

Spatial Informatics-Monsoon 2022

Project Report

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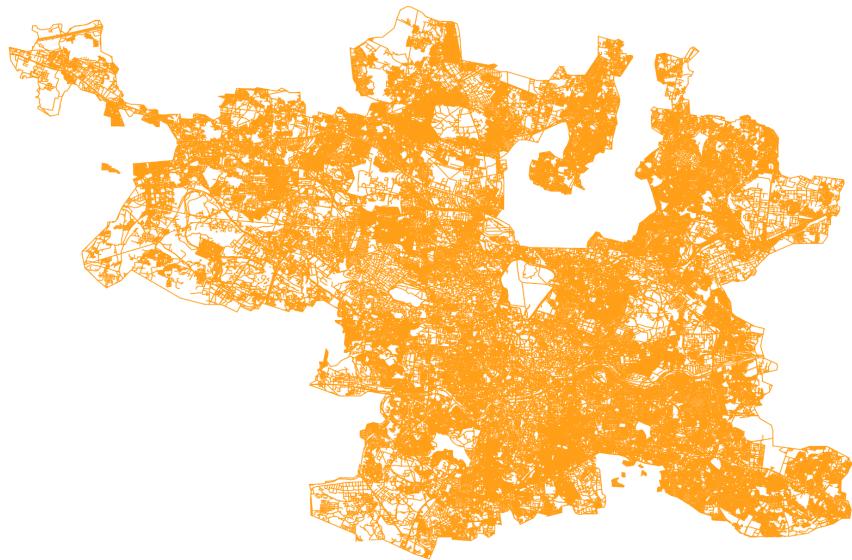
Title: Finding shortest path to Covid-19 Booster Vaccine Centers in Hyderabad(GHMC)

Description: With the cases of Covid-19 plummeting in recent times, one might feel the pandemic is nearing an end which it sure did and is now termed an endemic. But the need for vaccination is of the top most priority when it comes to protection against SARS-CoV-2. The government has now made public vaccination mandatory and also opened up vaccination centers across many Urban , Community, Rural health care centers and Area Hospitals all over the country and the same is done by the Telangana government in view of distribution of Booster vaccine doses. This project is focussing on the Greater Hyderabad Municipal Corporation area which covers most of Hyderabad and Secunderabad. The CoWin app which is responsible for vaccination slot and center selection falls flat when it comes to nearest vaccination center selection since it takes an area pincode as input and shows only the vaccination centers in/near the pincoded area. This is not always accurate, especially in the case of boundary areas. For this exact purpose I have taken up the project, where for any given random point in the GHMC area, the shortest path to the nearest vaccination is shown irrespective of factors such as zonal area, pincode area,municipality etc.

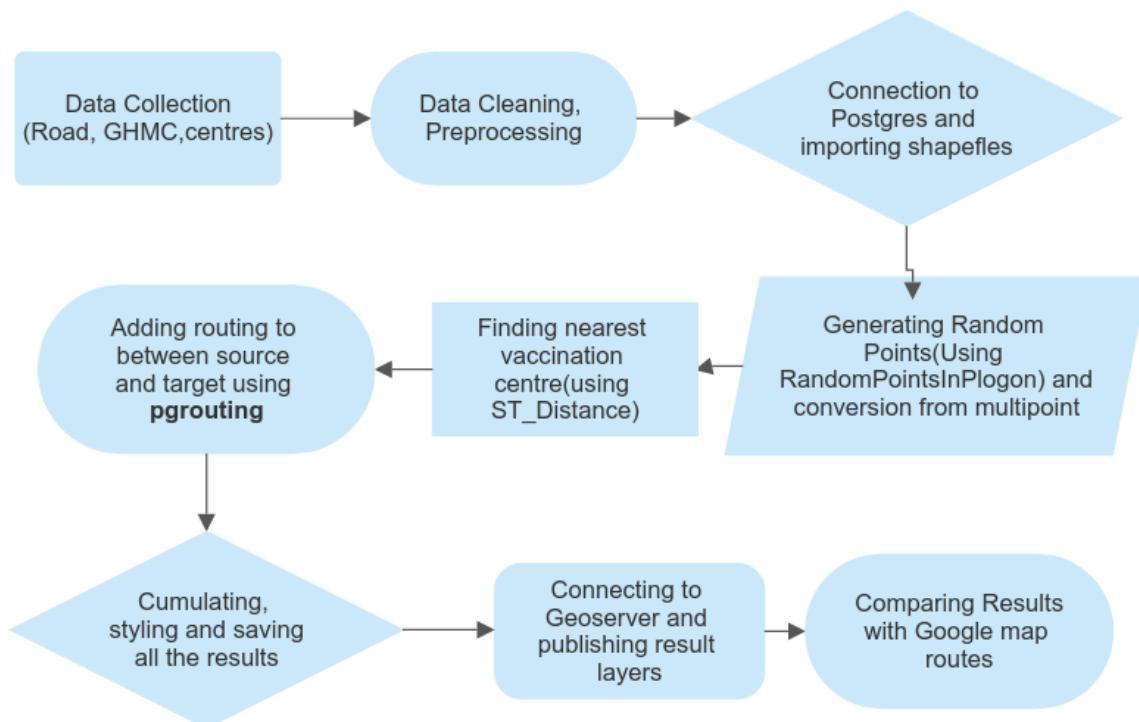
Data used:

