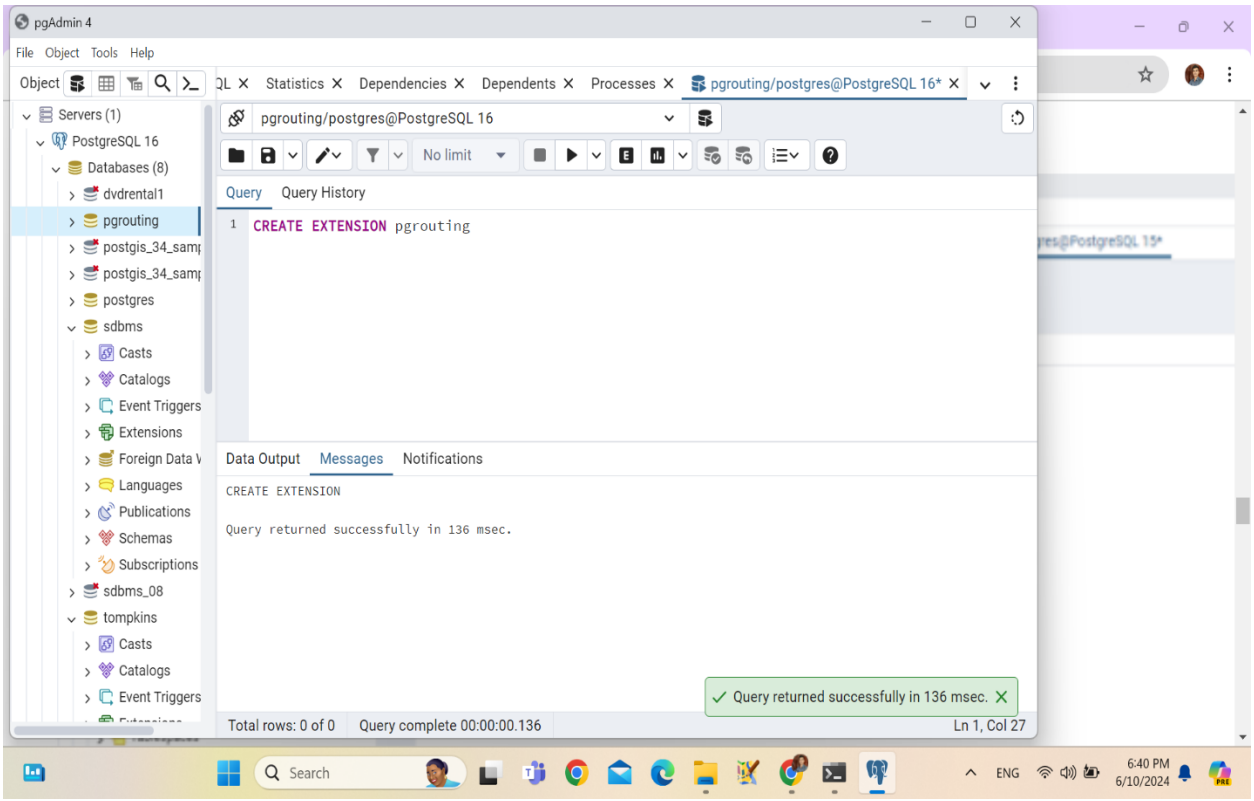
Provides with the location of converted SQL file.



Creating Database pgrouting in pgAdmin and Extension Postgis and pgrouting:

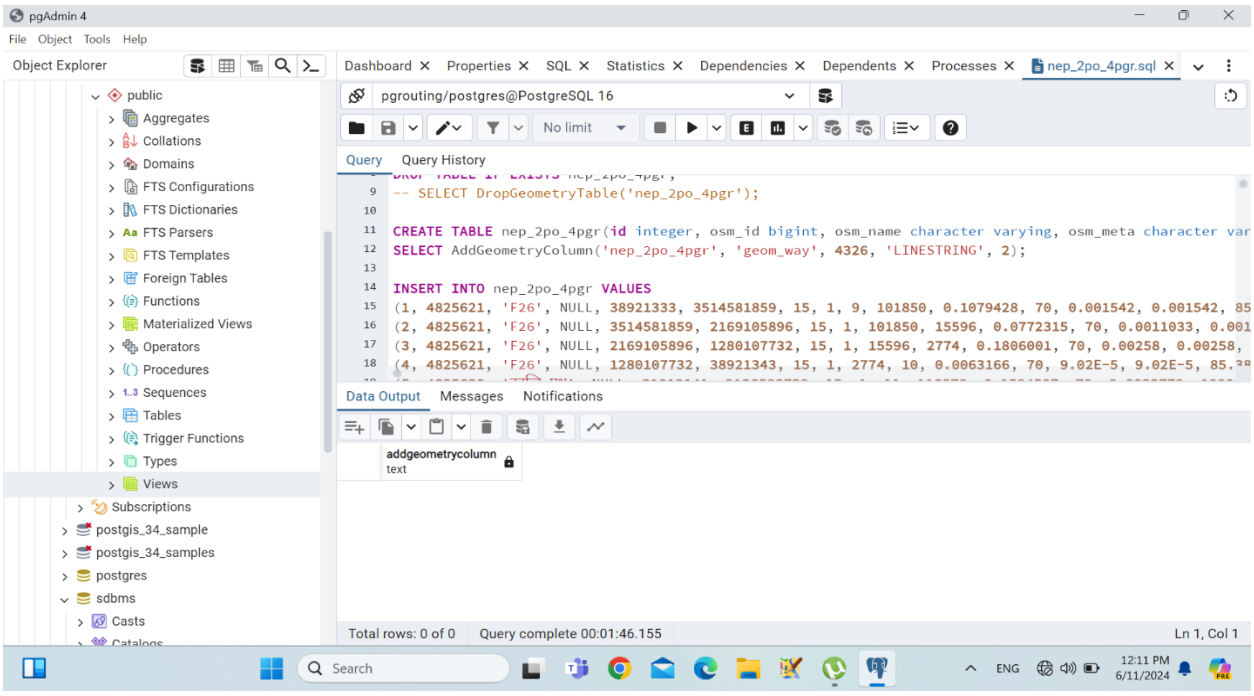
Go to pgAdmin> Click on database> create database pgrouting> create extensions postgis and pgrouting.

