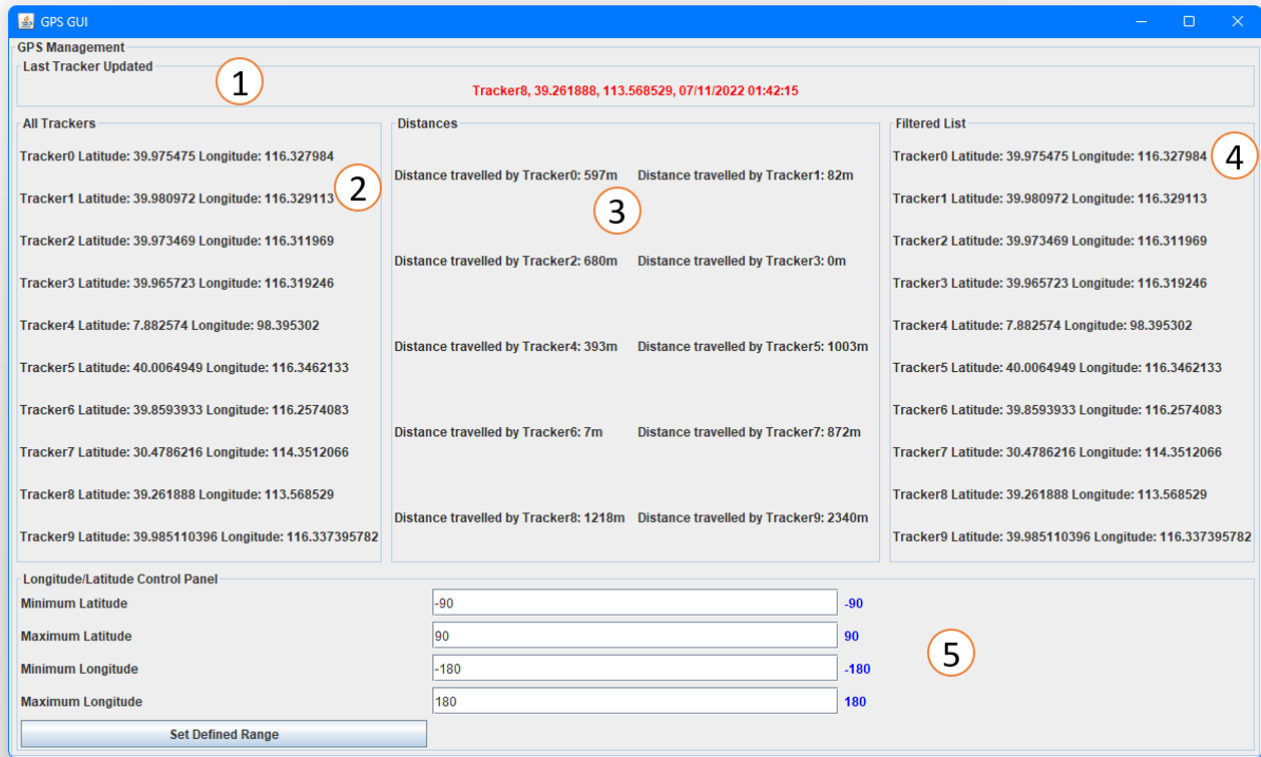


Testing Report for EDC Assignment 3:



The user interface of the GPS GUI is divided into 5 distinct sections. According to the Expected GUI Display/ Output Format, the following are the points and the corresponding sections:

1. **[SECTION 2]** Ten tracker simplified displays. Simplified tracking data has its altitude data removed and this should be carried out with Sodium FRP operations. From this stream, display, in separate cells:
 - Tracker number
 - latitude
 - longitude
2. **[SECTION 1]** A display field shows each event as it is passed to the GUI, at the time it occurs.
 - This is presented as a comma-delimited string of 4 items
 - Only a single entry is presented at a time, and cleared after 3 seconds if not overwritten.
3. **[SECTION 4 & 5]** A single (1) display that combines all input streams, and only outputs GPS events in the defined range of Latitude and Longitude.
 - The defined range is controlled by a control panel consisting of a latitude input field, a longitude input field, and a button to set the restriction.