- The government had officially released the set of Government Vaccination Centres in GHMC in their website at [GHMC Vaccination Centres](#), using this data of Vaccination Centre names, I created a dataset by manually listing down the lat,long coordinates of all the 119 centers in GHMC area. The link to the dataset is at: [Vaccination Centres Co-ordinates](#). For this purpose I made use of Google maps and Mappls.com websites.
- For the area boundary of the GHMC division, I collected the shapefile data from an open source page at [GHMC Area](#). (Accuracy is obscure since it is not official data).
- Then for the road networks data, I had made use of Open Street Maps(OSM) from the website [Open street maps India Download](#). I had downloaded the “pbf file” for Telangana state and narrowed it down to GHMC area using the clip feature of QGIS. I made use of only the roads feature, which was later cleaned to get rid of unnecessary segments such as footpaths, cycling tracks etc. And then the major roads(ORR, highways) and Minor Roads(secondaries roads, residential roads) were both merged to a single road network layer.

GHMC Road Network



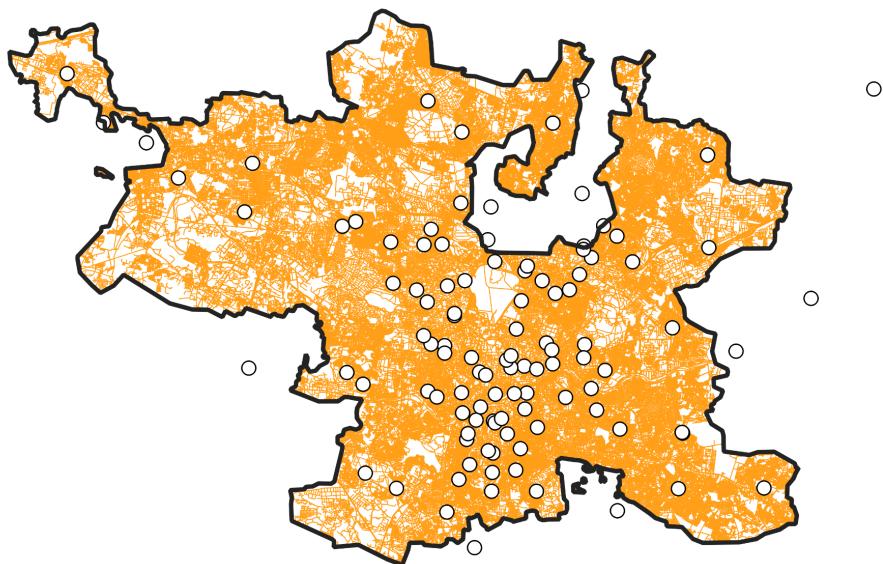
Flow Chart of the process:



Methodology:

- First all the relevant shapefiles of Vaccination Centres, Road Network and GHMC area boundaries were loaded into QGIS.