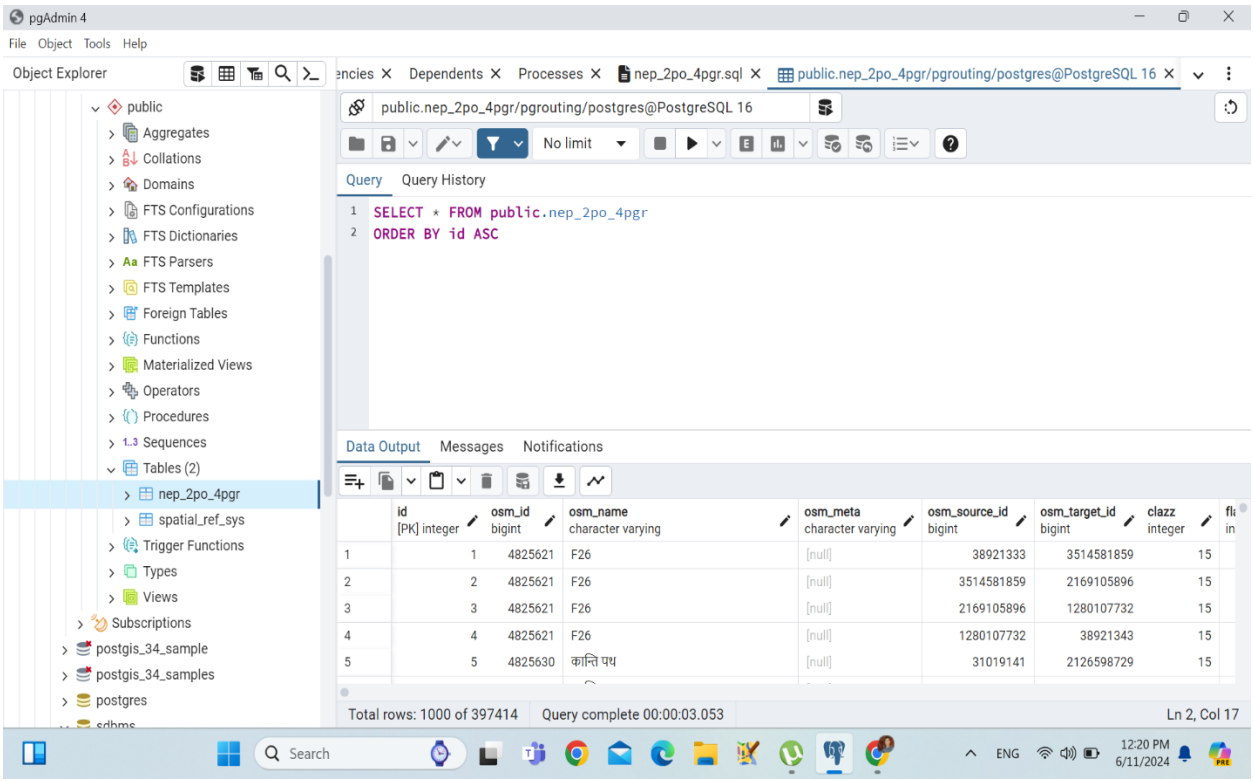




Importing SQL file:

Click Alt + O in query tool> Add the sql file.





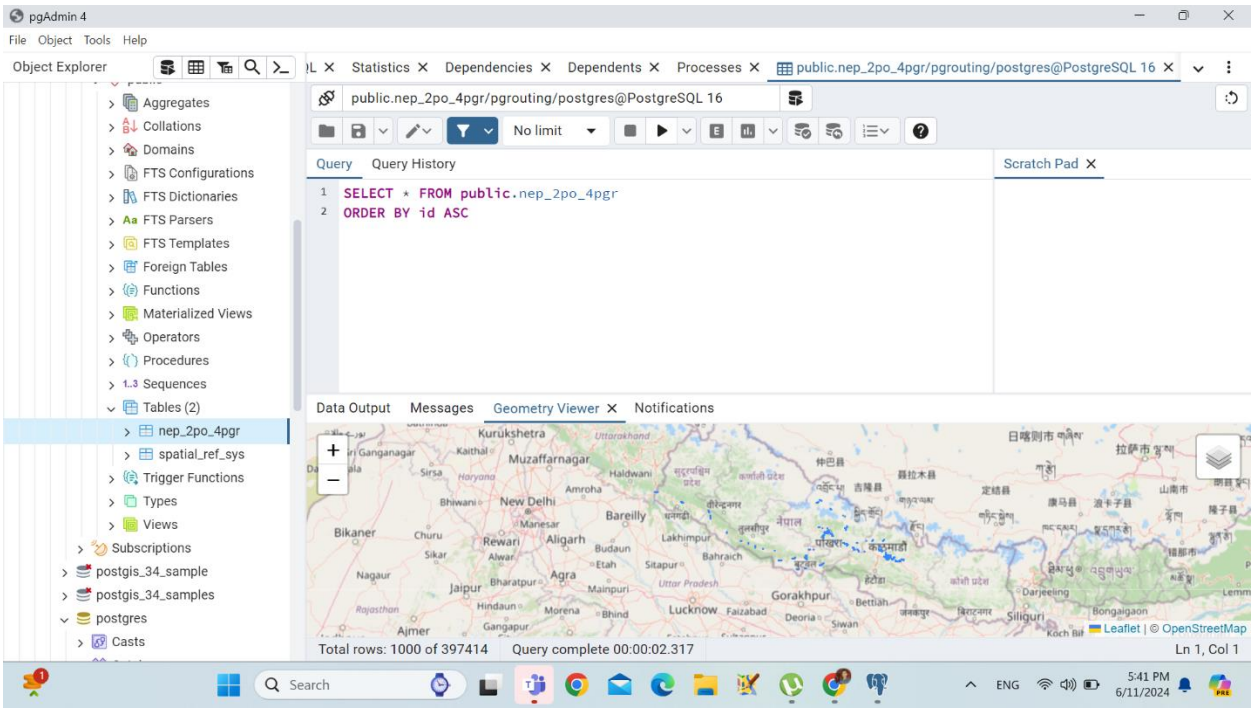
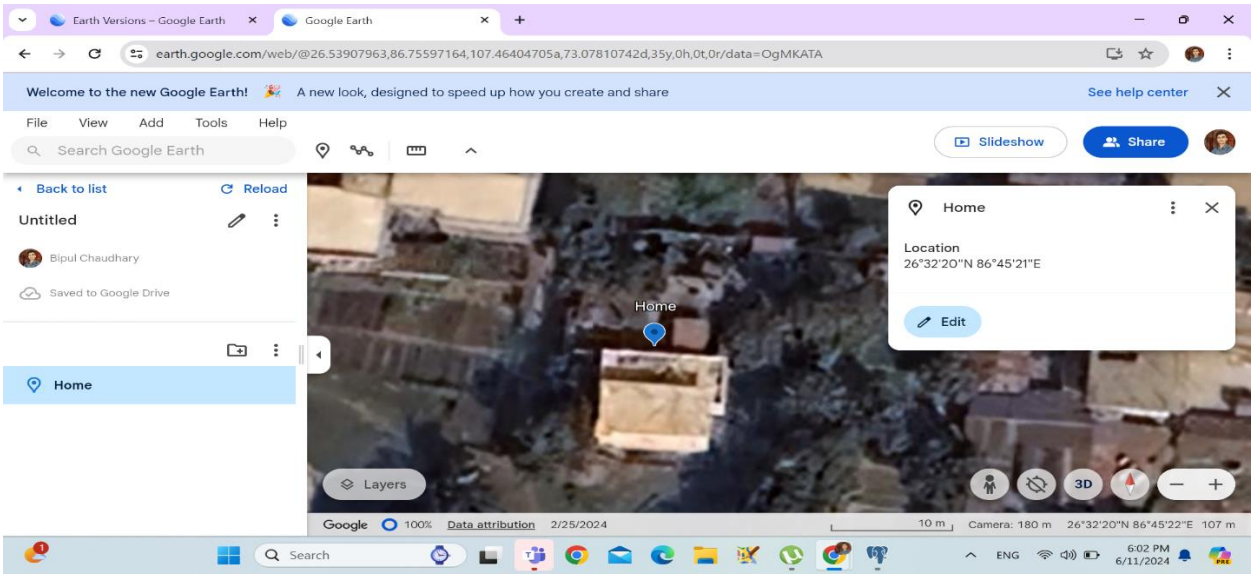


