# Internship at: Master Control Facility(MCF) - ISRO Hassan

by Aniruddha Kulkarni
4MC21CS016

# About MCF Hassan

- **Master Control Facility (MCF)** at Hassan in Karnataka established in 1982 and Bhopal in Madhya Pradesh monitors and controls all the geo-stationary satellites of ISRO - Indian Space Research Organisation.

- MCF carries out operations related to initial orbit raising of satellites, in-orbit payload testing, and on-orbit operations throughout the life of these satellites.

- The operations involve continuous tracking, telemetry and commanding, special operations like eclipse management, station-keeping manoeuvres and recovery in case of contingencies.

# Satellites

1. INSAT Series: INSAT stands for Indian National Satellite System.

Communication, meteorology, and broadcasting satellites.

2. GSAT Series: GSAT stands for Geostationary Satallites.

Enhancing India’s communication infrastructure.

3. Kalpana-1: Meteorological satellite for weather monitoring.

4. Edusat (GSAT-3): First Indian satellite dedicated to education.

- **Telemetry**: This involves collecting and transmitting data from satellites to ground stations for monitoring and control purposes.
- **Upconverters**: These devices convert low-frequency signals from ground systems to higher frequencies suitable for satellite transmission. They enable effective communication with satellites.
- **Downconverters**: These components convert high-frequency satellite signals back to lower frequencies for processing on the ground. They ensure that received signals can be analysed and used.
- **HPA (High Power Amplifier)**: HPAs amplify signals to ensure they are strong enough for transmission to satellites. They enhance the signal strength to maintain communication quality over long distances.
- **Earth Station**: An Earth station is a ground-based facility with antennas and equipment for communicating with satellites. It manages data reception and transmission, supporting satellite operations and services.

- In MCF, telemetry data is collected and monitored, upconverters and downconverters handle signal frequency conversions, HPAs boost signal strength, and Earth stations facilitate overall satellite communication and control.

# Space Debries

Space debris, also known as space junk or space trash, refers to non-functional, human-made objects in orbit around Earth. Here are three key points about space debris:

1.**Types of Space Debris**: Space debris includes defunct satellites, spent rocket stages, fragments from collisions or explosions, and mission-related debris like used tools or parts. These objects vary in size from tiny fragments to large, intact spacecraft.

2.**Hazards to Space Operations**: Space debris poses a significant risk to active satellites, spacecraft, and crewed missions. Collisions with debris can damage or destroy operational satellites and pose dangers to astronauts in space.

3.**Mitigation Efforts**: Various strategies are being developed to manage and reduce space debris, including debris tracking, collision avoidance maneuvers, and technologies for debris removal. International guidelines and cooperation aim to minimize the creation of new debris and address existing issues

# Norad Data

- The NORAD satellite database, officially known as the NORAD Catalog, is a comprehensive list of objects in Earth's orbit that are tracked by the North American Aerospace Defense Command (NORAD).
- This catalog includes satellites, debris, rocket bodies, and other objects that are larger than a certain size and are being tracked by NORAD's Space Surveillance Network.

Here are some of the columns in NORAD data for tracking space objects:

SNo: Serial Number

This is a unique identifier assigned to each entry in the dataset for easy reference and indexing.

NORAD-ID: NORAD Catalog Number

A unique identifier assigned to each space object by the North American Aerospace Defense Command (NORAD). This catalog number helps track and identify satellites, debris, and other space objects.

DATE:

The date on which the observation or data was recorded, usually formatted as YYYY-MM-DD.

TIME(UT): Time in Coordinated Universal Time

The time of the observation or data recording, given in Coordinated Universal Time (UTC). This helps standardize observations across different time zones.

SMA(km): Semi-Major Axis (kilometers)

The length of the semi-major axis of the object's orbit, measured in kilometers. This parameter defines the size of the orbit, representing the object's average distance from the center of the Earth.

ECC: Eccentricity

A dimensionless parameter that describes the shape of the object's orbit. Eccentricity values range from 0 (a perfect circle) to 1 (a parabolic trajectory). Values between 0 and 1 indicate elliptical orbits.

INC(deg): Inclination (degrees)

The angle between the plane of the object's orbit and the Earth's equatorial plane, measured in degrees. This determines how tilted the orbit is relative to the equator.

RAAN(deg): Right Ascension of the Ascending Node (degrees)

The angle, measured in degrees, from a reference direction (usually the vernal equinox) to the direction of the ascending node of the orbit. The ascending node is the point where the object crosses the equatorial plane from south to north.

AOP(deg): Argument of Perigee (degrees)

The angle, measured in degrees, from the ascending node to the point of closest approach to Earth (perigee) within the object's orbit. It describes the orientation of the elliptical orbit within its orbital plane.

MA(deg): Mean Anomaly (degrees)

An angular parameter that represents the object's position along its orbit at a specific time, measured in degrees. It helps determine the object's location in its orbital path.

# Mini Project

The goal is to analyze NORAD (North American Aerospace Defense Command) data to plot various necessary graphs and derive insights for effective space debris management. This analysis will help in understanding the current state of space debris, identifying potential risks, and planning mitigation strategies.

# Software Requirements

Set Up Development Environment:

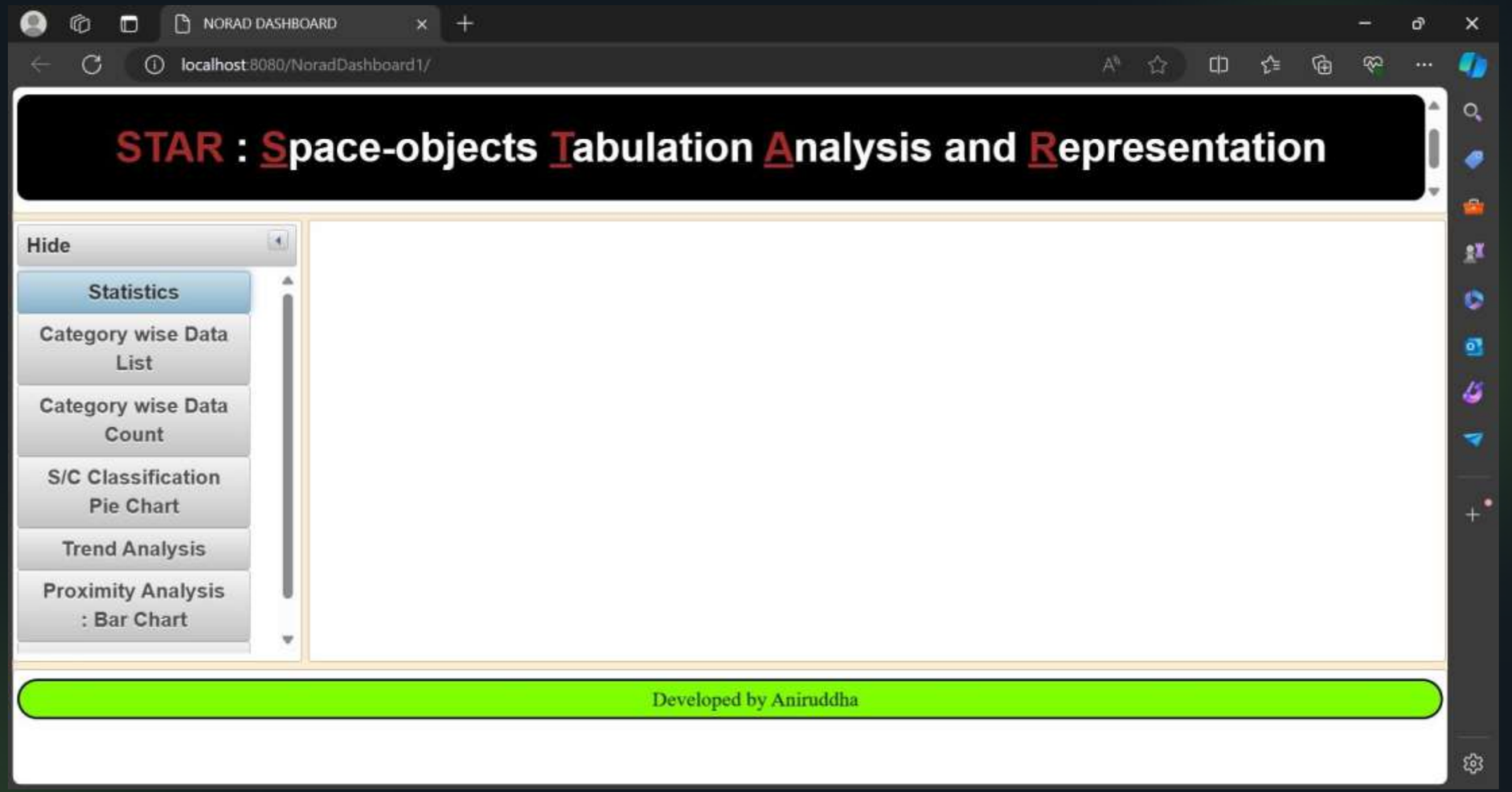
- NetBeans IDE.
- Set up a MySQL database server.
- Integrate JavaServer Faces (JSF) framework within NetBeans.
- JDBC

# Project STAR

The Abbreviation of STAR is : Space Objects Tabulation Analysis & Representation.

It consists of the following :