GHMC Road Network and Vaccination Centres



- Then a PostGis database was made using pgAdmin4 and a connection was established to that database from QGIS and all the shapefiles were loaded into the database. Then random points were generated in the GHMC area in PostgreSQL using the commands mentioned in a separate file.

```
SELECT RandomPointsInPolygon( (ST_Dump
(ST_SetSRID(geom, 4283))
).geom, 12)
FROM Ghmc-area;
```

Activities pgAdmin 4 ▾ Mon 12:34 pgAdmin 4

PgAdmin File Object Tools Help

Browser

Schemas (1) public Aggregates Collations Domains FTS Configurations FTS Dictionaries FTS Parsers FTS Templates Foreign Tables Functions Materialized Views Operators Sequences Tables (15) Major_Roads Minor_Roads Vaccination_Centre cordinates distance ghmc-area nearest nera_points paths random_points_post spatial_ref_sys vac_selected vaccination_centres_post x y Trigger Functions Types Views Subscriptions Spatial postgres Login/Group Roles

SI-Project/postgres@PostgreSQL 10

Query History

```
1 select id,st_x,st_y from cordinates;
```

Data Output Messages Notifications

	Id	st_X	st_Y
1	1	78.461075489846	17.4758403273051
2	2	78.2810641565928	17.4370866095915
3	3	78.4241286241126	17.5423464656846
4	4	78.506090889449	17.395715216737
5	5	78.3321730822181	17.4554332540529
6	6	78.4596716105696	17.3776106641558
7	7	78.533347558476	17.3673620602394
8	8	78.28894503532	17.4465253882027
9	9	78.4633227452348	17.4623903358096
10	10	78.4459569998915	17.3259951221255
11	11	78.3399784433536	17.4208268493964
12	12	78.444547814026	17.523031587417

Total rows: 12 of 12 Query complete 00:00:00.057



- Then geometries for each of the points were returned as a multipoint which was then dumped and split up and converted into readable form using **ST_ASTEXT** and **ST_DUMP**, the result looked like

The screenshot shows the pgAdmin 4 interface. The left sidebar displays the database schema, including Schemas (1) and Tables (15). The Tables section is expanded, showing various tables such as Major_Roads, Minor_Roads, Vaccination_Centre, coordinates, distance, ghmc-area, nearest, nera_points, paths, random_points_post, spatial_ref_sys, vac_selected, vaccination_centres_post, x, and y. The right pane shows a query editor with the following SQL code:

```
1 select id,st_x,st_y from coordinates;
```

The results are displayed in a Data Output tab, showing 12 rows of data:

	Id bigint	st_x double precision	st_y double precision
1	1	78.461075489846	17.4758403273051
2	2	78.2810641565928	17.4370866095915
3	3	78.4241286241126	17.5423464656846
4	4	78.5060908894449	17.395715216737
5	5	78.3321730822181	17.4554332540529
6	6	78.459671610569	17.3776106641558
7	7	78.533347558476	17.3673620602394
8	8	78.2889845035332	17.4465253882027
9	9	78.4633227452348	17.4623903358096
10	10	78.4459569998915	17.3259951221255
11	11	78.3399784433536	17.4208268493964
12	12	78.444547814026	17.523031587417

- Then the distance from all the random points to all the vaccination centers was calculated and a new table was created as:

The screenshot shows the pgAdmin 4 interface. On the left, the 'Tables (15)' section is selected in the tree view, listing tables like Major_Roads, Minor_Roads, Vaccination_Centre, coordinates, distance, ghmc-area, nearest, nera_points, paths, random_points_post, spatial_ref_sys, vac_selected, vaccination_centres_p, x, y, Trigger Functions, Types, Views, Subscriptions, Spatial, and postgres. The main pane displays a query result for the 'nearest' table.

Query Result:

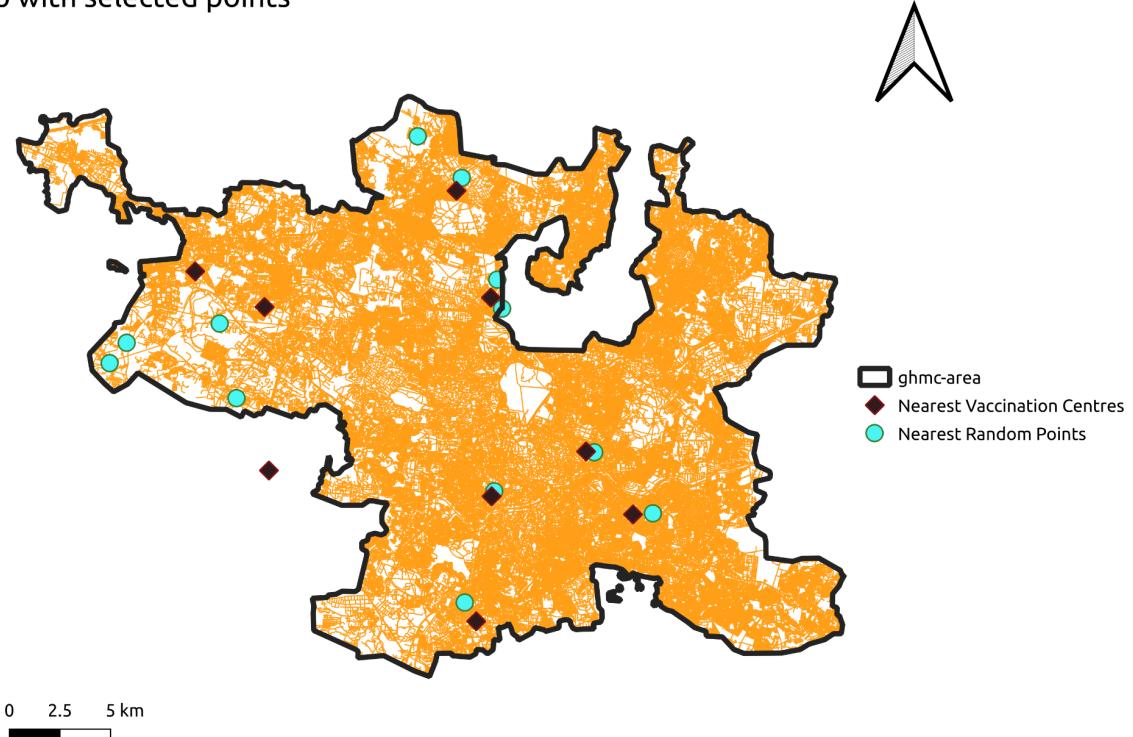
```
1 select *from nearest;
```

	Id integer	vacc_centre character varying (255)	id_vc integer	distance double precision
1	4	Fever Hospital	75	399.44552783
2	1	Balanagar PHC CVC	2	978.0560917
3	2	PHC Serilingampally	118	6326.97970422
4	3	UHC Shapurnagar CVC	17	3389.39809524
5	5	AH.Kondapur	115	2371.01787464
6	6	Karwan-2 UPHC	69	289.62337429
7	7	Gaddianaram NGO UPHC	71	979.79421124
8	8	PHC Serilingampally	118	4988.00193363
9	9	Balanagar PHC CVC	2	788.65199023
10	10	UPHC Mailardevapally	117	1119.71888114
11	11	PHC Narsingi	116	4045.96862517
12	12	UHC Shapurnagar CVC	17	709.20788663

Total rows: 12 of 12 Query complete 00:00:00.163 Ln 1, Col 21

- These nearest vaccination centers and their corresponding random points are then visualized in QGIS as:

Map with selected points



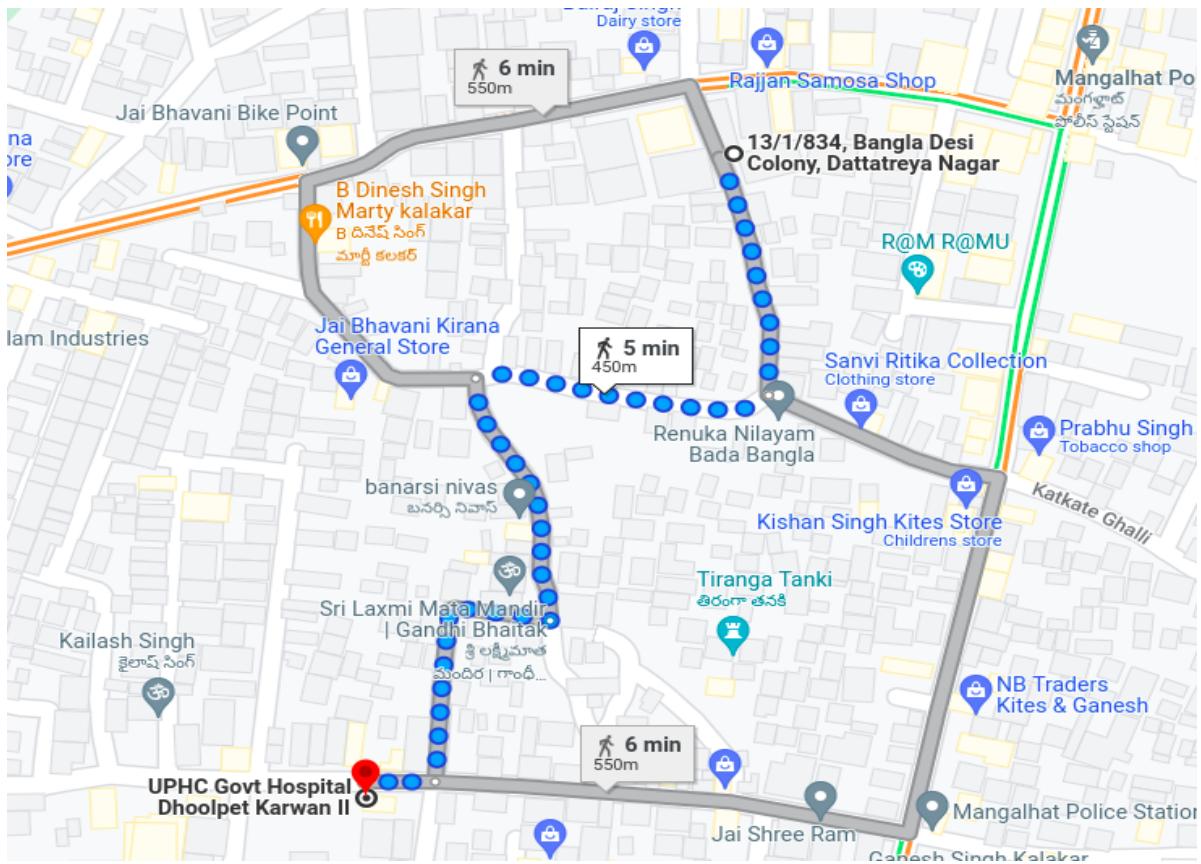
- Then we will move back to pgadmin and concatenate the geometries of both the points into a single table. Then we installed the PGRouting extension for Postgis. Then changes the ids and rest of the source and target requirements to fit that of pgRouting.

```
SELECT source
FROM ALL-roads
ORDER BY ST_Distance(
    ST_StartPoint(geom) ,
    ST_SetSRID(ST_MakePoint(78.461075489846,17.4758403273051),
    4326), true) ASC
LIMIT 1;
```

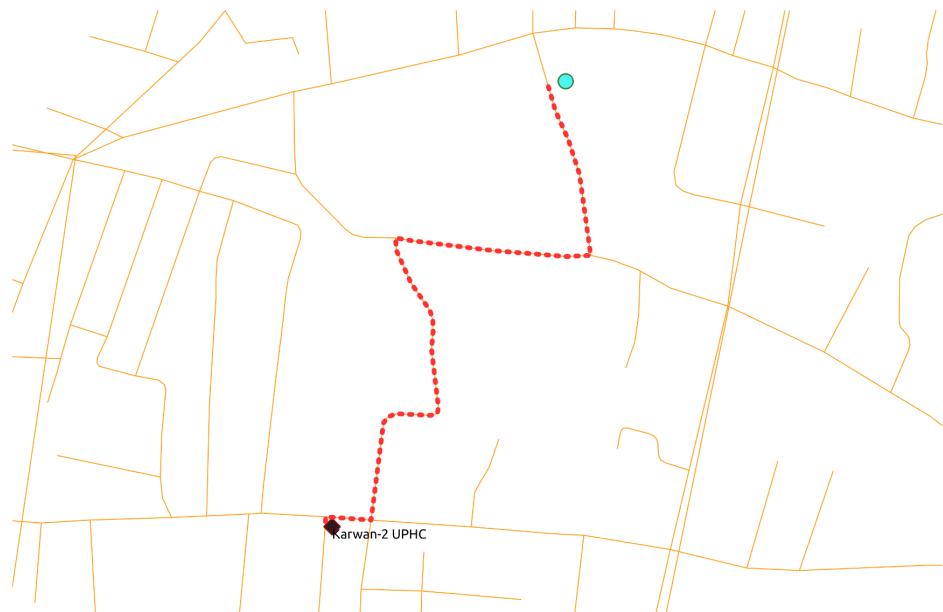
This was done manually for each and every random point and all the results or paths were stored into a single table and presented in QGIS.