Table of the SQL file created and through the column,with the geometry viewer tab above geographic data is obtained.

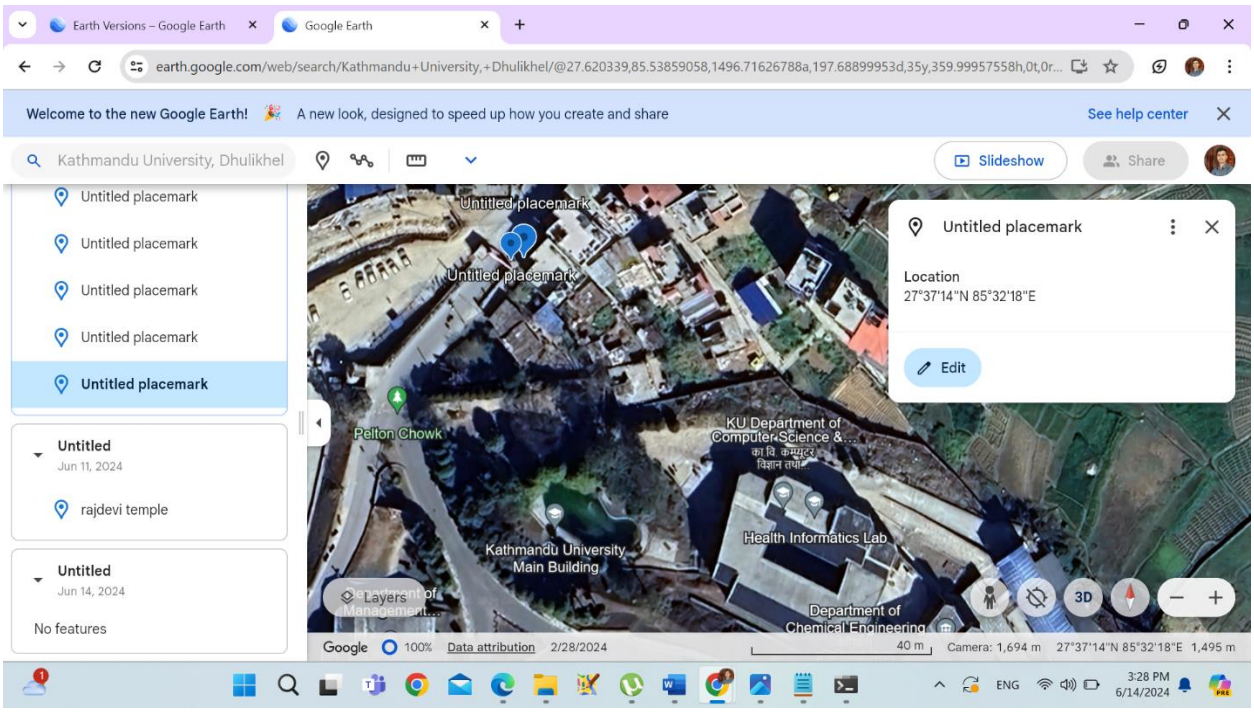
Location Of Origin(start):

This is the geographic location of my home which is located in Rajbiraj, saptari ,Nepal. This location is obtained by navigating with the help of Google Earth tool.