- Statistics: Displays numerical values summarizing the counts and key orbital parameters.
- Category wise Data List: Provides a detailed tabular list of space objects, categorized into groups like satellites, debris, longitude & inclination control etc.
- Category wise Data Count: Shows a count of objects in each category, represented as numbers clarity.
- S/C Classification Pie Chart: A pie chart visually illustrating the proportion of space objects in different spacecraft classifications.
- Trend Analysis: Line or bar charts displaying changes in the number of space objects or debris over a specific timeline.
- Proximity Analysis: Bar Chart: Bar charts showing the frequency or distance distribution of objects based on proximity.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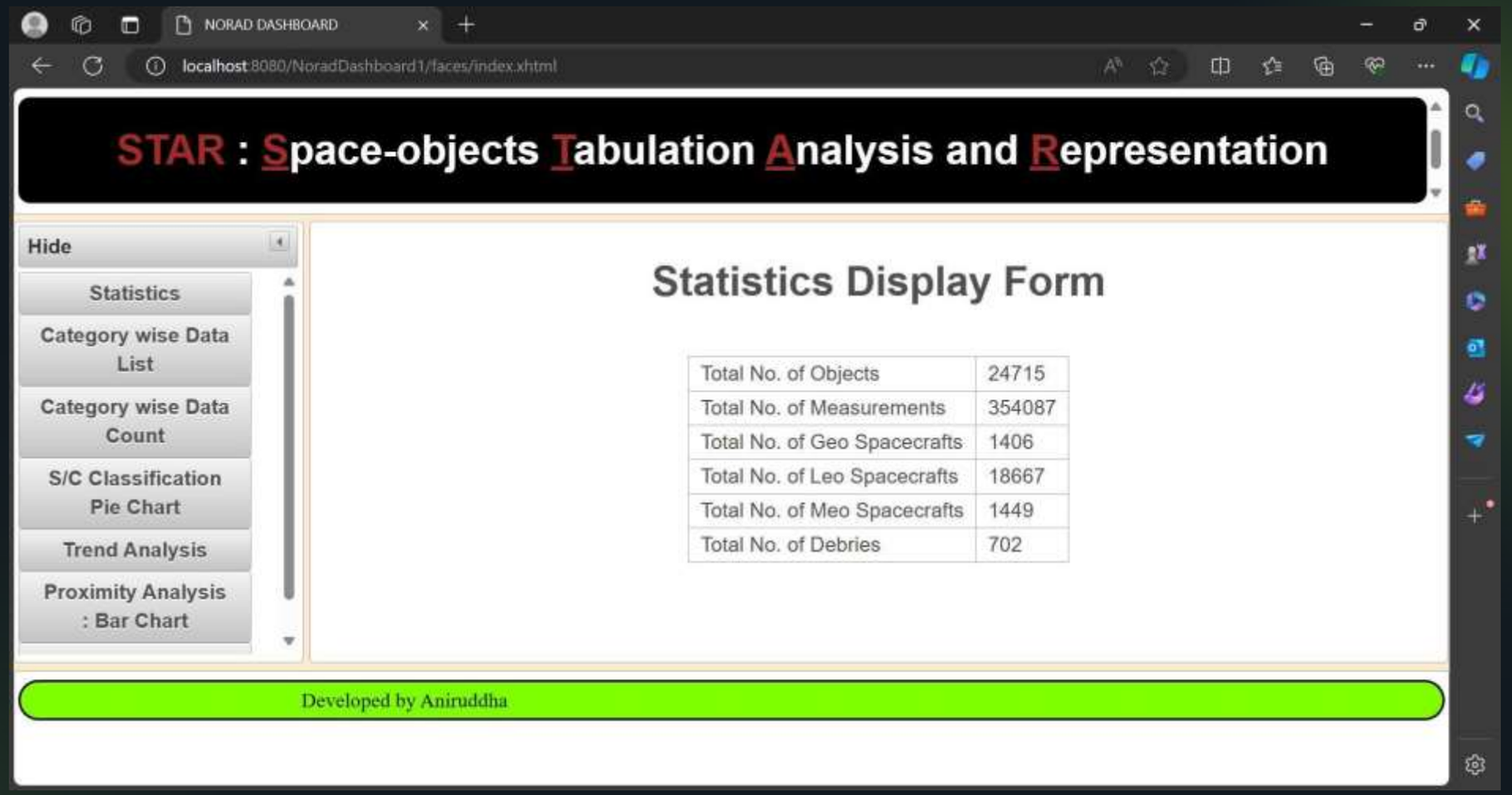
Statistics
Category wise Data List
Category wise Data Count
S/C Classification Pie Chart
Trend Analysis
Proximity Analysis : Bar Chart
Developed by Aniruddha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STAR : Space-objects Tabulation Analysis and Representation
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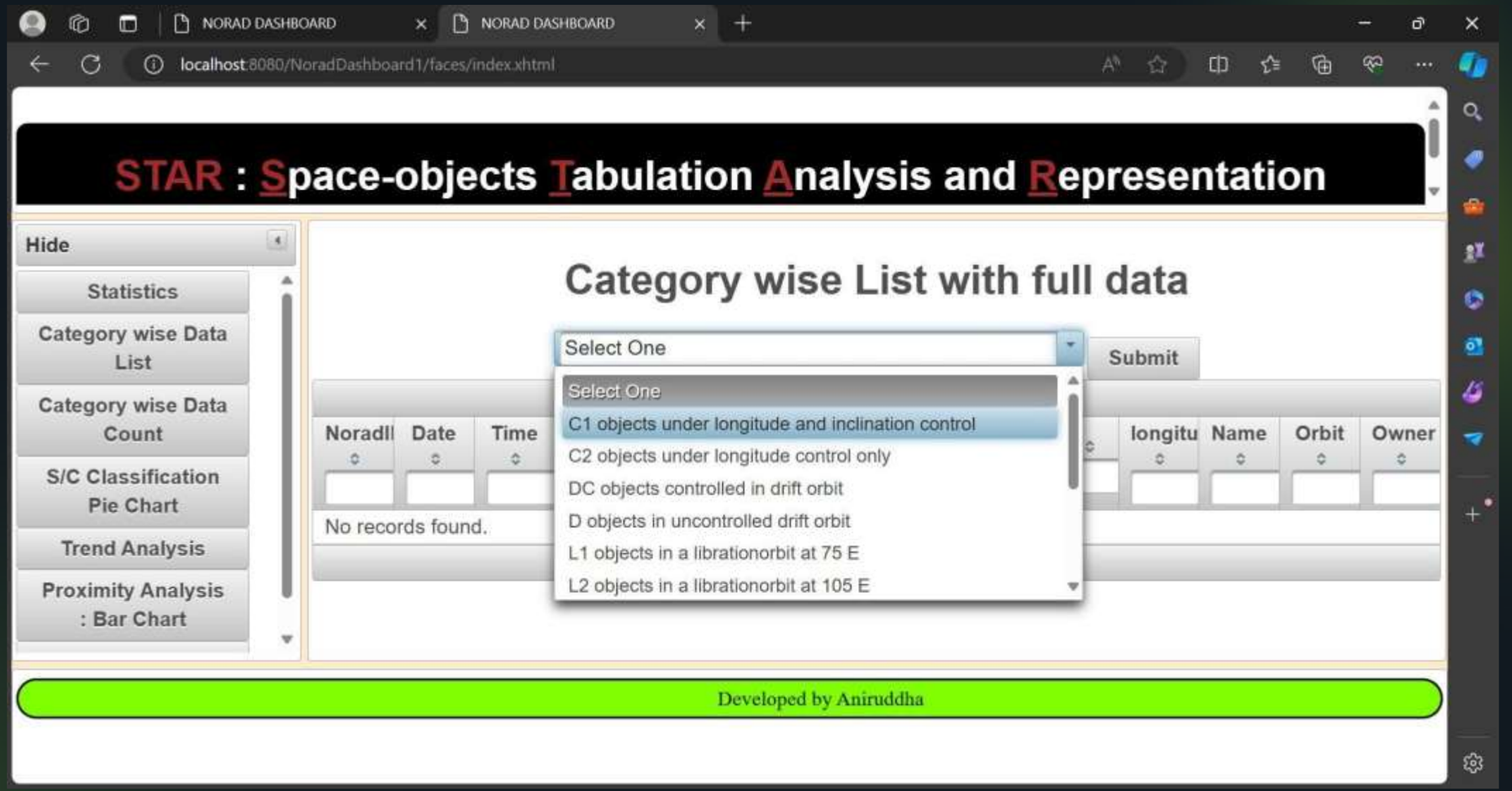
Category wise Data List
Category wise Data Count
S/C Classification Pie Chart
Trend Analysis
Proximity Analysis : Bar Chart
Statistics Display Form
Total No. of Objects 24715
Total No. of Measurements 354087
Total No. of Geo Spacecrafts 1406
Total No. of Leo Spacecrafts 18667
Total No. of Meo Spacecrafts 1449
Total No. of Debries 702
Developed by Aniruddha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STAR : Space-objects Tabulation Analysis and Representation
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Category wise Data List
Category wise Data Count
S/C Classification Pie Chart
Trend Analysis
Proximity Analysis : Bar Chart
Category wise List with full data
Select One
Submit
Select One
C1 objects under longitude and inclination control
C2 objects under longitude control only
DC objects controlled in drift orbit
D objects in uncontrolled drift orbit
L1 objects in a librationorbit at 75 E
L2 objects in a librationorbit at 105 E
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Name
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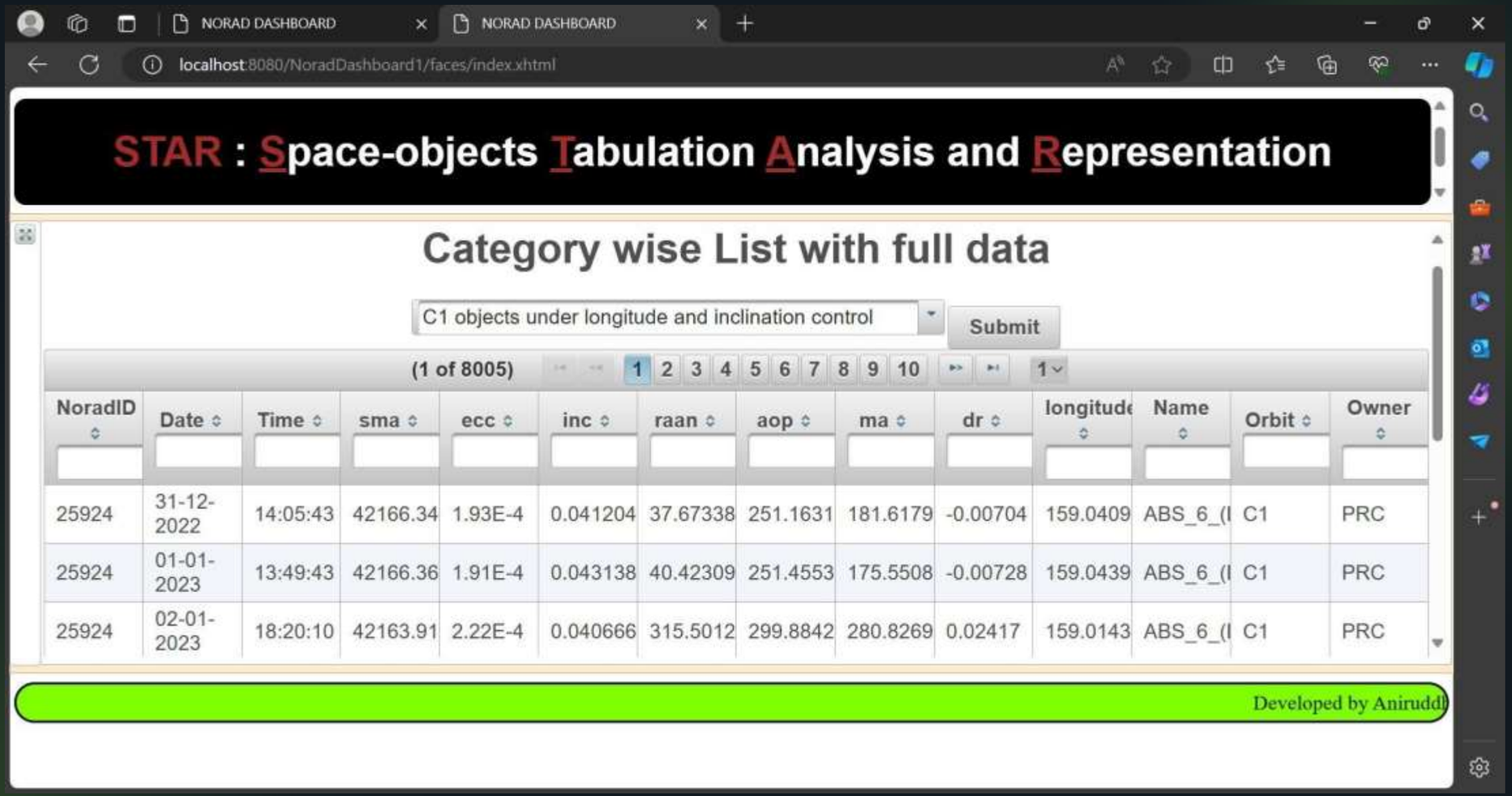
No records found.
Developed by Aniruddha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STAR : Space-objects Tabulation Analysis and Representation
Category wise List with full data
C1 objects under longitude and inclination control
Submit
(1 of 8005)
1 2 3 4 5 6 7 8 9 10
1
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25924 31-12-2022 14:05:43 42166.34 1.93E-4 0.041204 37.67338 251.1631 181.6179 -0.00704 159.0409 ABS_6_(I C1 PRC
25924 01-01-2023 13:49:43 42166.36 1.91E-4 0.043138 40.42309 251.4553 175.5508 -0.00728 159.0439 ABS_6_(I C1 PRC
25924 02-01-2023 18:20:10 42163.91 2.22E-4 0.040666 315.5012 299.8842 280.8269 0.02417 159.0143 ABS_6_(I C1 PRC
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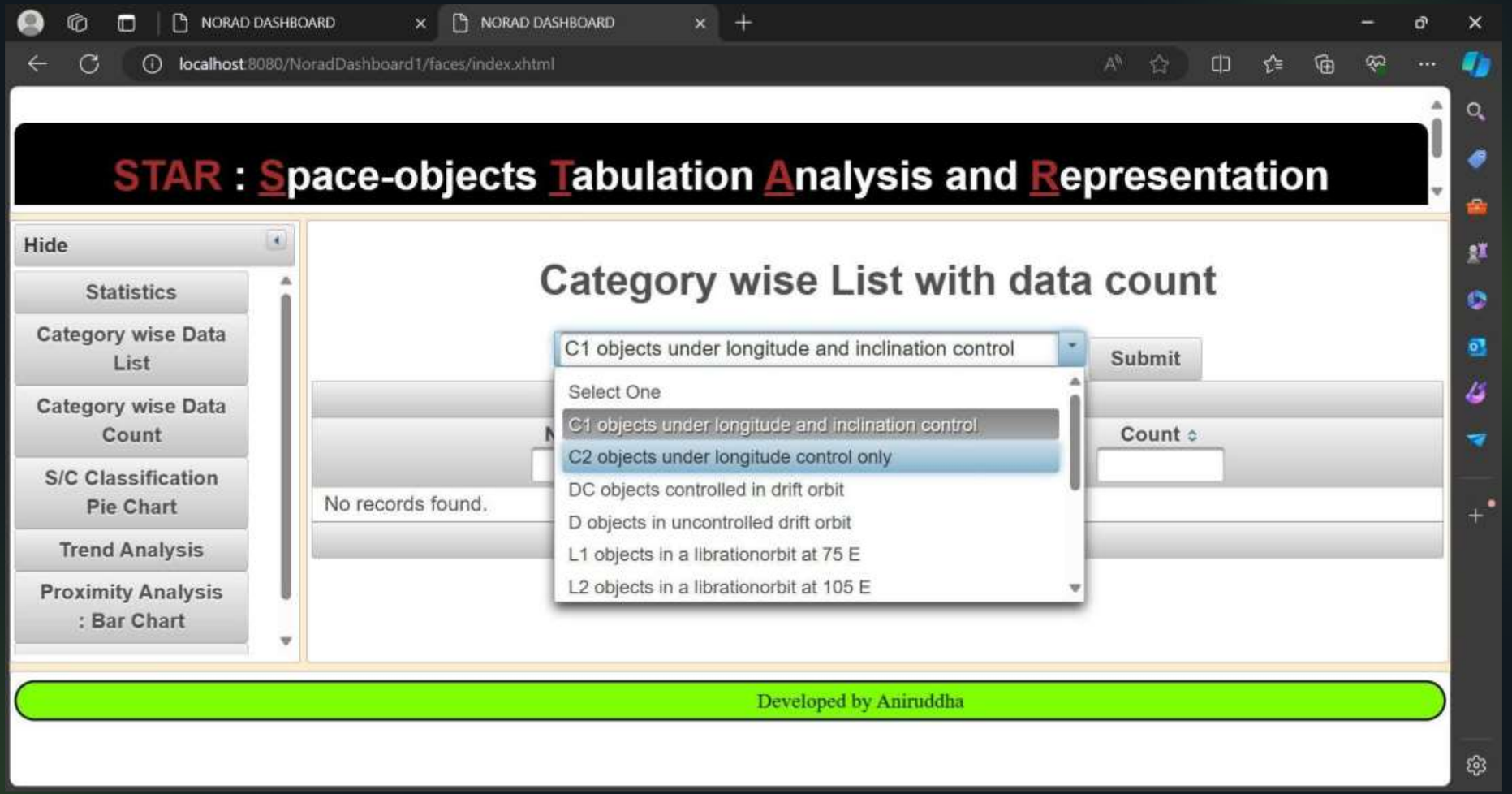
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C1 objects under longitude and inclination control
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L2 objects in a librationorbit at 105 E
Count
No records found.
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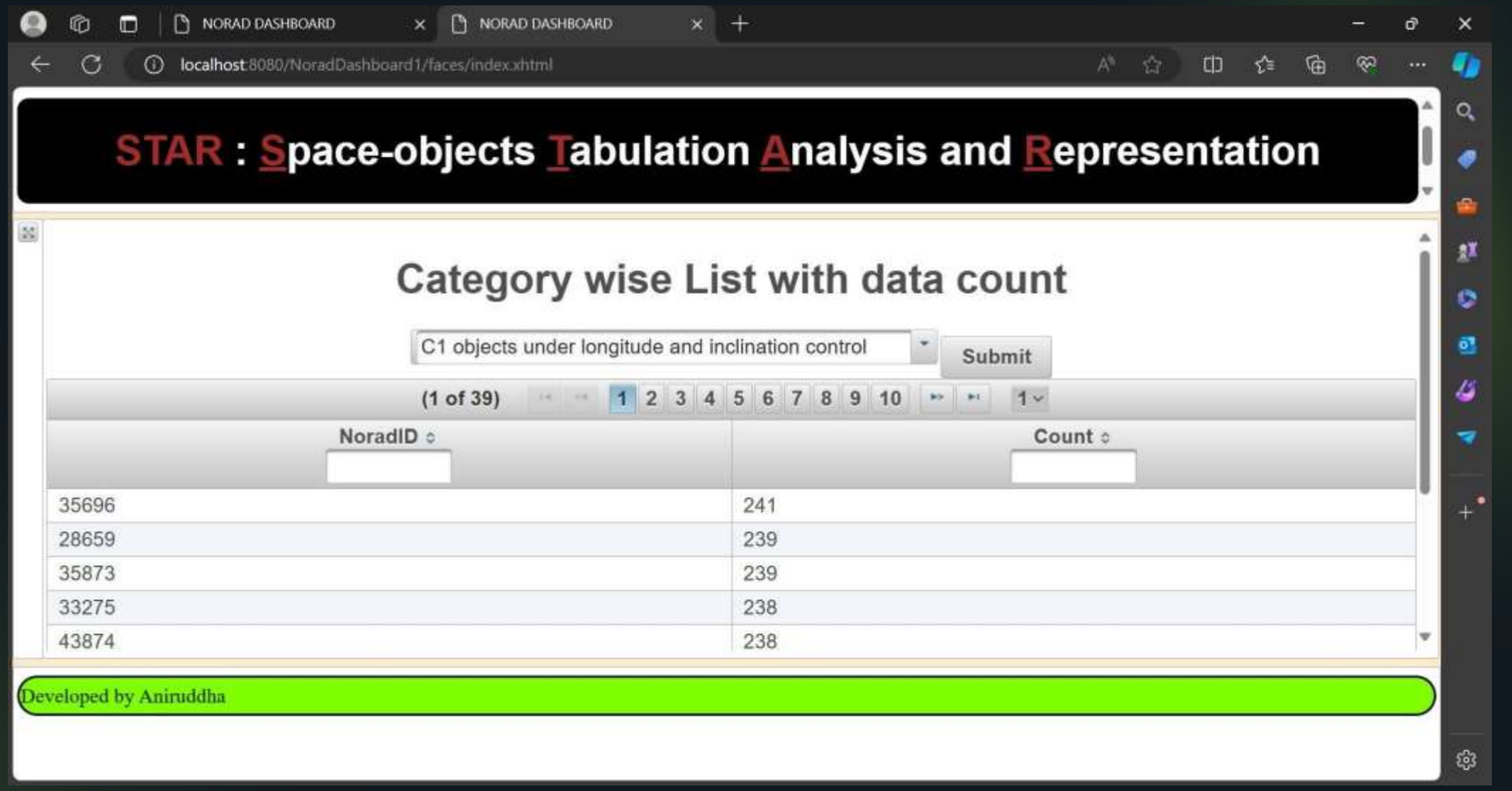
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Submit
(1 of 39) 1 2 3 4 5 6 7 8 9 10 1
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35696 241
28659 239
35873 239
33275 238
43874 238
Developed by Aniruddha