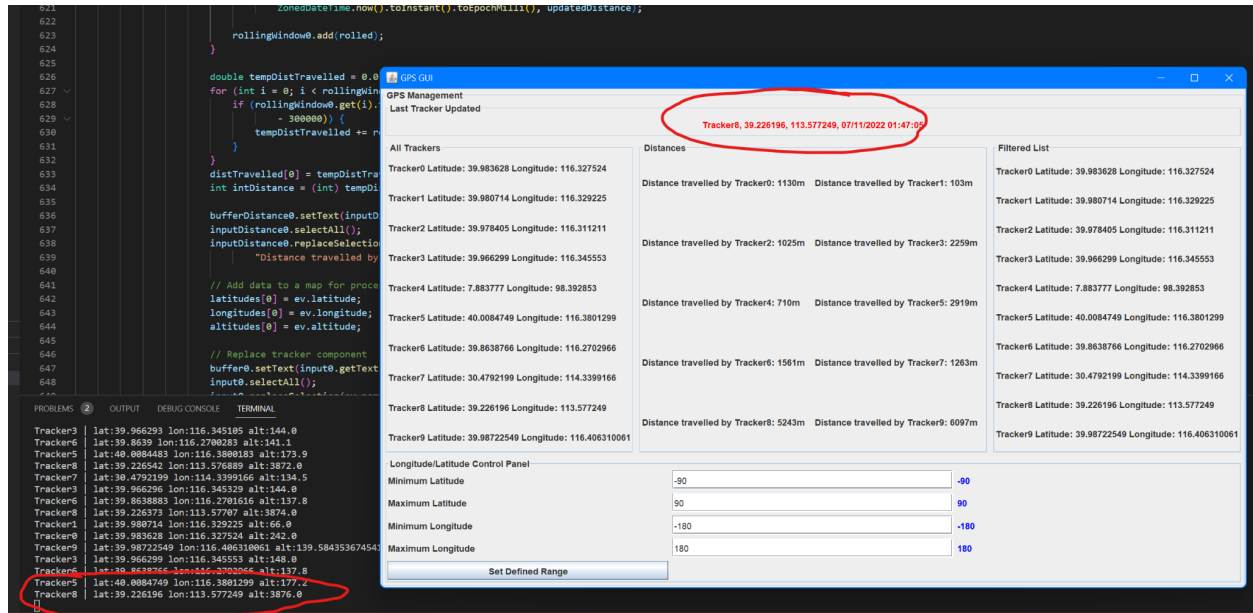
- The latitude and longitude restriction will probably require the use of the **snapshot** primitive.
 - Labels show the current setting of the restriction.
 - The GUI element displays the data in an identical form to the display field in (2), as long as the data is in the range.
4. **[SECTION 3 & 5]** A distance field for each tracker that outputs the total distance travelled over the last 5 minutes for each tracker.
- Your GUI should display a label for each tracker, with the current distance travelled next to it.
 - This only includes events that are within the currently set Lat/Long range.
 - The value should be a distance in meters, rounded up to the nearest integer meter.
 - **Important: The tracker altitude data is in feet. You should use **map** to transform this data.**
 - Distance calculations may be calculated without considering the curvature of the Earth but must take the altitude into account.
(See Latitude and Longitude section below)
 - **Hint:** You might want to look at the FRP primitive **snapshot**.
 - **Hint:** A sliding window of 5 minutes, however you implement it, will make this calculation easier. You only calculate distances between known positions, i.e. two distinct events

Your GUI should use framing and clear structure to group similar elements and make it easy to understand what is going on.

Section 1 Last Tracker Updated (Point 2)

This section shows a display field of each event that happens as a comma-delimited string of 4 items that is cleared after 3 seconds if not overwritten.

Testing this section was just corresponding to the last events that were printed in the terminal with the tracker that was showing as the 'last event'. This test shows that it works:



We can inspect that every 3 seconds if not updated it will clear itself by placing a print statement and modifying the code in the loop to stop events from happening. From this it has been verified that the timer every 3 seconds works.