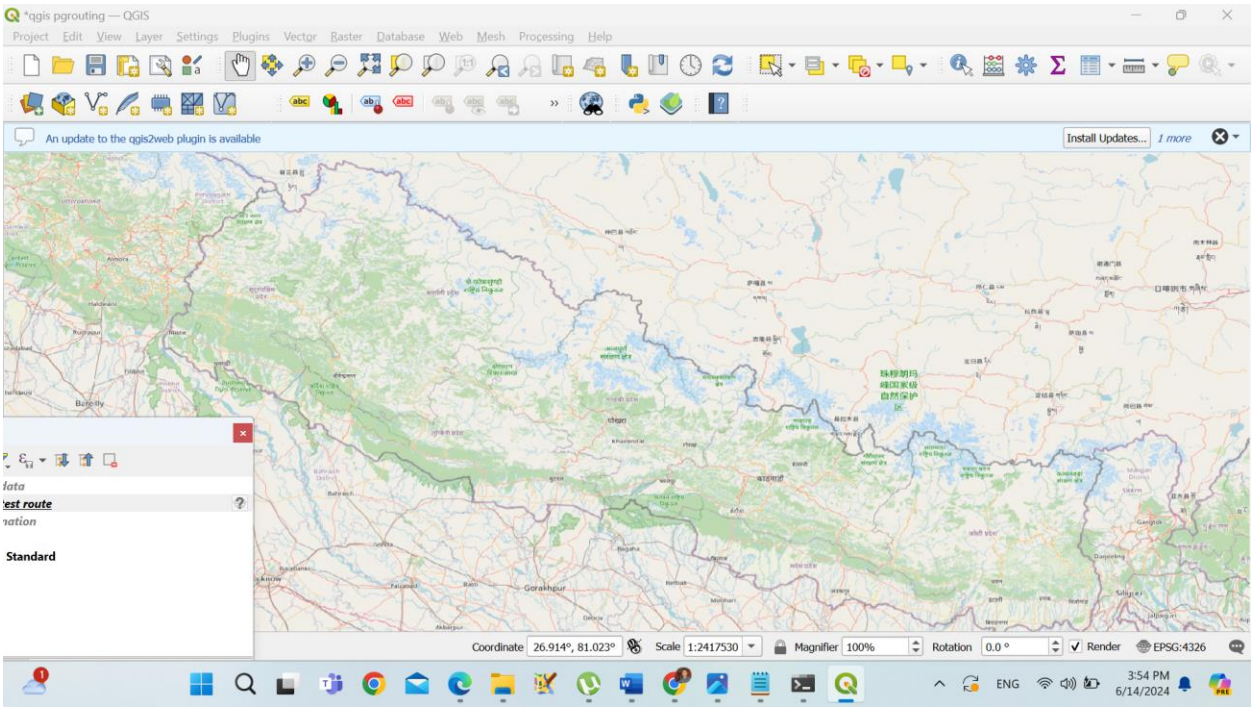
Location Of Destination:

This is the geographic location of KATHMANDU UNIVERSITY, Dhulikhel which is located in Dhulikhel, Kavre ,Nepal. This location is obtained by navigating with the help of Google Earth tool.



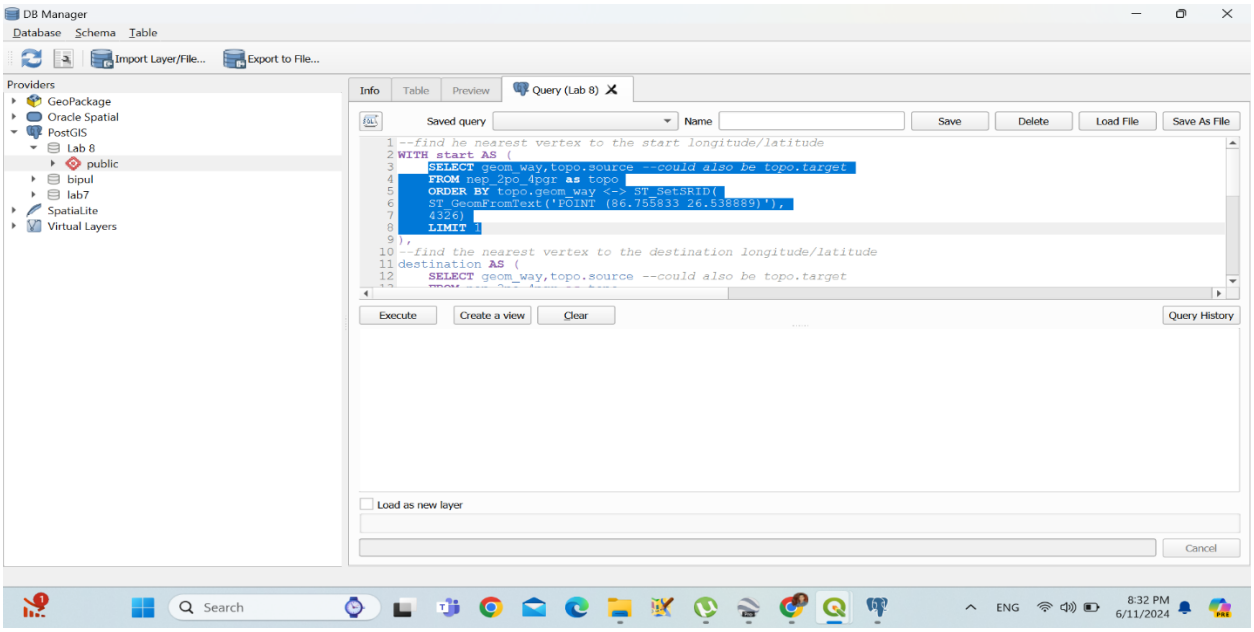
OSM DATA plugin:

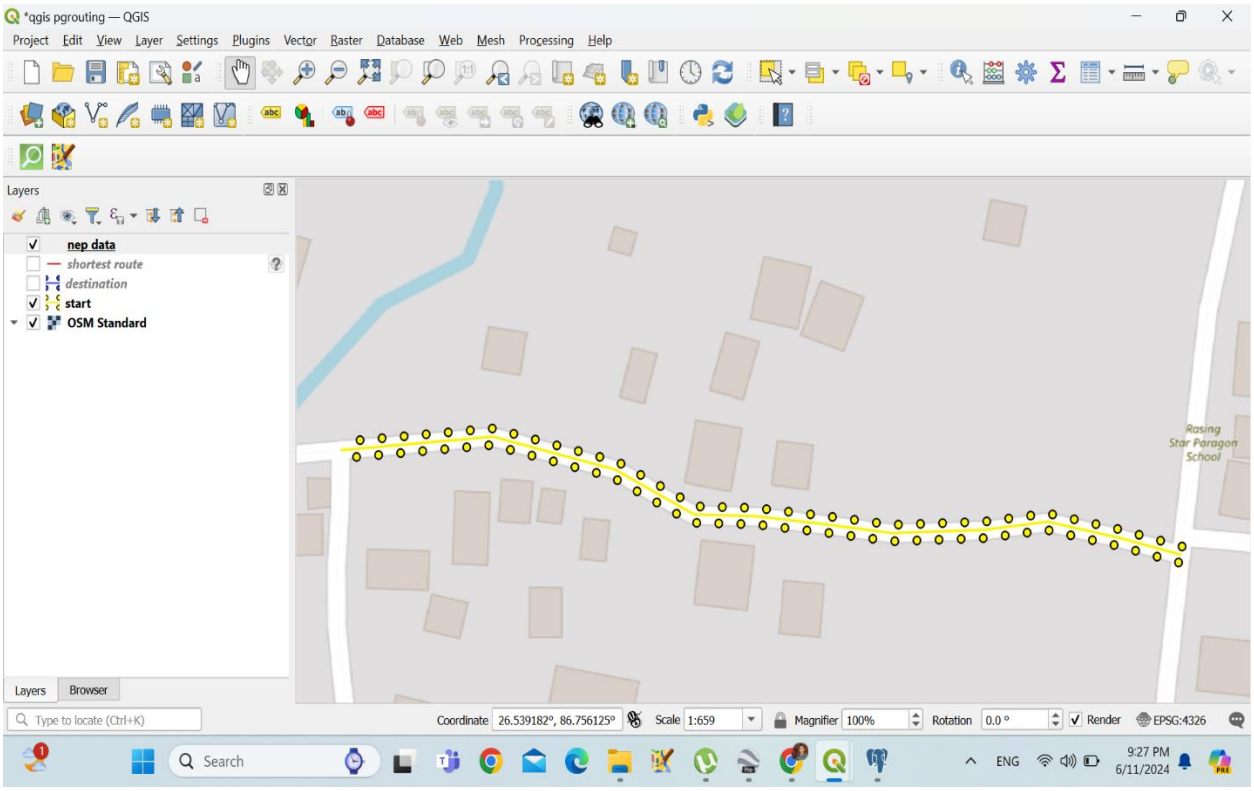
Open QGIS > in Browser> Add new connection to the Database crated in pgAdmin> Go To DB Manager> Write spatial query mentioned below:

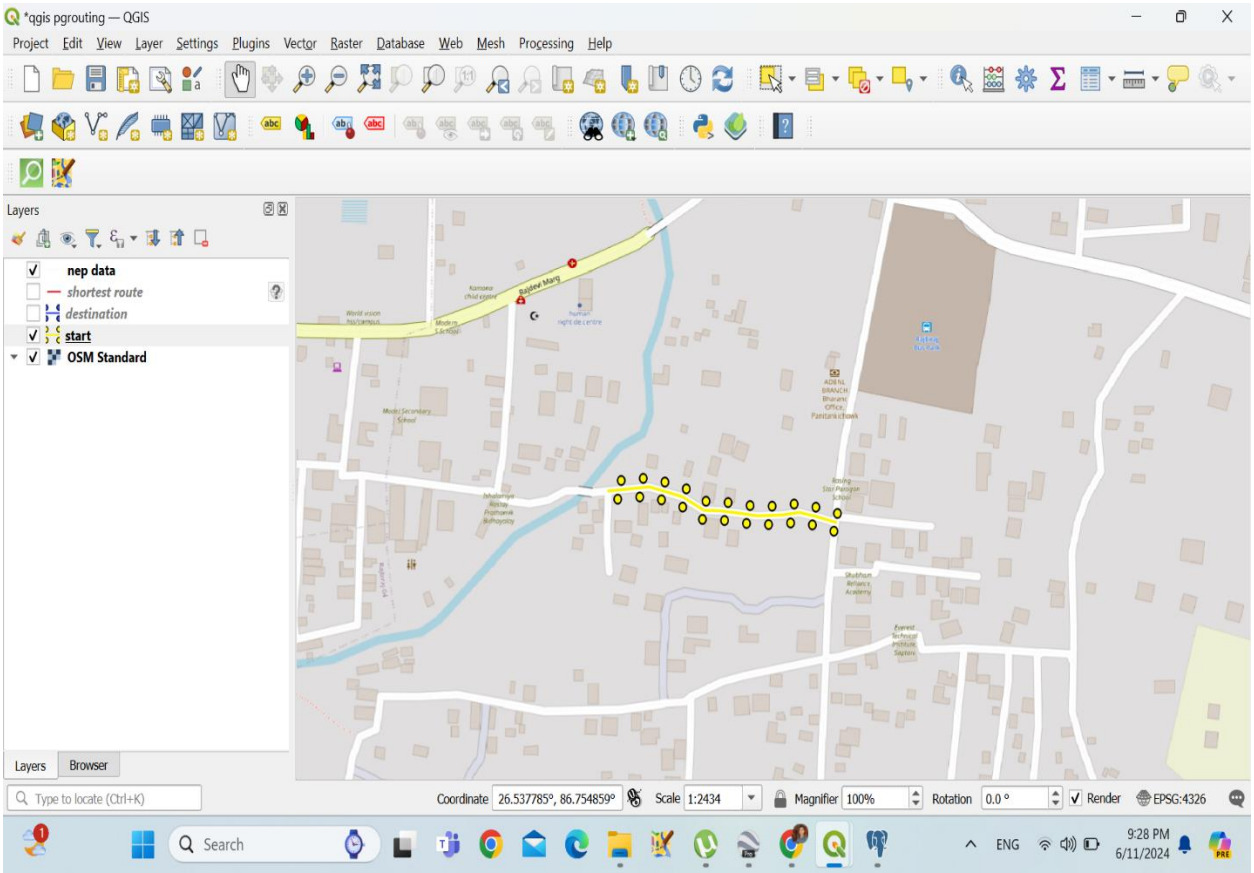


For start:

Write the required query> execute only for the origin> load as layer.