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# STAR : Space-objects Tabulation Analysis and Representation

## Pie Chart

Pie Chart

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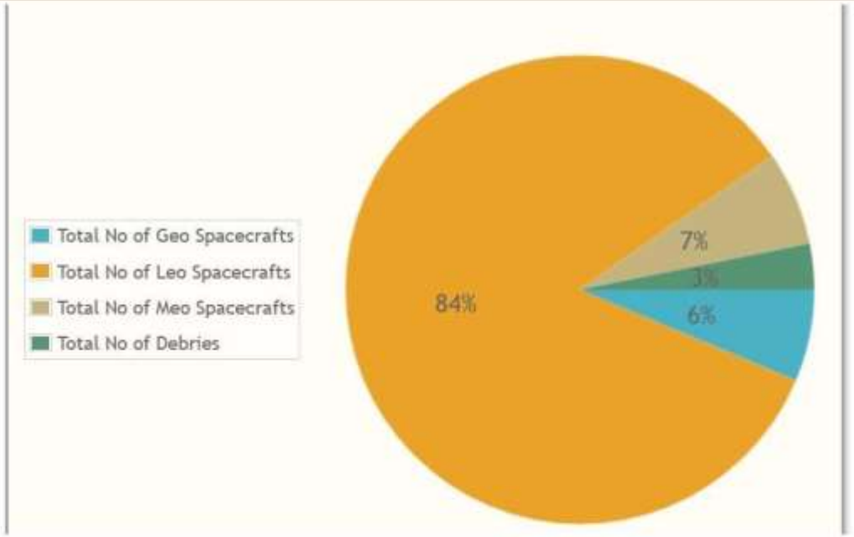
# STAR : Space-objects Tabulation Analysis and Representation