Section 2 All Trackers (Point 1)

This section shows ten simplified tracker displays. The altitude of this data has been removed with Sodium FRP operations.

Testing this section was just corresponding to the events that were printed in the terminal with the tracker that was showing as the 'last event'. This test shows that it works:

The image shows a terminal window on the left and a GUI window titled "GPS GUI" on the right. The terminal displays a list of trackers with their latitude, longitude, and altitude. The GUI window has a blue header and contains sections for "GPS Management", "All Trackers", and "Longitude/Latitude Control Panel". Red lines connect specific tracker entries in the terminal to their corresponding entries in the GUI's "All Trackers" list.

Tracker Data from Terminal:

Tracker	lat	lon	alt
Tracker7	30.4775883	114.3582583	150.9
Tracker1	39.980998	116.329279	157.0
Tracker6	39.8593933	116.2573716	164.0
Tracker3	39.965723	116.319246	627.0
Tracker9	39.984960026	116.31073856	489.42900496063
Tracker4	7.879058	98.39548	0.0
Tracker5	40.0138699	116.3434599	154.2
Tracker2	39.968415	116.314171	237.0
Tracker8	39.266822	113.578671	3427.0
Tracker6	39.8593933	116.2574083	141.1
Tracker8	39.266557	113.579018	3456.0
Tracker5	40.0138716	116.3435749	154.2
Tracker7	30.4777516	114.3582616	147.6
Tracker1	39.981074	116.329211	156.0
Tracker5	40.0138799	116.3436883	154.2
Tracker8	39.266614	113.57891	3441.0
Tracker2	39.968477	116.31416	237.0
Tracker5	40.0138816	116.3438099	154.2
Tracker1	39.981125	116.32917	155.0
Tracker7	30.4779166	114.3582699	147.6
Tracker5	40.0138849	116.34393	154.2
Tracker9	39.98489813	116.311883625	477.595242782152
Tracker4	7.879091	98.395467	3.0
Tracker2	39.968537	116.314144	237.0
Tracker5	40.0138833	116.3440516	154.2
Tracker1	39.981163	116.329138	153.0
Tracker7	30.4780833	114.3582749	144.4
Tracker5	40.0138783	116.3441733	154.2
Tracker8	39.26651	113.579198	3486.0
Tracker2	39.968605	116.314109	237.0
Tracker5	40.0138766	116.3442933	154.2
Tracker7	30.4782449	114.3582733	144.4
Tracker1	39.981175	116.329128	152.0
Tracker5	40.0138783	116.3444083	154.2
Tracker2	39.96868	116.314077	237.0
Tracker5	40.0138766	116.3445249	154.2
Tracker7	30.4783999	114.3582666	144.4
Tracker1	39.98119	116.32911	152.0
Tracker4	7.879182	98.395465	0.0
Tracker9	39.984902575	116.313035513	465.691780089239
Tracker8	39.266415	113.579292	3504.0
Tracker5	40.0138599	116.3446366	154.2
Tracker2	39.968773	116.314048	237.0
Tracker5	40.0138483	116.3447549	154.2
Tracker1	39.981182	116.329089	152.0
Tracker7	30.4785433	114.3582649	144.4
Tracker2	39.96883	116.314033	238.0
Tracker5	40.0138466	116.3448766	154.2

GPS GUI Window:

- GPS Management**
 - Last Tracker Updated
- All Trackers**
 - Tracker0 Latitude: 39.977643 Longitude: 116.327703
 - Tracker1 Latitude: 39.981182 Longitude: 116.329089
 - Tracker2 Latitude: 39.96883 Longitude: 116.314033
 - Tracker3 Latitude: 39.965723 Longitude: 116.319246
 - Tracker4 Latitude: 7.879182 Longitude: 98.395465
 - Tracker5 Latitude: 40.0138466 Longitude: 116.3448766
 - Tracker6 Latitude: 39.8593933 Longitude: 116.2574083
 - Tracker7 Latitude: 30.4785433 Longitude: 114.3582649
 - Tracker8 Latitude: 39.266415 Longitude: 113.579292
 - Tracker9 Latitude: 39.984902575 Longitude: 116.313035513
- Longitude/Latitude Control Panel**
 - Minimum Latitude
 - Maximum Latitude
 - Minimum Longitude
 - Maximum Longitude
 - Set Defined Range

Section 3 Distances (Point 4)

This section shows ten tracker labels with their corresponding distance traveled.