*qgis pgrouting — QGIS
Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help
Layers
nep data
shortest route
destination
start
OSM Standard
Rising Star Paragon School
Layers Browser
Type to locate (Ctrl+K)
Coordinate 26.539182°, 86.756125°
Scale 1:659
Magnifier 100%
Rotation 0.0 °
Render
EPSG:4326
Search
ENG
9:27 PM
6/11/2024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shortest route
destination
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Coordinate 26.537785°, 86.754859°
Scale 1:2434
Magnifier 100%
Rotation 0.0 °
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EPSG:4326
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ENG
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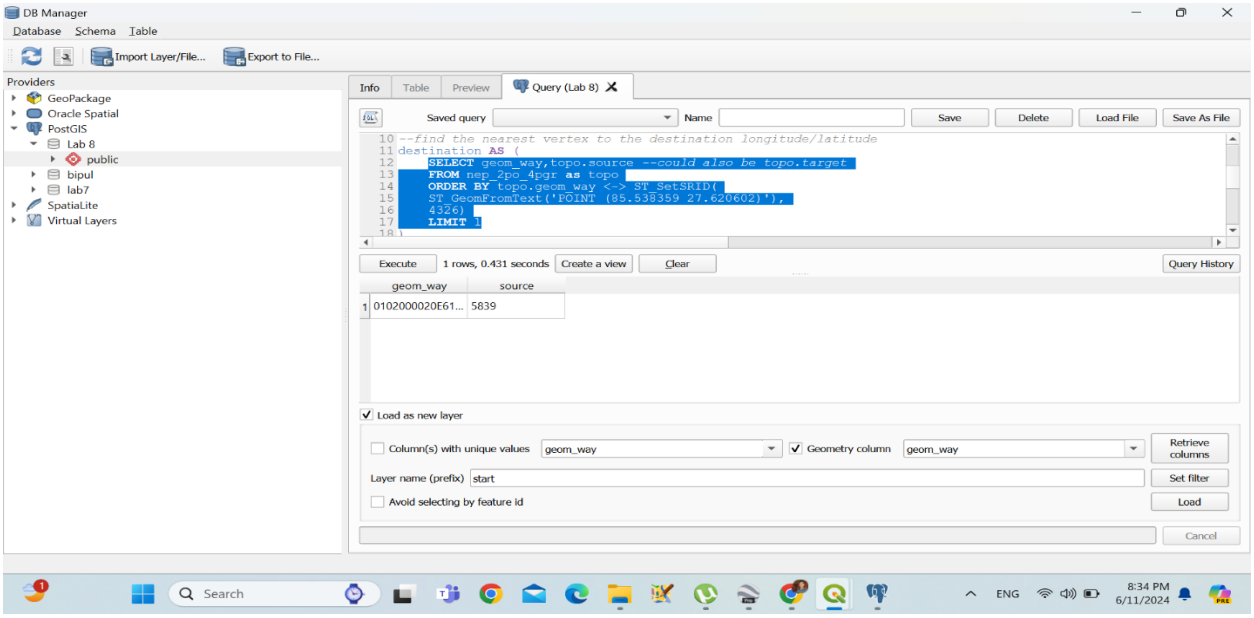
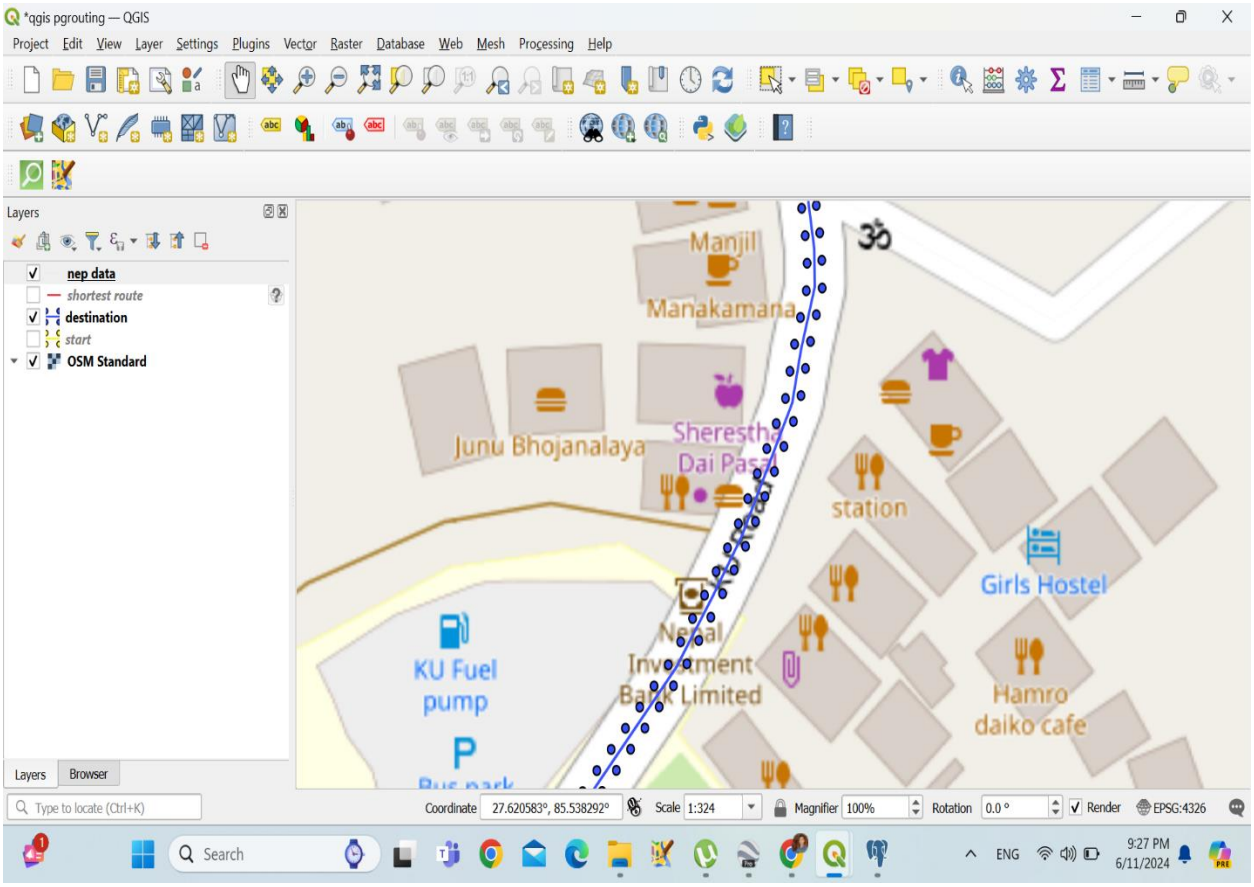
For Destination:

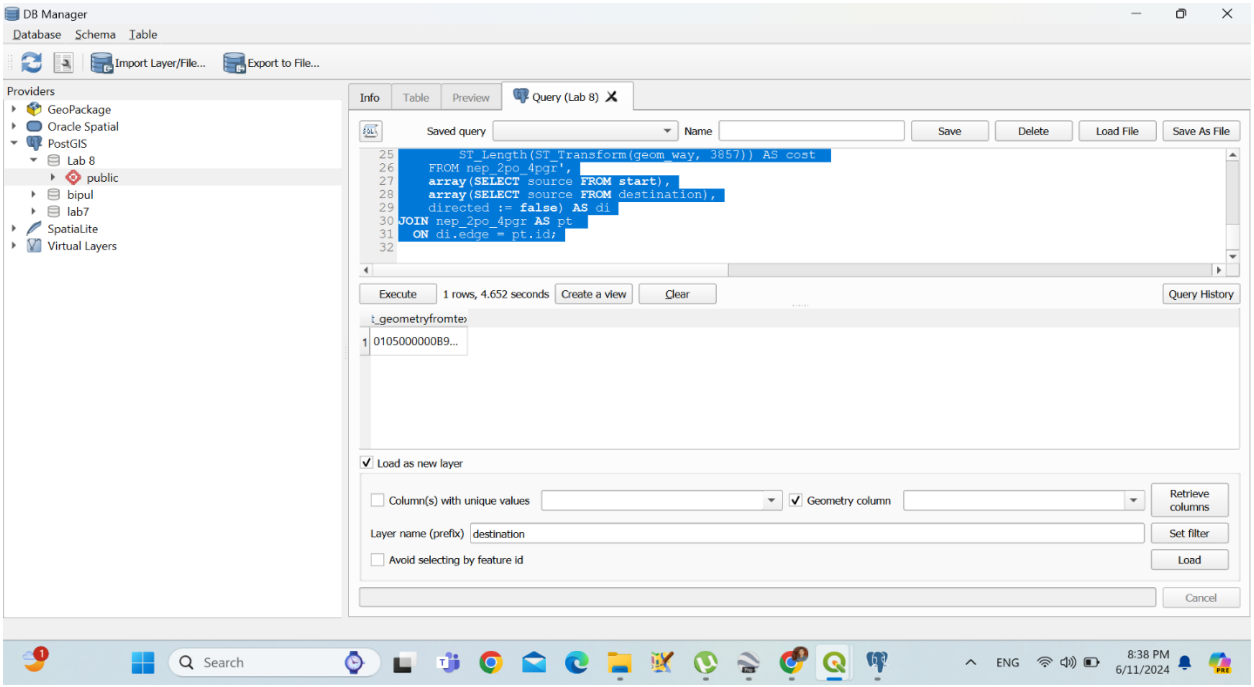
Execute only for the destination > loas as layer.