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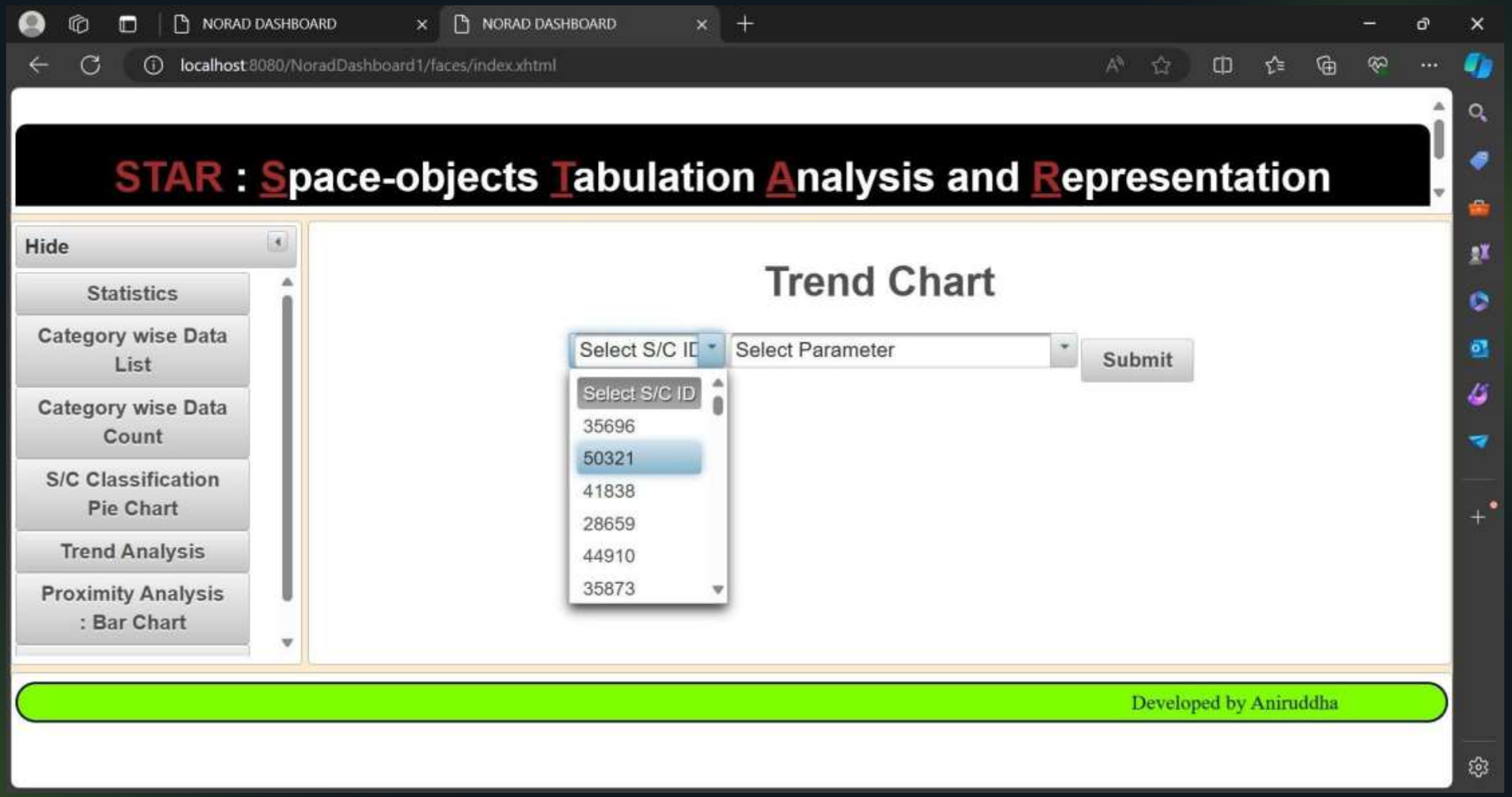
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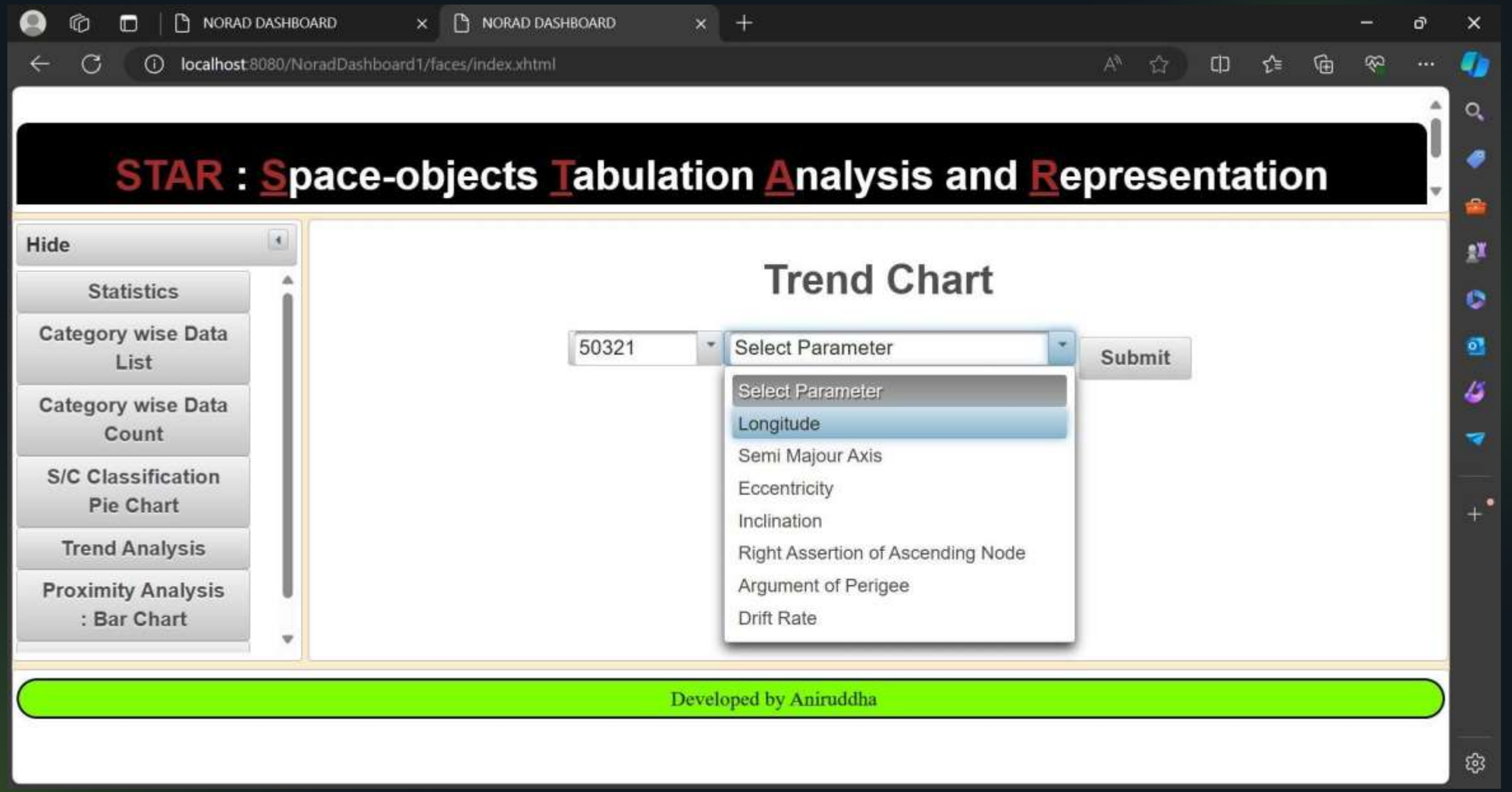
Developed by Aniruddha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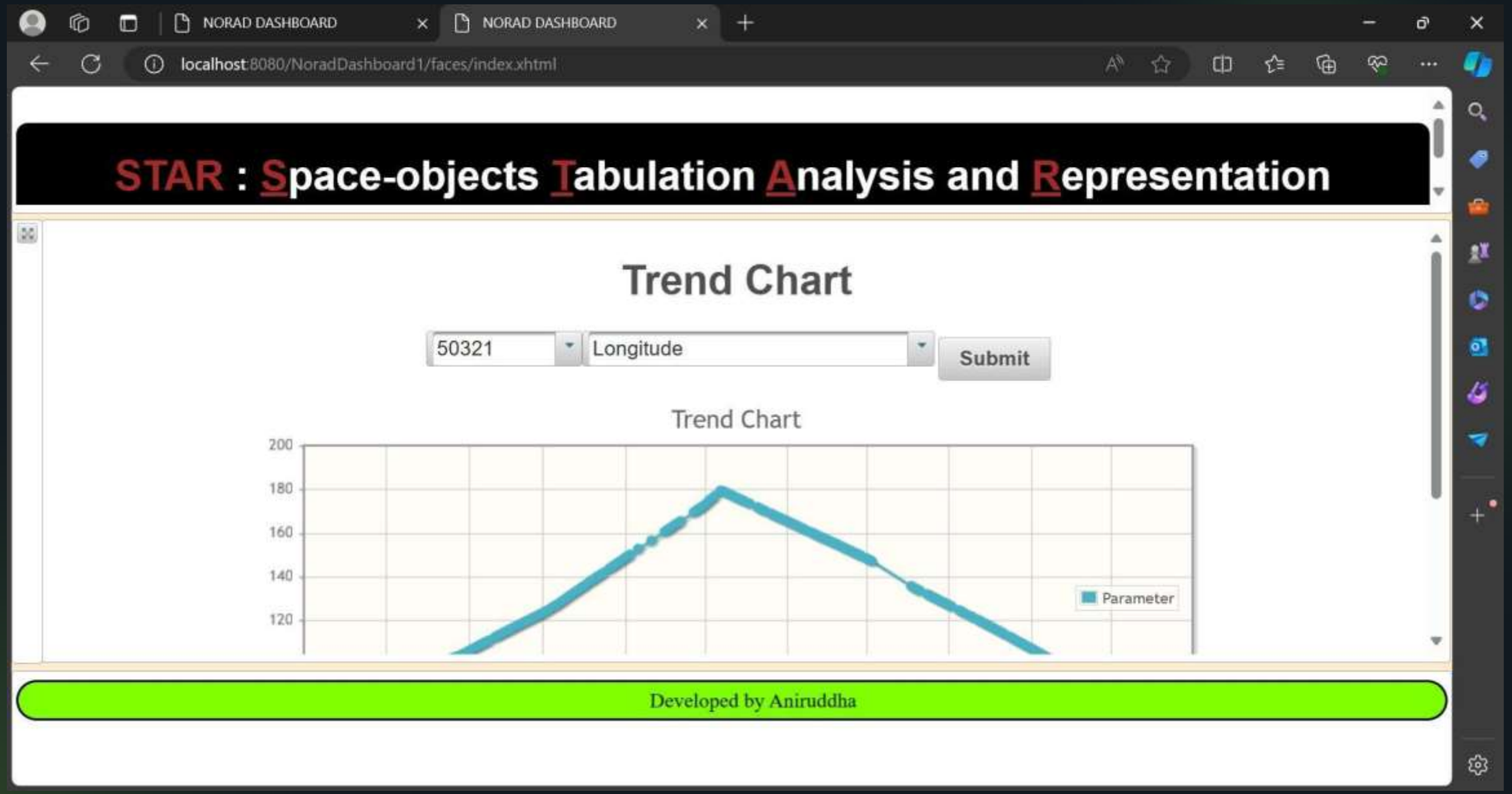
Right Assertion of Ascending Node
Argument of Perigee
Drift Rate
Developed by Aniruddha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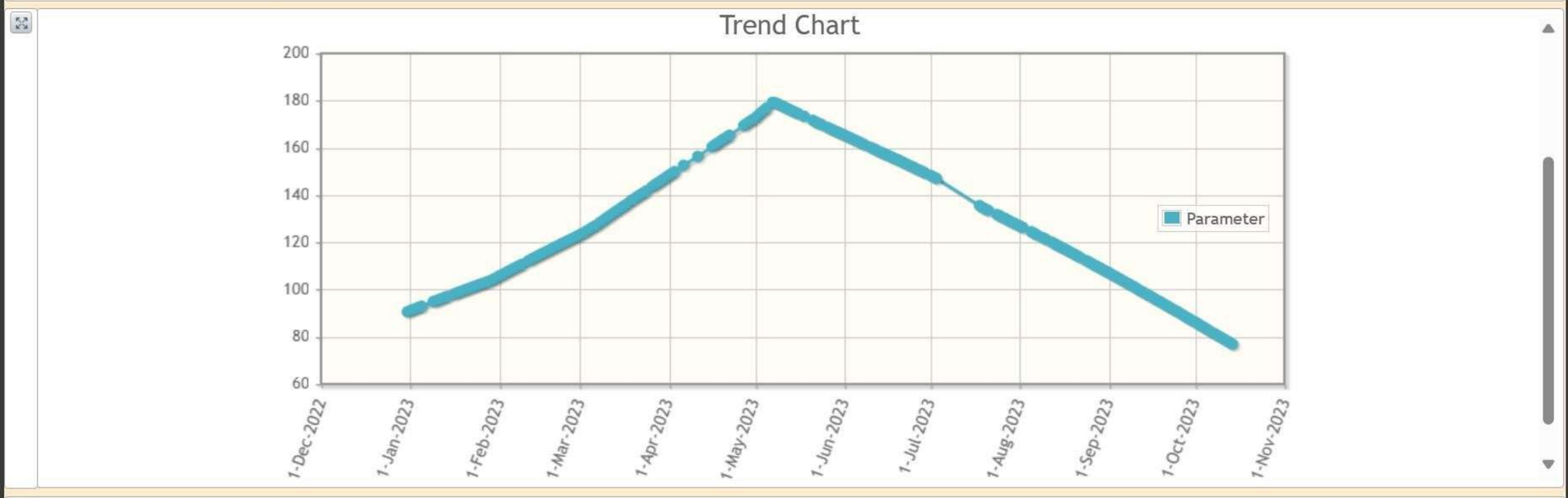


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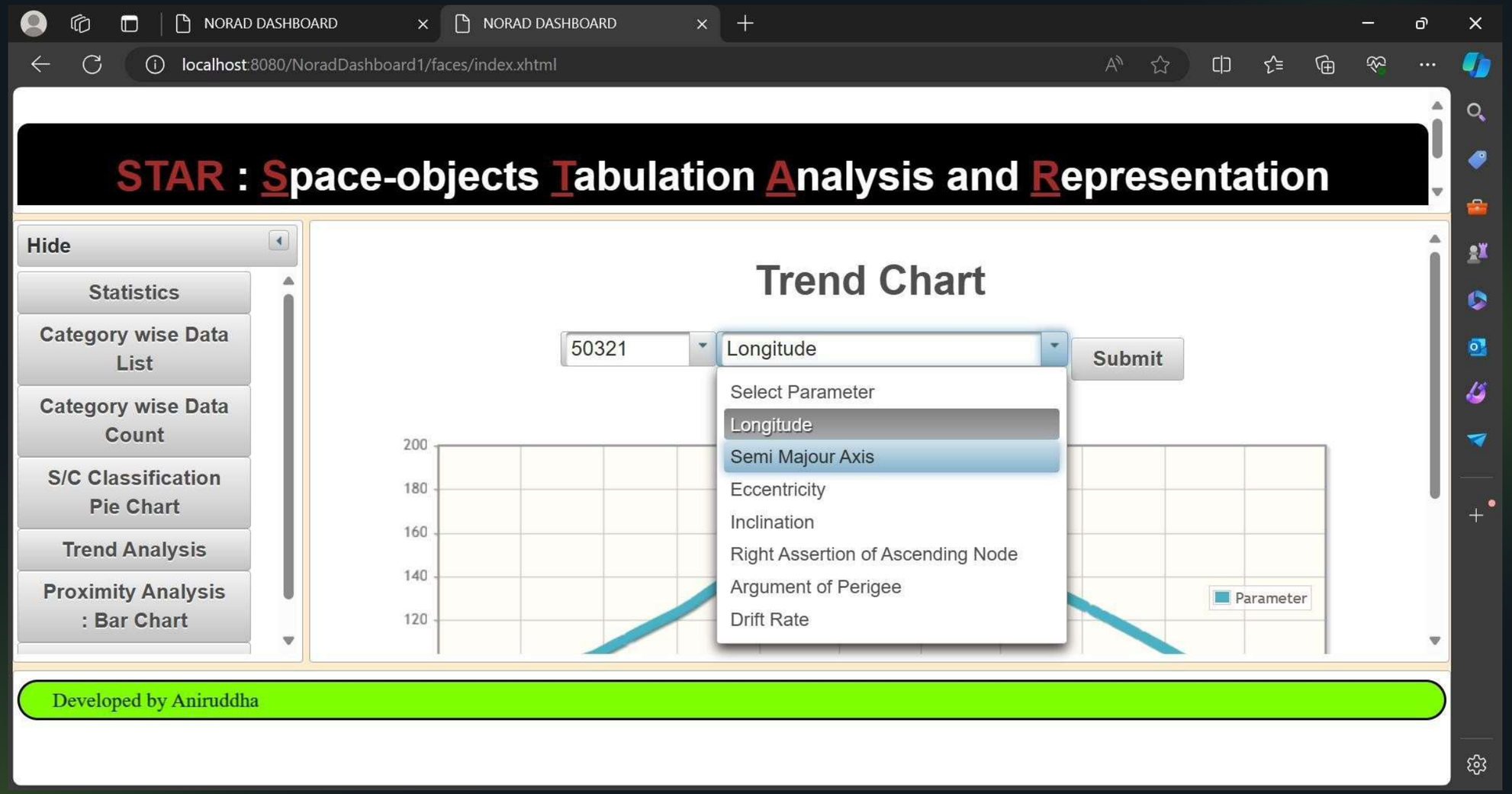
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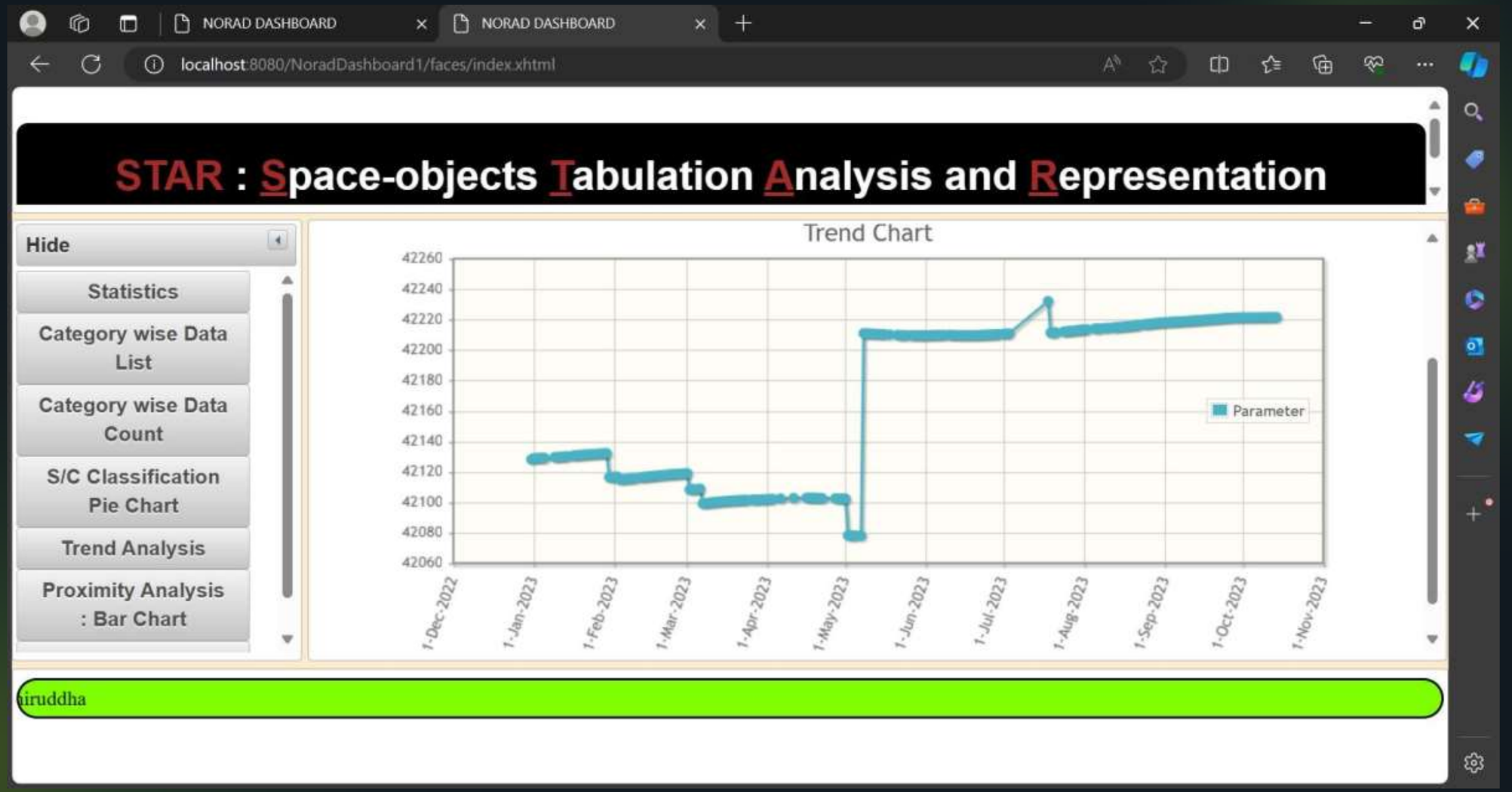
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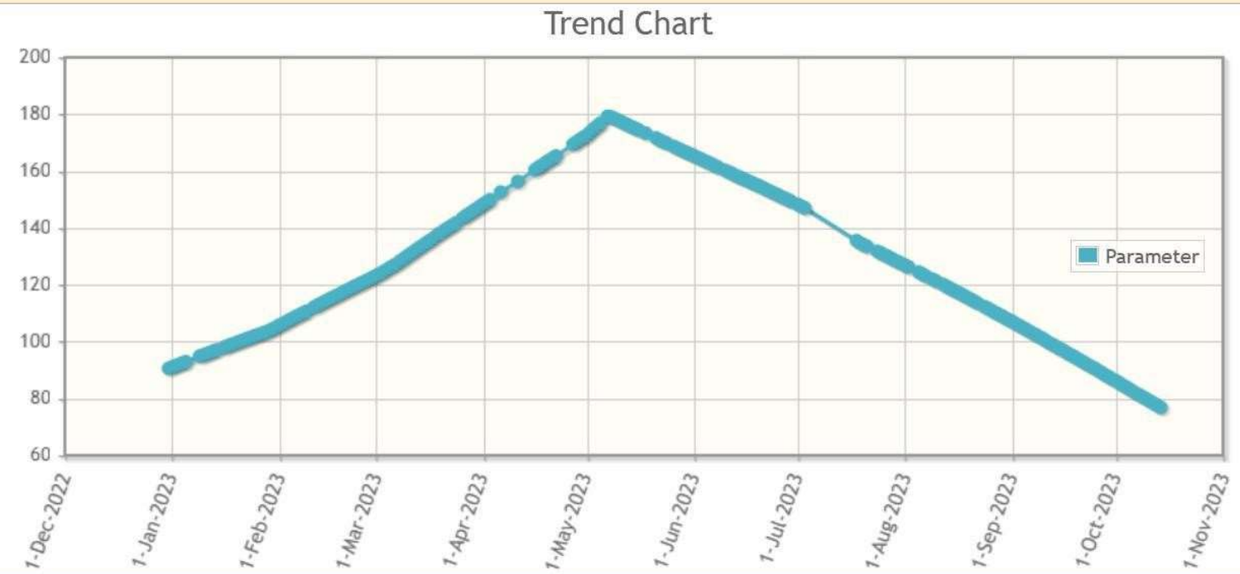