It only includes events that are within the Lat/Long range from Section 5.

The value should be in meters (rounded up).

To test this section, I first just looked at the values of the distances traveled in correspondence to what was displayed on the output of the GPS Service.

The screenshot shows a Windows PowerShell terminal window on the left and a GPS GUI application on the right.

PowerShell Terminal Output:

```
Windows PowerShell
Copyright (c) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements! https://aka.ms/PowerShellLatest

PS C:\Users\chris\Documents\GitHub\edcassignment3> & 'C:\Program Files\GPS Service\GPS.exe'
Tracker0 | lat:39.977643 lon:116.327703 alt:492.0
Tracker7 | lat:30.4775883 lon:114.3582583 alt:150.9
Tracker2 | lat:39.968415 lon:116.314171 alt:237.0
Tracker9 | lat:39.984960026 lon:116.31073856 alt:489.42906496863
Tracker8 | lat:39.266822 lon:113.579018 alt:3427.0
Tracker6 | lat:39.8593933 lon:116.2574083 alt:164.0
Tracker5 | lat:40.0138716 lon:116.3435749 alt:154.2
Tracker1 | lat:39.980998 lon:116.329279 alt:157.0
Tracker3 | lat:39.965723 lon:116.319246 alt:627.0
Tracker4 | lat:7.879058 lon:98.39548 alt:0.0
Tracker8 | lat:39.266557 lon:113.579018 alt:3456.0
Tracker6 | lat:39.8593933 lon:116.2574083 alt:141.1
Tracker5 | lat:40.0138716 lon:116.3435749 alt:154.2
```

GPS GUI Application:

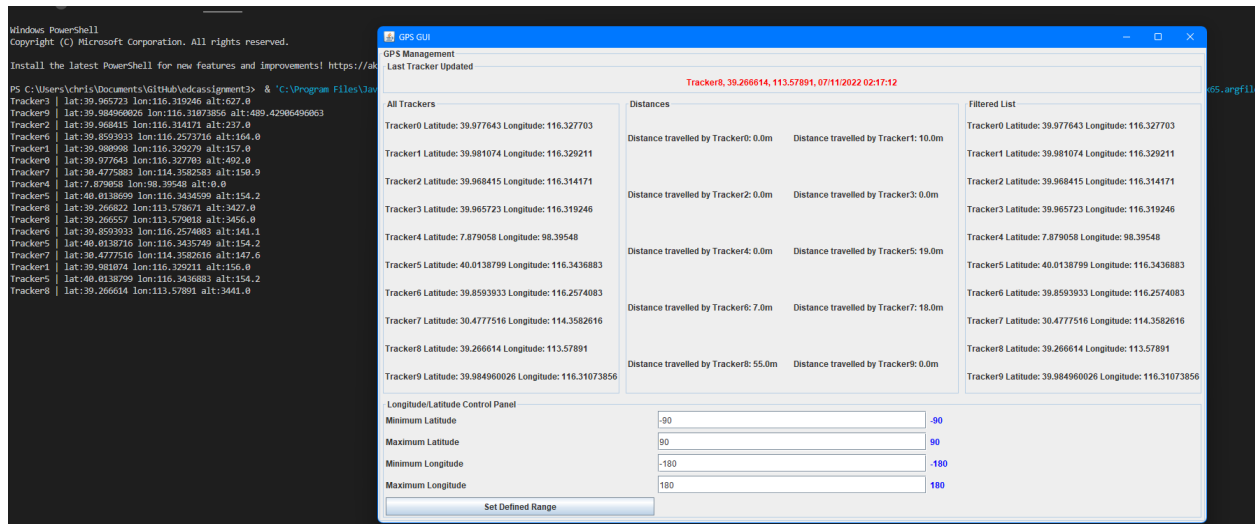
The GUI application has a title bar "GPS GUI" and a menu bar "GPS Management". The main window is titled "Last Tracker Updated" and displays the following information:

Tracker5, 40.0138716, 116.3435749, 07/11/2022 02:08:13

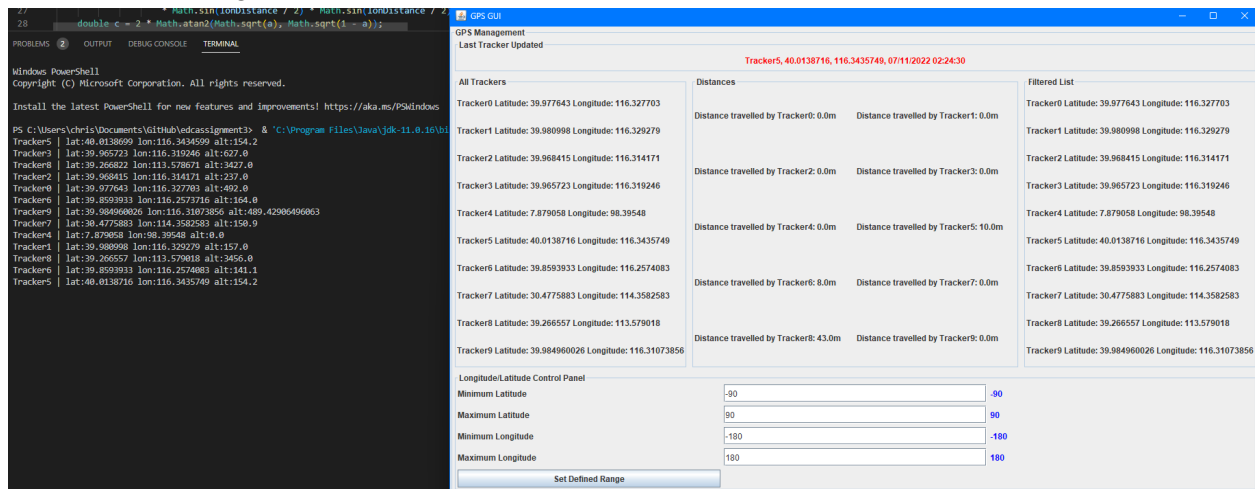
All Trackers	Distances	Filtered List
Tracker0 Latitude: 39.977643 Longitude: 116.327703	Distance travelled by Tracker0: 0.0m	Tracker0 Latitude: 39.977643 Longitude: 116.327703
Tracker1 Latitude: 39.980998 Longitude: 116.329279	Distance travelled by Tracker1: 0.0m	Tracker1 Latitude: 39.980998 Longitude: 116.329279
Tracker2 Latitude: 39.968415 Longitude: 116.314171	Distance travelled by Tracker2: 0.0m	Tracker2 Latitude: 39.968415 Longitude: 116.314171
Tracker3 Latitude: 39.965723 Longitude: 116.319246	Distance travelled by Tracker3: 0.0m	Tracker3 Latitude: 39.965723 Longitude: 116.319246
Tracker4 Latitude: 7.879058 Longitude: 98.39548	Distance travelled by Tracker4: 0.0m	Tracker4 Latitude: 7.879058 Longitude: 98.39548
Tracker5 Latitude: 40.0138716 Longitude: 116.3435749	Distance travelled by Tracker5: 9.0m	Tracker5 Latitude: 40.0138716 Longitude: 116.3435749
Tracker6 Latitude: 39.8593933 Longitude: 116.2574083	Distance travelled by Tracker6: 7.0m	Tracker6 Latitude: 39.8593933 Longitude: 116.2574083
Tracker7 Latitude: 30.4775883 Longitude: 114.3582583	Distance travelled by Tracker7: 0.0m	Tracker7 Latitude: 30.4775883 Longitude: 114.3582583
Tracker8 Latitude: 39.266557 Longitude: 113.579018	Distance travelled by Tracker8: 42.0m	Tracker8 Latitude: 39.266557 Longitude: 113.579018
Tracker9 Latitude: 39.984960026 Longitude: 116.31073856	Distance travelled by Tracker9: 0.0m	Tracker9 Latitude: 39.984960026 Longitude: 116.31073856

Longitude/Latitude Control Panel:

Minimum Latitude: -90
Maximum Latitude: 90
Minimum Longitude: -180
Maximum Longitude: 180
Set Defined Range



In this scenario, I got tracker5 for example and saw that the rounded value was 10.0 m.