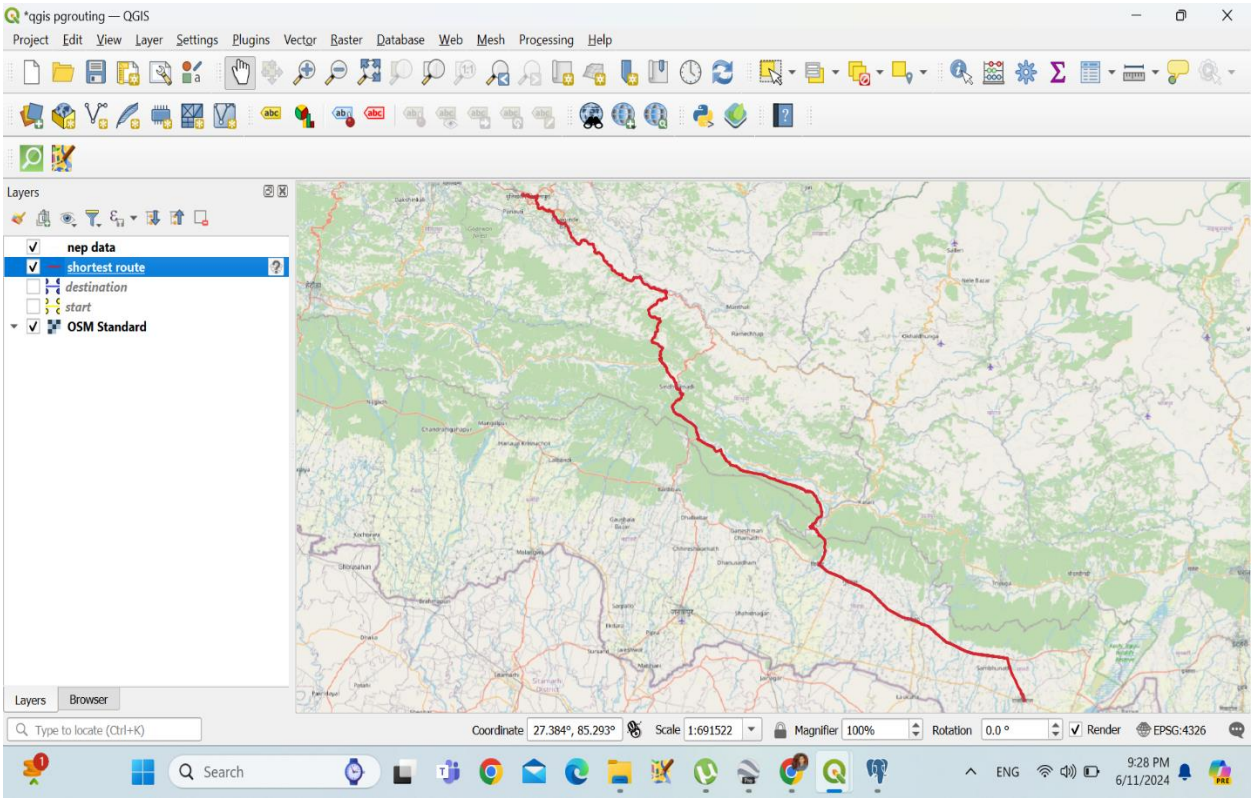


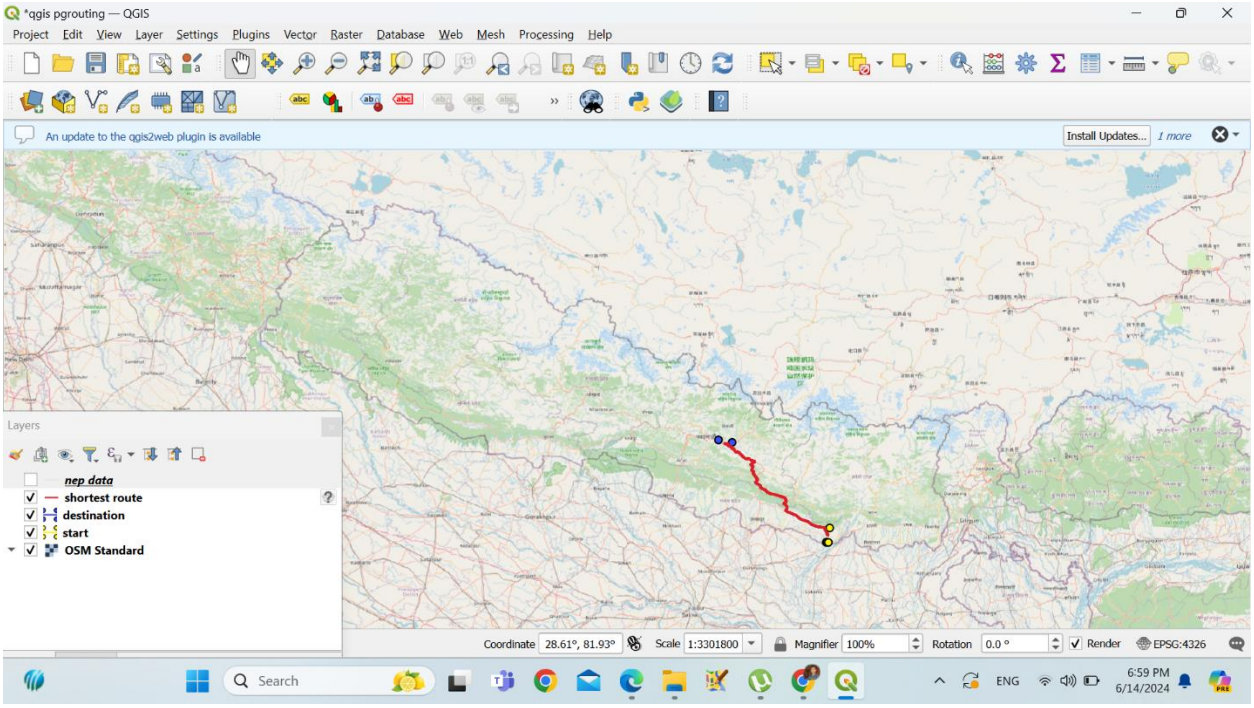


For Shortest route:

Execute whole query > load as layer.






*qgis pgrouting — QGIS
Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help
An update to the qgis2web plugin is available
Install Updates...
1 more
Layers
nep data
shortest route
destination
start
OSM Standard
Coordinate 28.61°, 81.93°
Scale 1:3301800
Magnifier 100%
Rotation 0.0 °
Render
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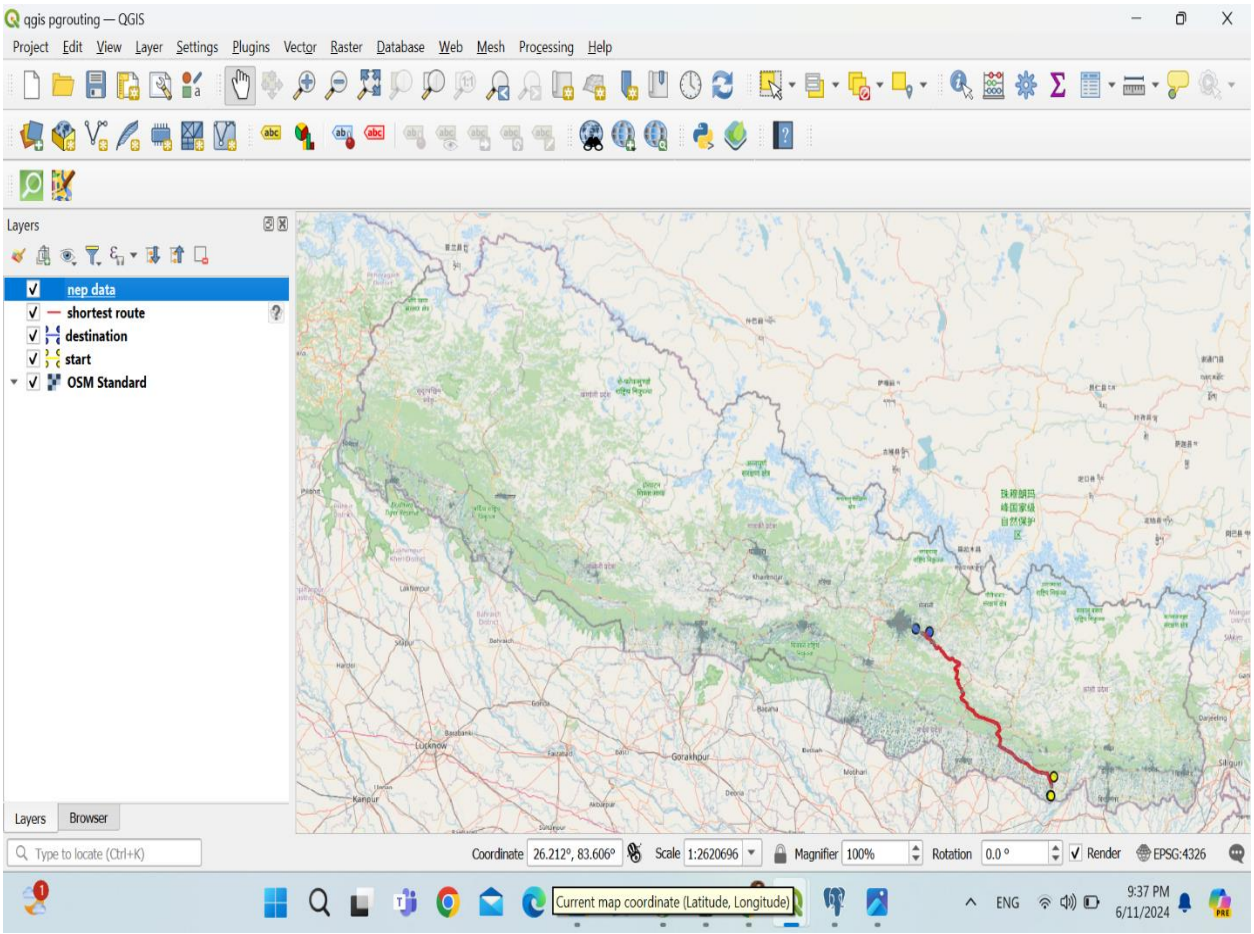
Search
ENG
6:59 PM
6/14/2024


qgis pgrouting — QGIS
Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help
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destination
start
OSM Standard
Layers
Browser
Type to locate (Ctrl+K)
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Scale 1:2620696
Magnifier 100%
Rotation 0.0 °
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EPSG:4326
Current map coordinate (Latitude, Longitude)
ENG
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6/11/2024

Shortest route determination using pgrouting:

Export the map as image.

4 CONCLUSION:

In this way the shortest route between the two points was established using pgrouting. The spatial queries were a very crucial part of the whole process. The accuracy of which must be the perfect to achieve the path.

5 References

Muñoz, B. (2020). Introducing Direct SQL Connection for QGIS, Databricks & more.

Puyam S. Singh, R. B. (2015). *Applied Geomatics.* springer.

Ramesh Janipella, R. V. (n.d.). Spatial Data. *2019*.

Regina O. Obe, L. S. (2017). *Pgrouting A practical guide.*

Smiraglia, R. P. (2001). *Network Analysis.*