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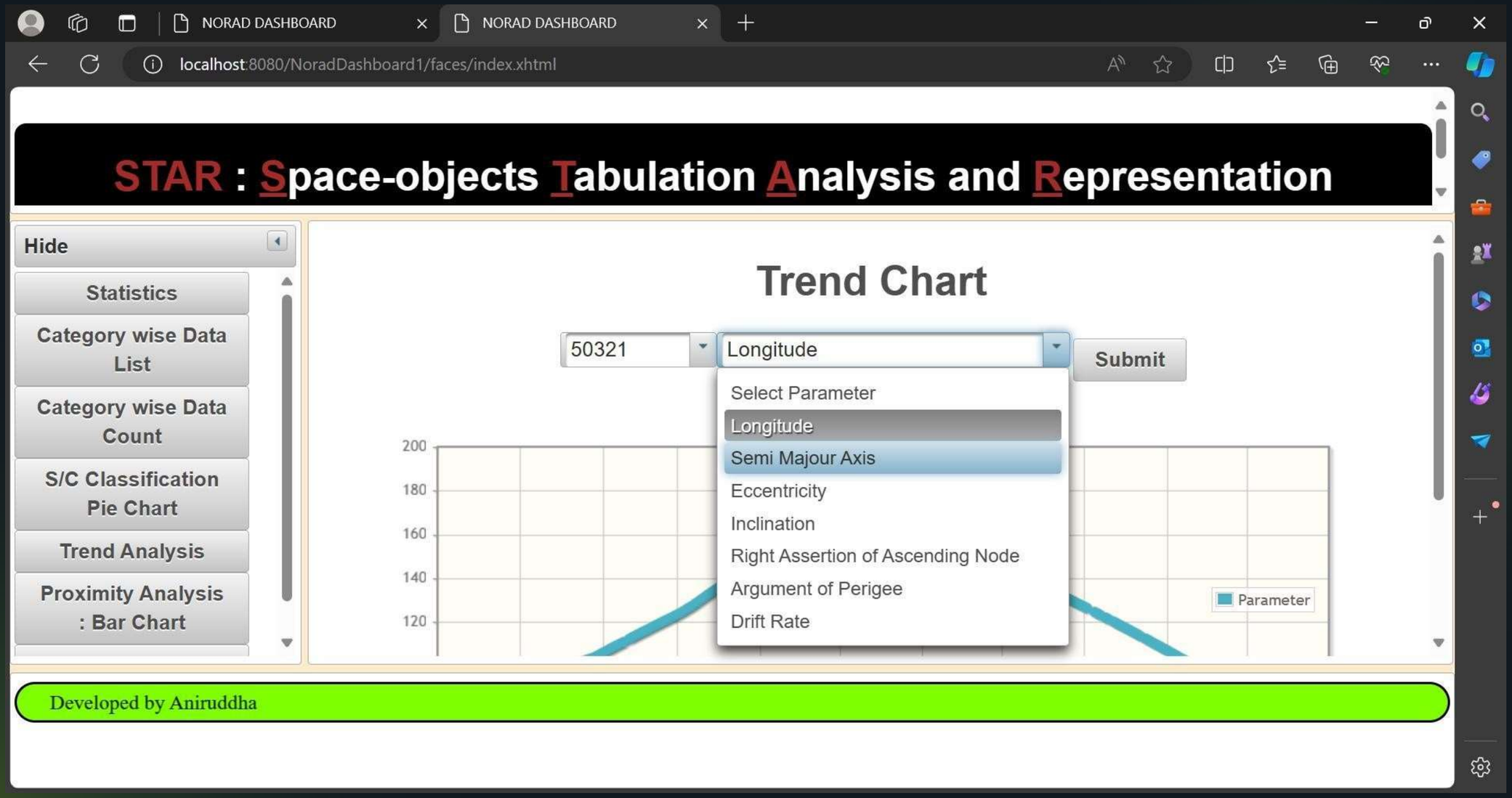
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Developed by Aniruddha

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# STAR : Space-objects Tabulation Analysis and Representation

Hide

- Statistics
- Category wise Data List
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- S/C Classification Pie Chart
- Trend Analysis
- Proximity Analysis : Bar Chart


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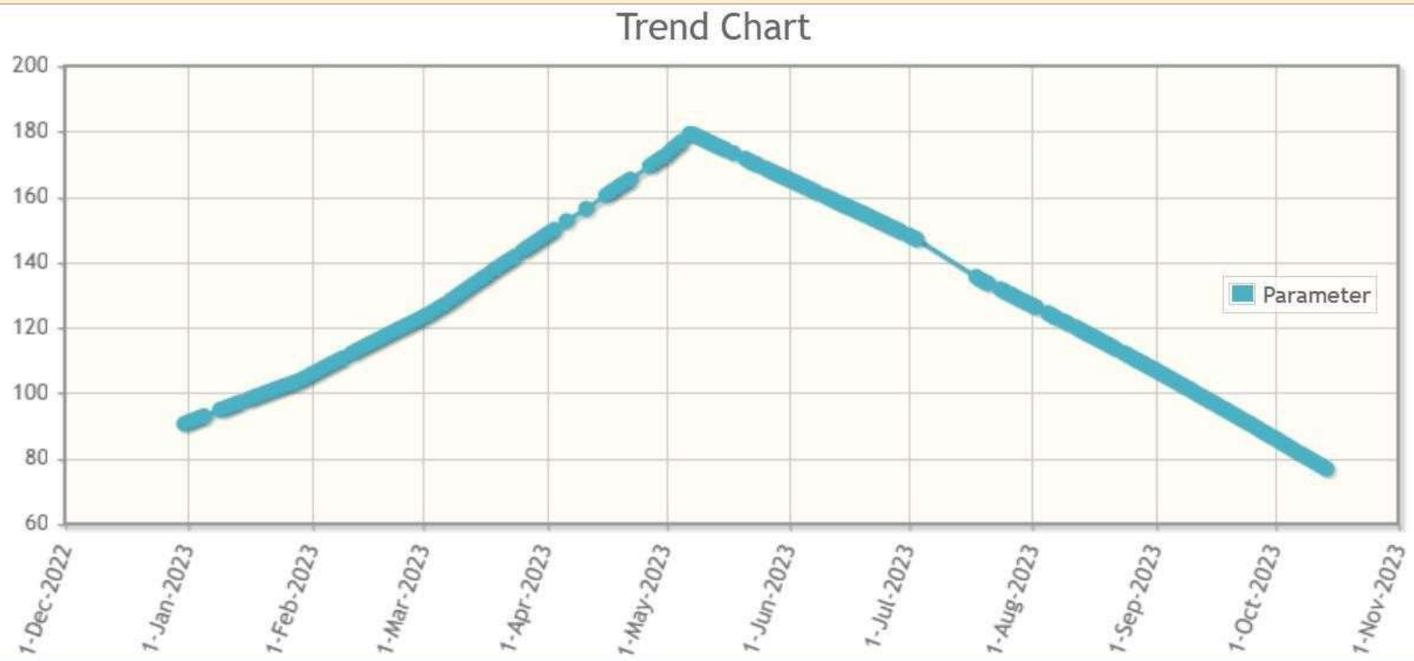