Results:

Fig(1)



Fig(2)

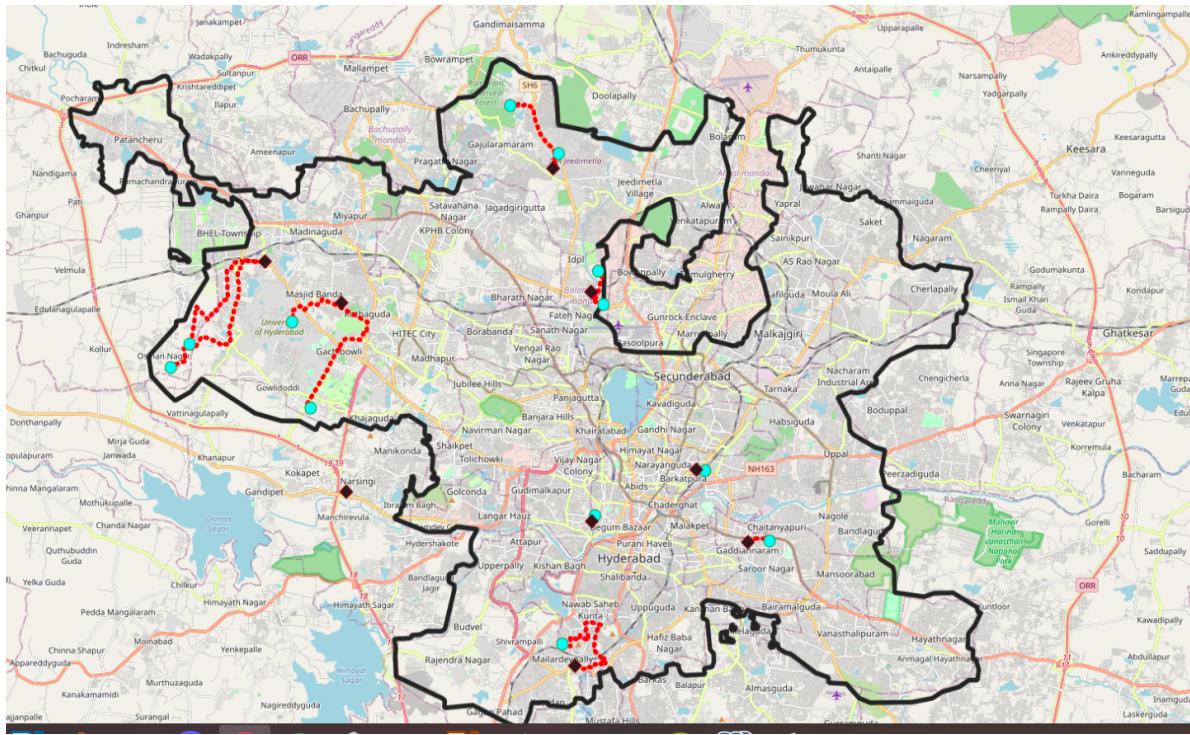


To check if our results were indeed right, we took one particular random point from the list of id=6, (lat,long)=(17.37762280, 78.45967510) and after routing it to its corresponding nearest Vaccination Centre, the path is visualized in QGIS and looks like above(fig 2). Now for comparison we put the coordinates of the random point and vaccination center in Google maps and it was the same path that we calculated. This tells that the method did find the shortest distanced center.