I then looked at the two strings that were shown highlighted at the beginning:

Tracker5 | lat:40.0138699 lon:116.3434599 alt:154.2

Tracker5 | lat:40.0138716 lon:116.3435749 alt:154.2

With the altitude multiplied by 0.3048 to convert to meters

After a few seconds we find that everything else has remained the same except for tracker 5, which has gone from 91 m to 168m. Therefore we know that the filter is working and it only updates if the tracker is in range. We can also see from the terminal all the other events that are happening which do update on the All Trackers part of the program but does not register on the distance - which is a clear separation of both modules.

```

8  private double longitude;
9  public double Longitude; // The Longitude of the GPS event as a value from -180.0 to +180.0
10 public double altitude; // The Altitude of the GPS event in feet
11
12 /**
13  * Creates a GpsEvent
14  */

```

```

tracker4 | lat:7.879058 lon:98.39548 alt:0.0
tracker6 | lat:39.859393 lon:116.257376 alt:164.0
tracker8 | lat:39.266822 lon:113.579071 alt:237.0
tracker5 | lat:40.0138716 lon:116.345749 alt:154.2
tracker6 | lat:39.859393 lon:116.2574083 alt:141.1
tracker8 | lat:39.266557 lon:113.579018 alt:2456.0
tracker7 | lat:30.477249 lon:114.3582616 alt:147.6
tracker1 | lat:39.981074 lon:116.329211 alt:156.0
tracker5 | lat:40.0138799 lon:116.343683 alt:154.2
tracker6 | lat:39.266614 lon:113.57901 alt:364.0
tracker2 | lat:39.968977 lon:116.31406 alt:237.0
tracker5 | lat:40.0138816 lon:116.343899 alt:154.2
tracker7 | lat:30.4779166 lon:114.3582699 alt:147.6
tracker1 | lat:39.981125 lon:116.32917 alt:155.0
tracker5 | lat:40.0138849 lon:116.34393 alt:154.2
tracker4 | lat:7.879091 lon:98.395467 alt:3.0
tracker9 | lat:39.968537 lon:116.31444 alt:237.0
tracker2 | lat:39.968537 lon:116.31444 alt:237.0
tracker5 | lat:40.0138833 lon:116.3440516 alt:154.2
tracker5 | lat:40.0138783 lon:116.3441733 alt:154.2
tracker1 | lat:39.981163 lon:116.329138 alt:153.0
tracker7 | lat:30.478033 lon:114.3582749 alt:144.4
tracker2 | lat:39.968605 lon:116.314109 alt:237.0
tracker8 | lat:39.26651 lon:113.579198 alt:3486.0
tracker5 | lat:40.0138766 lon:116.3442933 alt:154.2
tracker7 | lat:30.4782449 lon:114.3582733 alt:144.4
tracker1 | lat:39.981175 lon:116.329128 alt:152.0
tracker5 | lat:40.0138783 lon:116.344083 alt:154.2
tracker2 | lat:39.96868 lon:116.314077 alt:237.0
tracker5 | lat:40.0138756 lon:116.3442549 alt:154.2
tracker4 | lat:7.879182 lon:98.395465 alt:0.0
tracker9 | lat:39.968602575 lon:116.31385513 alt:465.491286889239
tracker7 | lat:30.4783999 lon:114.3582656 alt:144.4
tracker8 | lat:39.266415 lon:113.579292 alt:3594.0
tracker1 | lat:39.98119 lon:116.32911 alt:152.0
tracker5 | lat:40.0138599 lon:116.3446366 alt:154.2
tracker2 | lat:39.968773 lon:116.314088 alt:237.0
tracker5 | lat:40.0138483 lon:116.3447549 alt:154.2
tracker2 | lat:39.96883 lon:116.314033 alt:238.0
tracker7 | lat:30.4785433 lon:114.3582649 alt:144.4
tracker1 | lat:39.981182 lon:116.329089 alt:152.0
tracker5 | lat:40.0138466 lon:116.3448766 alt:154.2
tracker2 | lat:39.968891 lon:116.314021 alt:240.0
tracker8 | lat:39.266462 lon:113.579194 alt:3494.0
tracker5 | lat:40.0138416 lon:116.344895 alt:154.2
tracker2 | lat:39.968907 lon:116.314013 alt:243.0
tracker7 | lat:30.4786799 lon:114.3582683 alt:144.4
tracker1 | lat:39.981181 lon:116.329077 alt:151.0
tracker5 | lat:40.0138383 lon:116.3451099 alt:154.2
tracker9 | lat:39.968881428 lon:116.31413551 alt:454.477375328884
tracker2 | lat:39.969055 lon:116.313993 alt:248.0
tracker5 | lat:40.0138349 lon:116.3452233 alt:154.2
tracker2 | lat:39.969146 lon:116.313962 alt:252.0
tracker7 | lat:30.4788199 lon:114.3582649 alt:144.4
tracker1 | lat:39.981181 lon:116.329051 alt:151.0
tracker5 | lat:40.0138299 lon:116.3453283 alt:154.2
tracker2 | lat:39.969221 lon:116.313931 alt:258.0
tracker5 | lat:40.0138233 lon:116.3454216 alt:154.2