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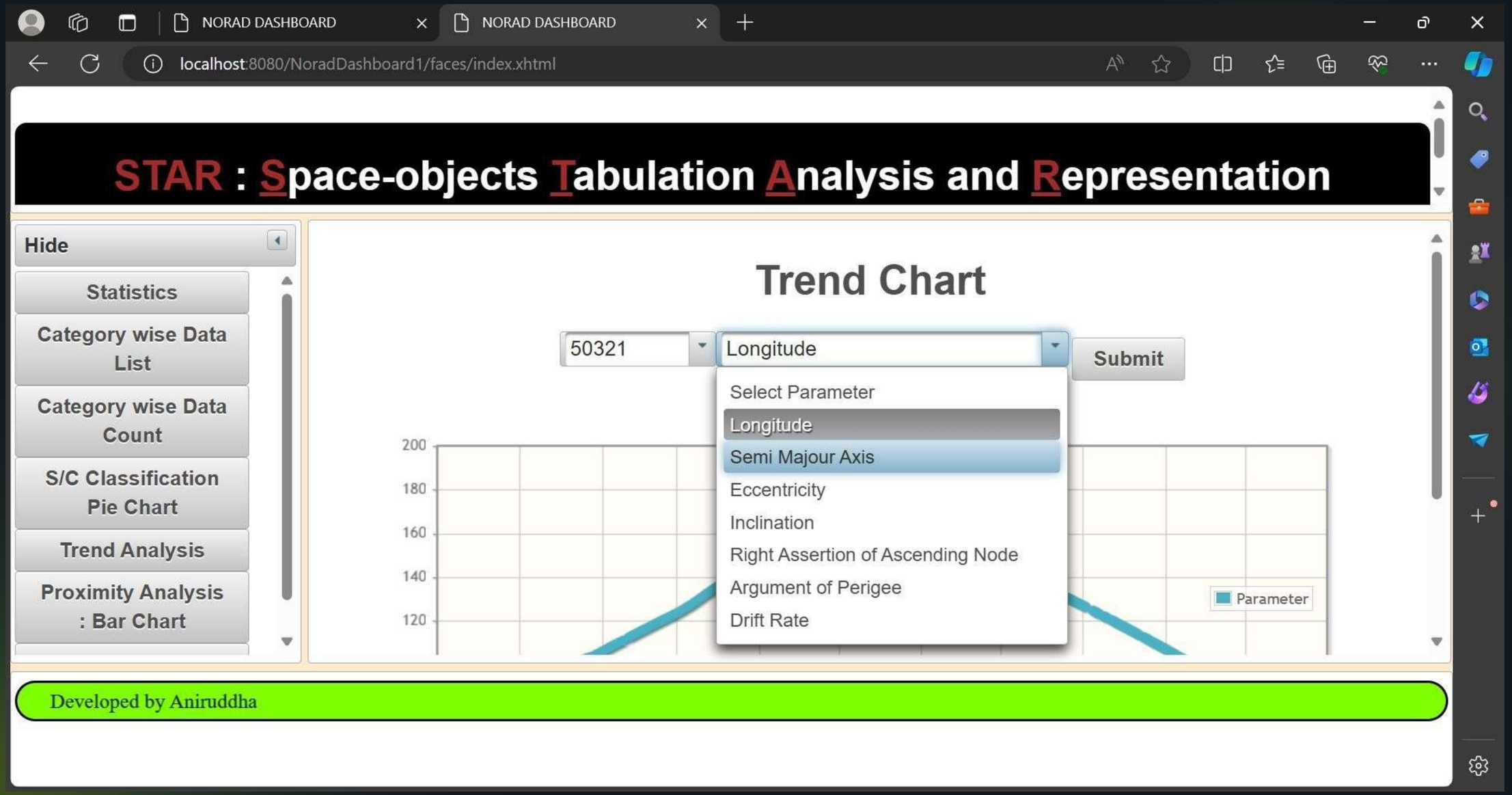
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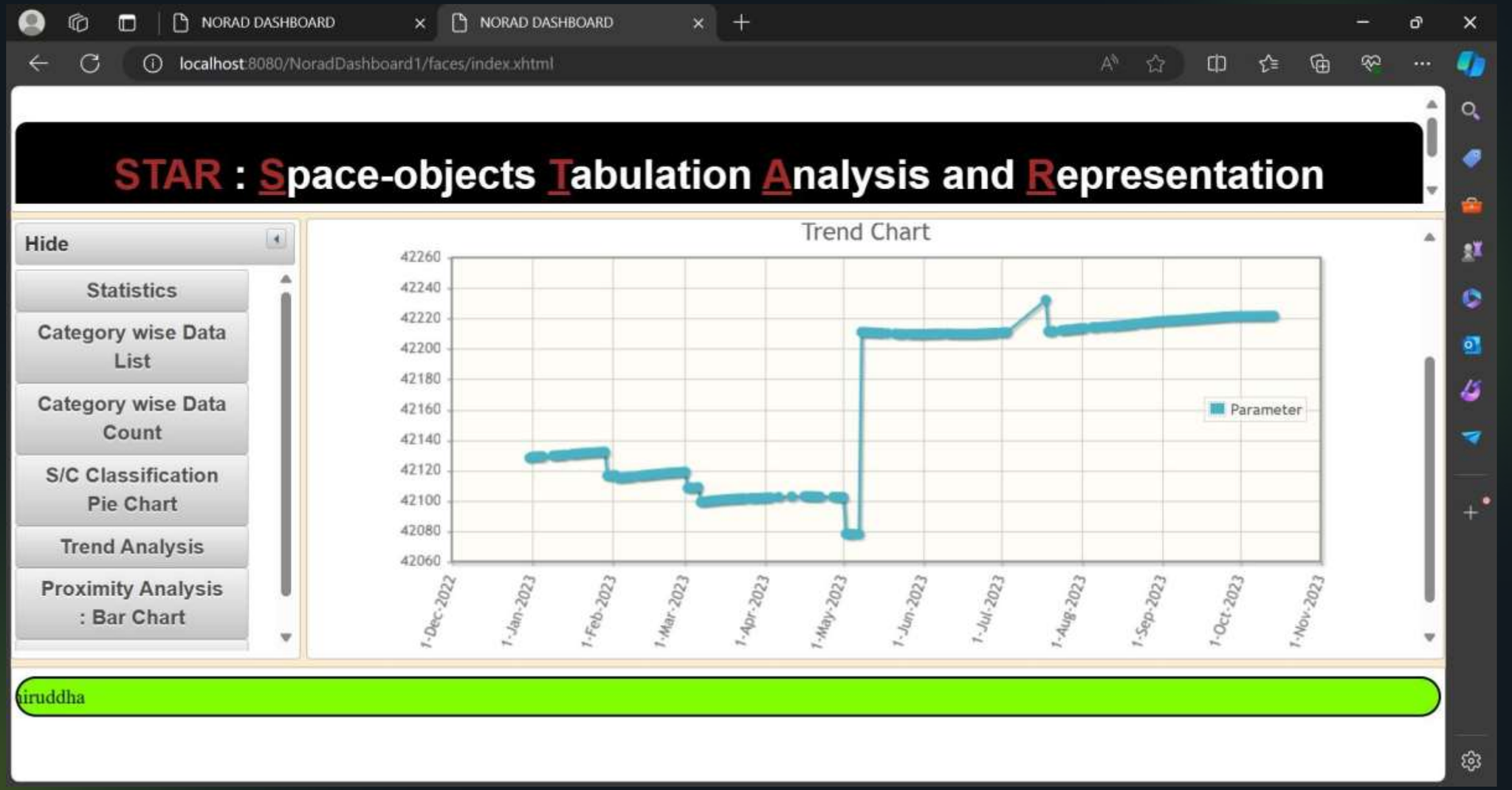
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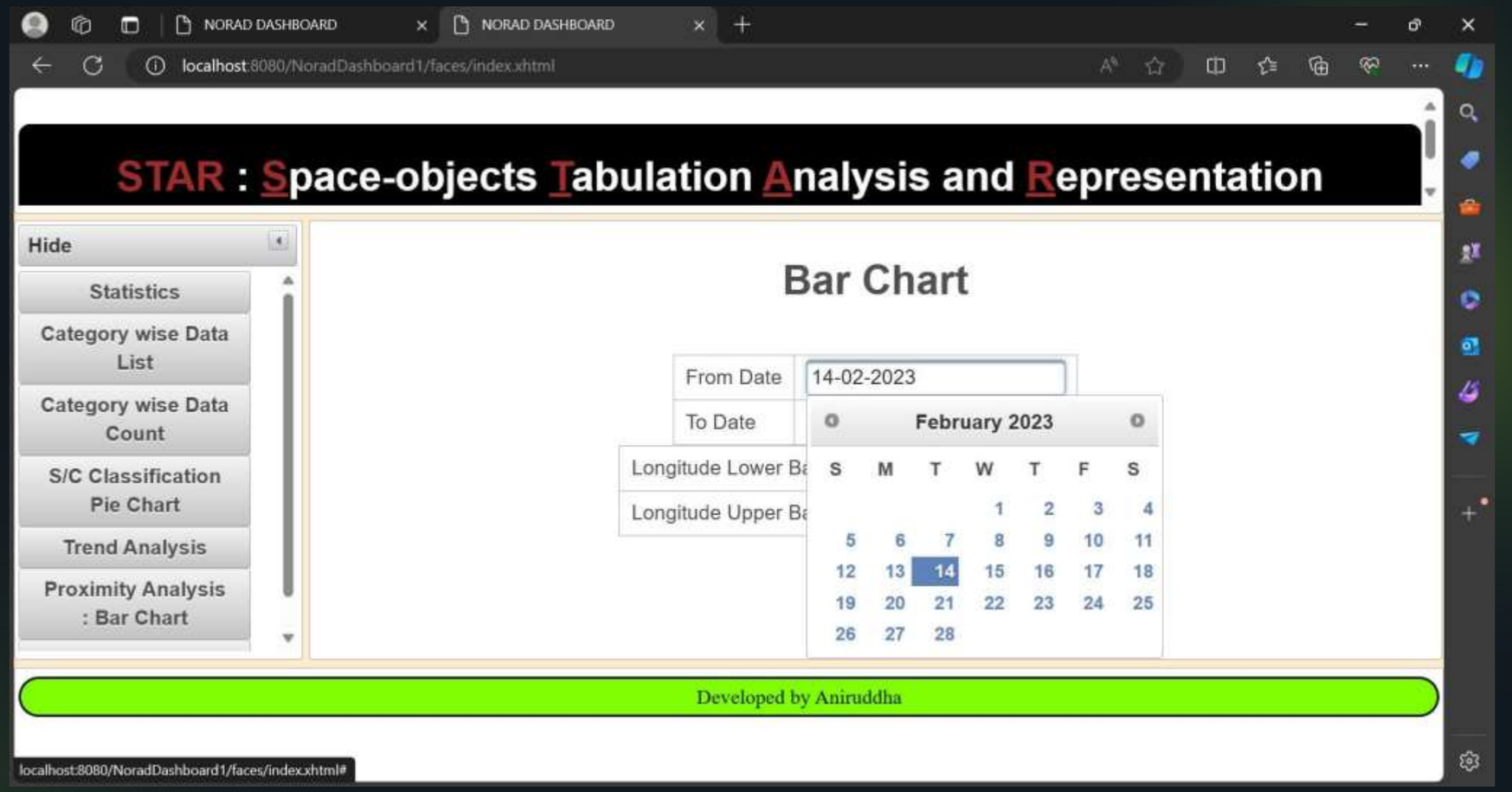
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STAR : Space-objects Tabulation Analysis and Representation
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Statistics
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S/C Classification Pie Chart
Trend Analysis
Proximity Analysis : Bar Chart
Bar Chart
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To Date
Longitude Lower Ba
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1 2 3 4
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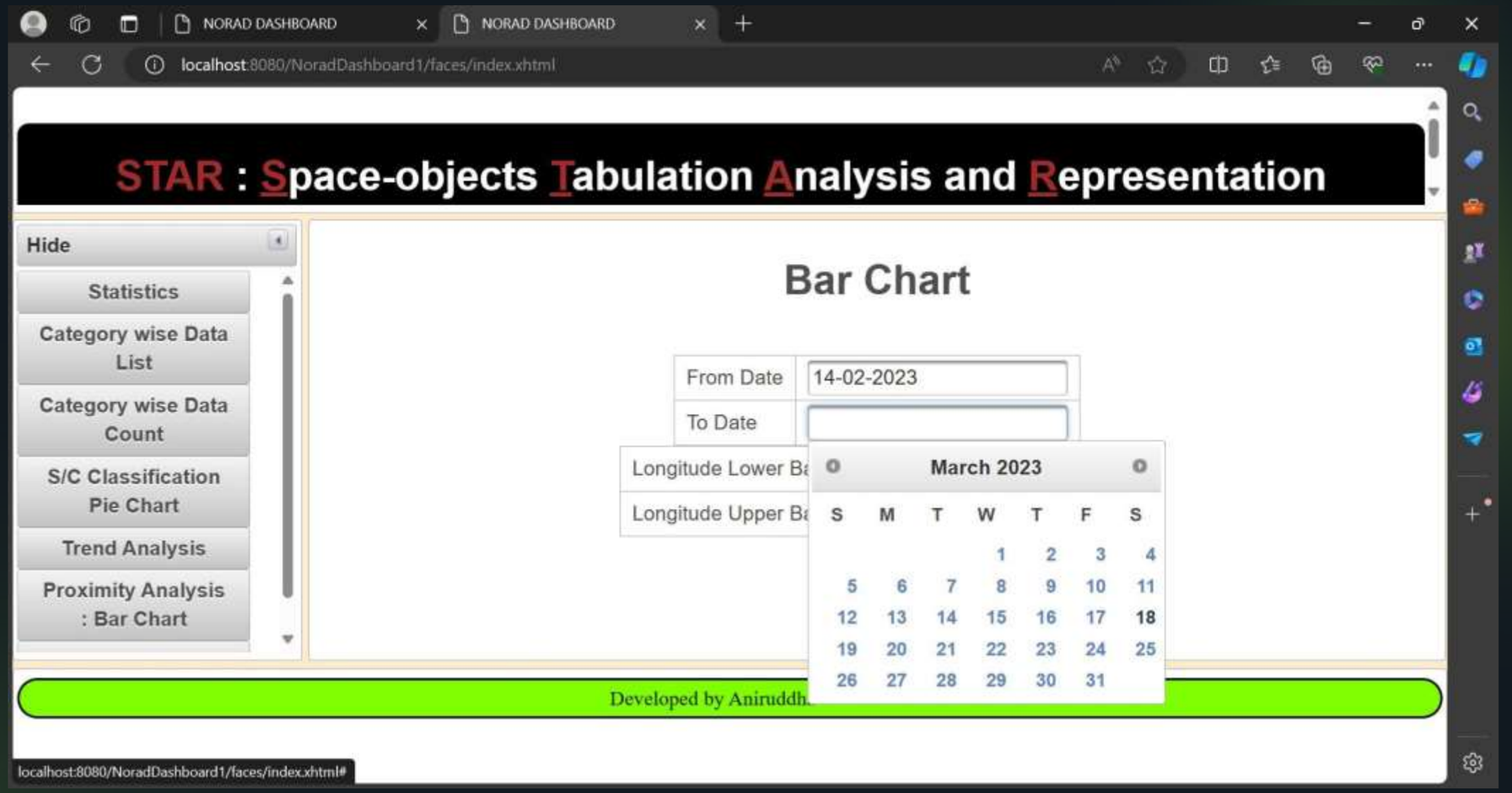
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S/C Classification Pie Chart
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Proximity Analysis : Bar Chart
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To Date