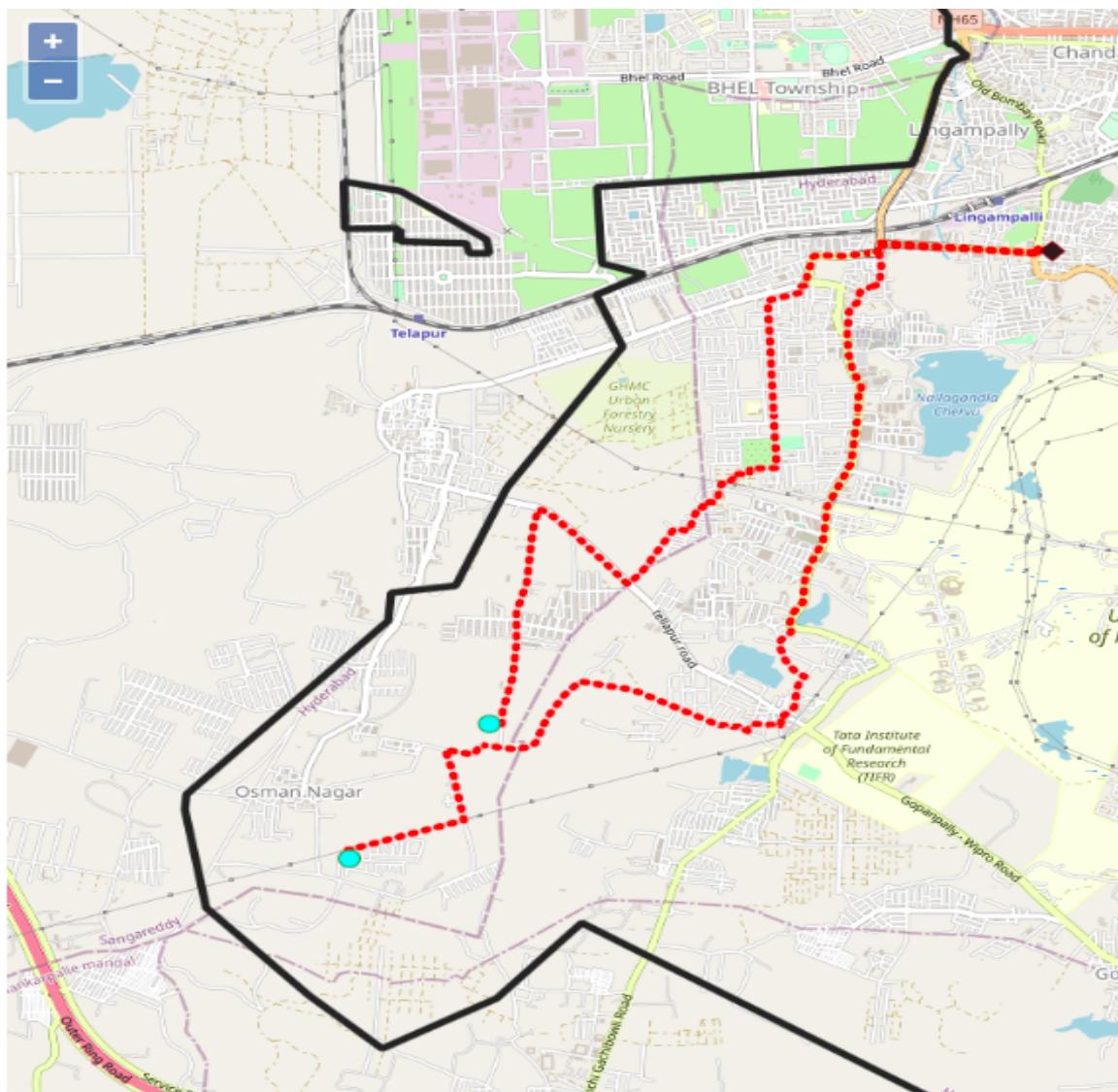
The results were made online through web map services that were hosted on a remote server in Geoserver. First a workspace was created, all the layers of shapefiles:

GHMC-area, Random Points generated, Nearest Vaccination Centres , Shortest Paths

Are published in the Geoserver and their styles are added as well which make the published map in open street view look like:



The zoomed in version looks like



Notes:

- We can extend these results to any random point within the GHMC municipal area and find the details of the nearest Vaccination Centre which takes the Shortest path along with the path itself.
- The Vaccination Centres data that we have is only of Government Booster Dose Vaccination Centres and therefore the results cannot directly be compared with that of CoWin App. The Cowin App has also launched a BETA version of search location of centers on the map which is still in the testing process.

Github Link to all the data:<https://github.com/Anvita2001/Spatial-Informatics-Project>

References:

- For PGRouting:
<https://blog.daftcode.pl/find-your-way-with-the-power-of-postgis-pgrouting-66d620ef201b>
- For Postgis:
<https://postgis.net/stuff/postgis-3.4.pdf>