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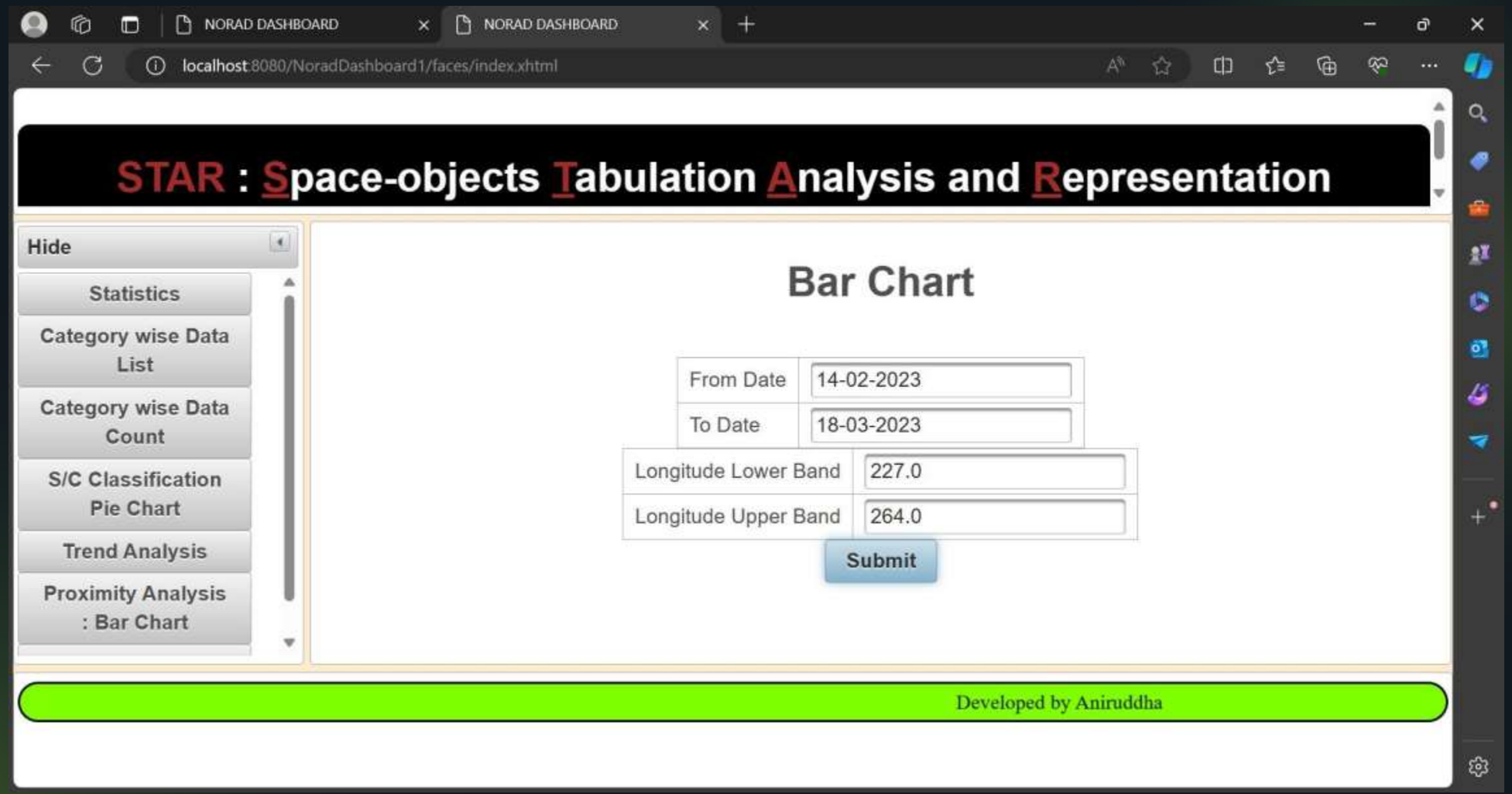
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Trend Analysis
Proximity Analysis : Bar Chart
Bar Chart
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To Date
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264.0
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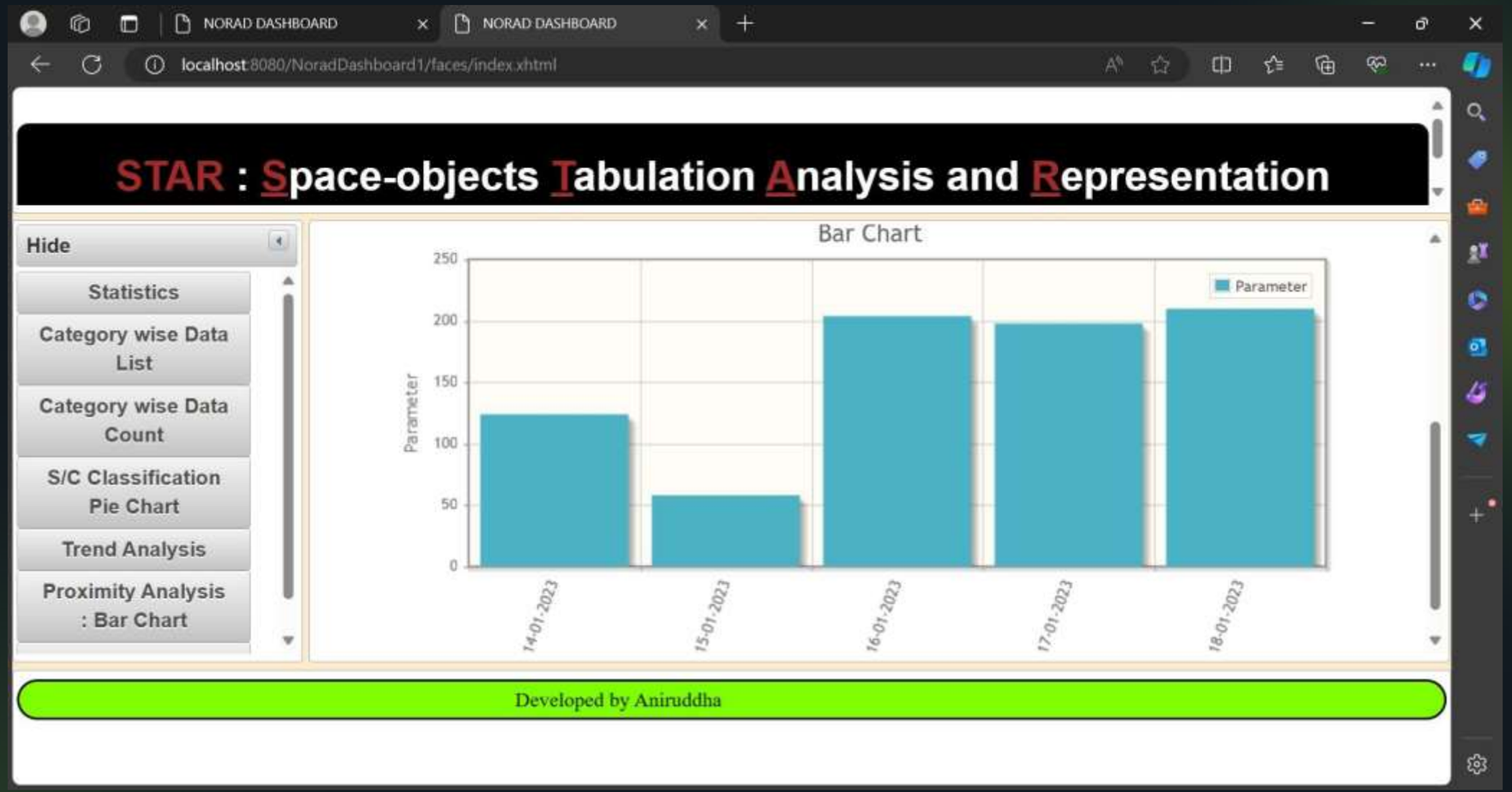
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S/C Classification Pie Chart
Trend Analysis
Proximity Analysis : Bar Chart
Bar Chart
Parameter
250
200
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100
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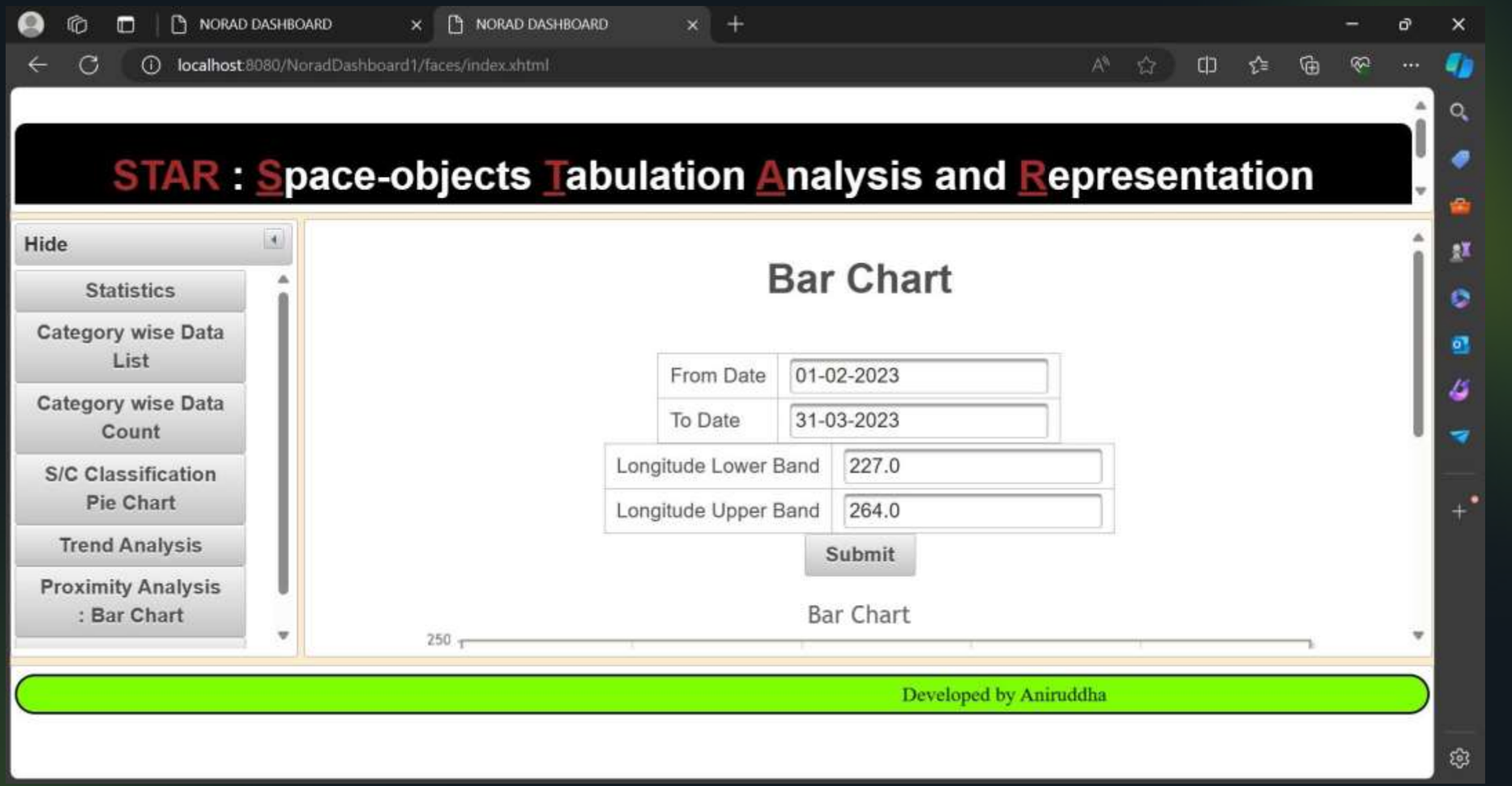
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Statistics
Category wise Data List
Category wise Data Count
S/C Classification Pie Chart
Trend Analysis
Proximity Analysis : Bar Chart
Bar Chart
From Date
01-02-2023
To Date
31-03-2023
Longitude Lower Band
227.0
Longitude Upper Band
264.0
Submit
Bar Chart
250
Developed by Aniruddha

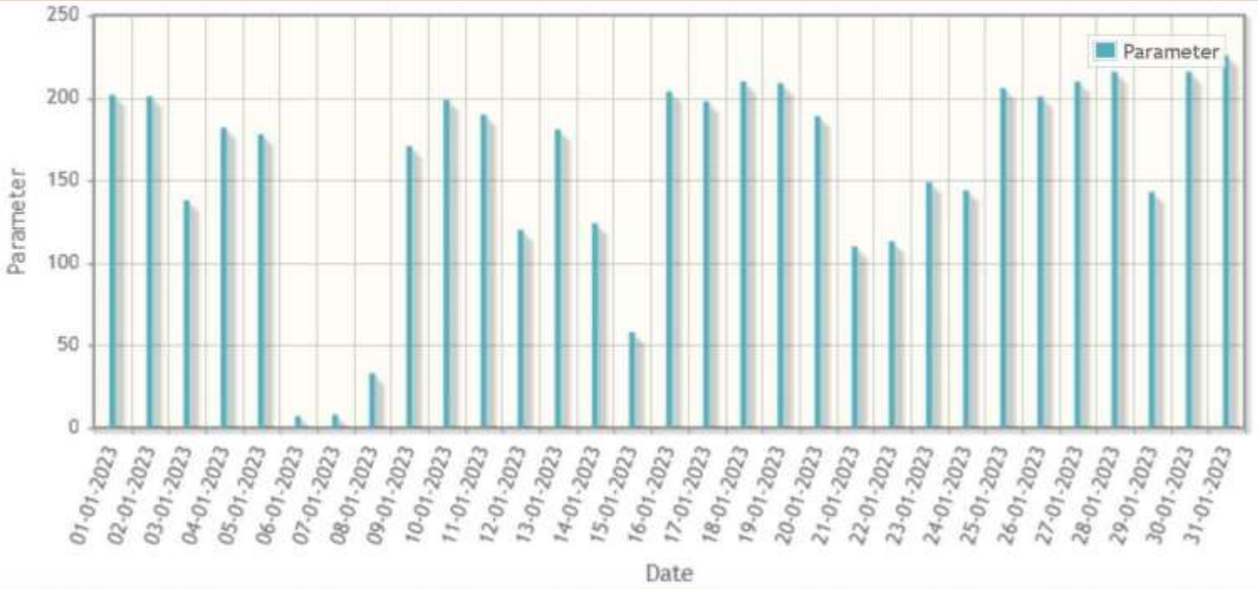
NORAD DASHBOARD | NORAD DASHBOARD

localhost:8080/NoradDashboard1/faces/index.xhtml

# STAR : Space-objects Tabulation Analysis and Representation

Hide

- Statistics
- Category wise Data List
- Category wise Data Count
- S/C Classification Pie Chart
- Trend Analysis
- Proximity Analysis : Bar Chart

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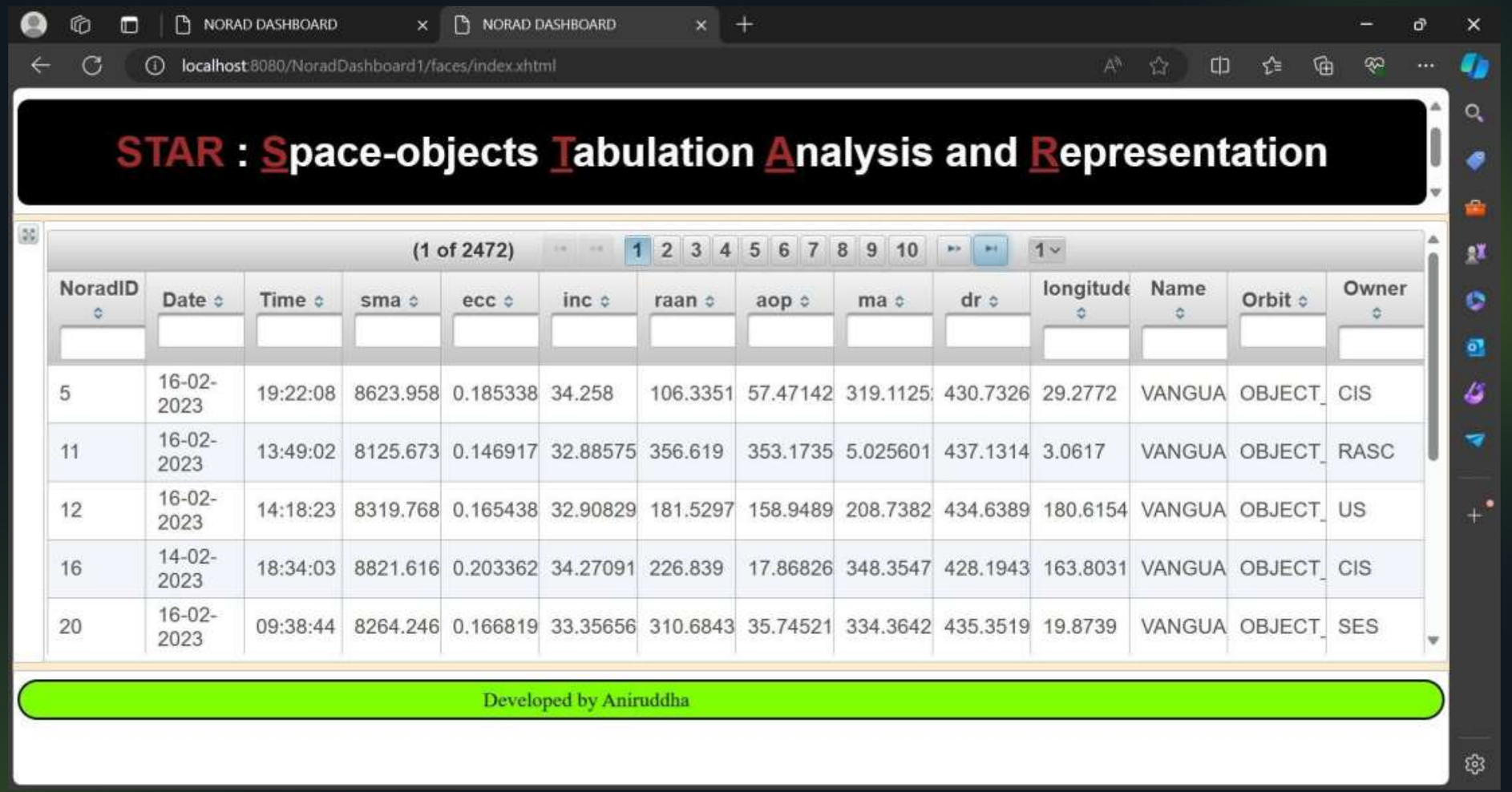
NORAD DASHBOARD
NORAD DASHBOARD
localhost:8080/NoradDashboard1/faces/index.xhtml
STAR : Space-objects Tabulation Analysis and Representation
(1 of 2472)
1 2 3 4 5 6 7 8 9 10
1
NoradID
Date
Time
sma
ecc
inc
raan
aop
ma
dr
longitude
Name
Orbit
Owner
5 16-02-2023 19:22:08 8623.958 0.185338 34.258 106.3351 57.47142 319.1125 430.7326 29.2772 VANGUA OBJECT_ CIS
11 16-02-2023 13:49:02 8125.673 0.146917 32.88575 356.619 353.1735 5.025601 437.1314 3.0617 VANGUA OBJECT_ RASC
12 16-02-2023 14:18:23 8319.768 0.165438 32.90829 181.5297 158.9489 208.7382 434.6389 180.6154 VANGUA OBJECT_ US
16 14-02-2023 18:34:03 8821.616 0.203362 34.27091 226.839 17.86826 348.3547 428.1943 163.8031 VANGUA OBJECT_ CIS
20 16-02-2023 09:38:44 8264.246 0.166819 33.35656 310.6843 35.74521 334.3642 435.3519 19.8739 VANGUA OBJECT_ SES
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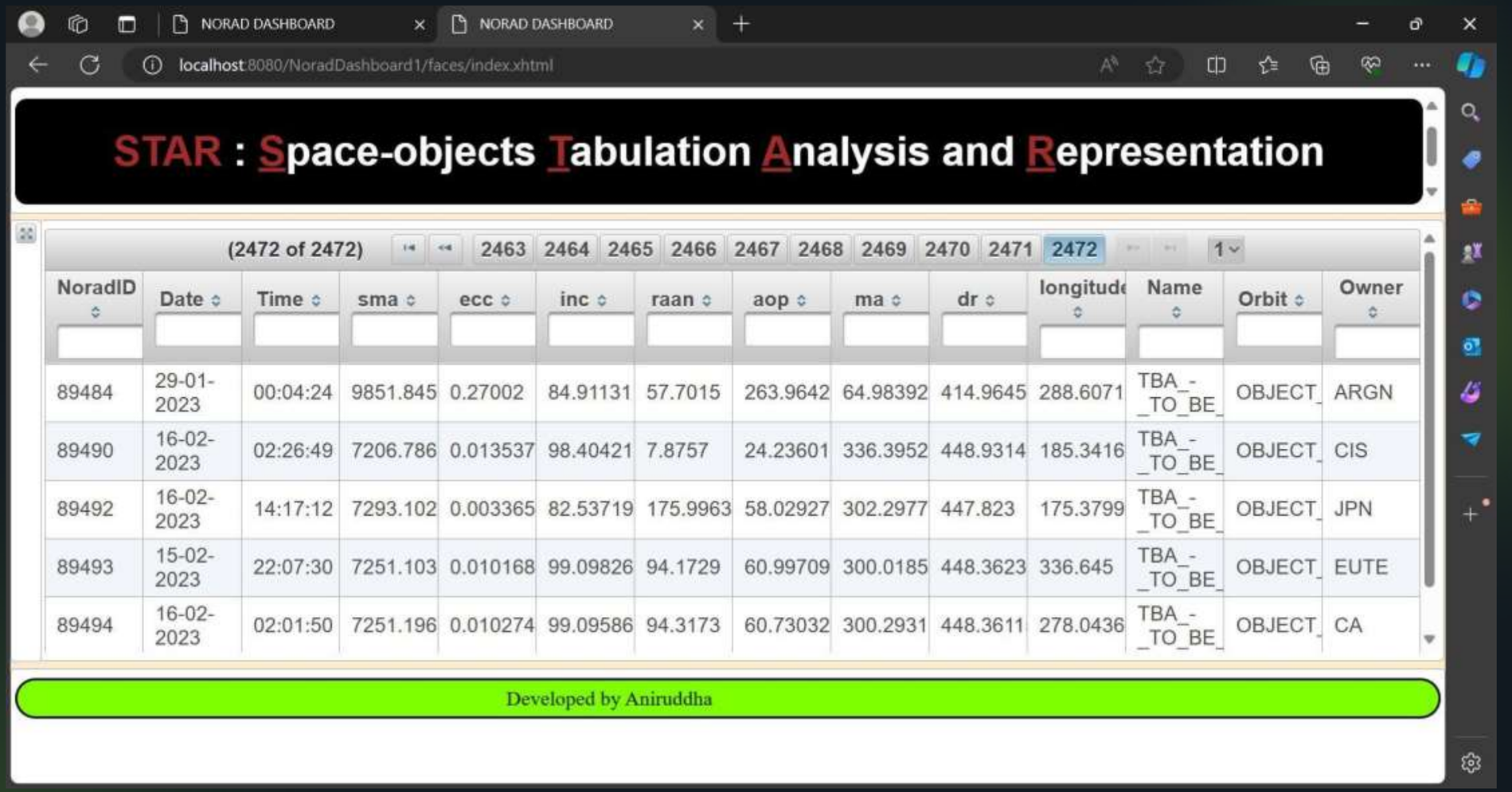
NORAD DASHBOARD
NORAD DASHBOARD
localhost:8080/NoradDashboard1/faces/index.xhtml
STAR : Space-objects Tabulation Analysis and Representation
(2472 of 2472)
2463 2464 2465 2466 2467 2468 2469 2470 2471 2472
1
NoradID Date Time sma ecc inc raan aop ma dr longitude Name Orbit Owner
89484 29-01-2023 00:04:24 9851.845 0.27002 84.91131 57.7015 263.9642 64.98392 414.9645 288.6071 TBA_-_TO_BE_ OBJECT_ ARGN
89490 16-02-2023 02:26:49 7206.786 0.013537 98.40421 7.8757 24.23601 336.3952 448.9314 185.3416 TBA_-_TO_BE_ OBJECT_ CIS
89492 16-02-2023 14:17:12 7293.102 0.003365 82.53719 175.9963 58.02927 302.2977 447.823 175.3799 TBA_-_TO_BE_ OBJECT_ JPN
89493 15-02-2023 22:07:30 7251.103 0.010168 99.09826 94.1729 60.99709 300.0185 448.3623 336.645 TBA_-_TO_BE_ OBJECT_ EUTE
89494 16-02-2023 02:01:50 7251.196 0.010274 99.09586 94.3173 60.73032 300.2931 448.3611 278.0436 TBA_-_TO_BE_ OBJECT_ CA
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Thank You