```

GPS GUI

GPS Management

Last Tracker Updated

Tracker5, 40.0138233, 116.3454216, 07/11/2022 02:29:13

All Trackers	Distances	Filtered List
Tracker0 Latitude: 39.977643 Longitude: 116.327703	Distance travelled by Tracker0: 0.0m	Distance travelled by Tracker1: 0.0m
Tracker1 Latitude: 39.981181 Longitude: 116.329051		
Tracker2 Latitude: 39.969221 Longitude: 116.313931	Distance travelled by Tracker2: 0.0m	Distance travelled by Tracker2: 0.0m
Tracker3 Latitude: 39.965723 Longitude: 116.319246		
Tracker4 Latitude: 7.879182 Longitude: 98.395465	Distance travelled by Tracker4: 0.0m	Distance travelled by Tracker5: 168.0m
Tracker5 Latitude: 40.0138233 Longitude: 116.3454216		Tracker5 Latitude: 40.0138233 Longitude: 116.3454216
Tracker6 Latitude: 39.859393 Longitude: 116.2574083	Distance travelled by Tracker6: 8.0m	Distance travelled by Tracker7: 0.0m
Tracker7 Latitude: 30.4788199 Longitude: 114.3582649		
Tracker8 Latitude: 39.266462 Longitude: 113.579194	Distance travelled by Tracker8: 43.0m	Distance travelled by Tracker9: 0.0m
Tracker9 Latitude: 39.968881428 Longitude: 116.31413551		

Longitude/Latitude Control Panel

Minimum Latitude

40

40

Maximum Latitude

90

90

Minimum Longitude

-180

-180

Maximum Longitude

180

180

Set Defined Range

Section 4 + 5 Filtered List and Control Panel (Point 3)

Section 4 and 5 correspond to point 3 where the requirements for testing were that the defined range is controlled by a control panel consisting of a latitude input field and a longitude input field and a button to set this restriction.

As we can see there are the input fields of the minimum and maximum latitude and longitudes. The labels show the current setting of the restriction.

GPS GUI

GPS Management

Last Tracker Updated

Tracker8, 39.265255, 113.574234, 07/11/2022 02:33:19

All Trackers

Tracker0 Latitude: 39.97541 Longitude: 116.329522

Tracker1 Latitude: 39.98099 Longitude: 116.329158

Tracker2 Latitude: 39.969906 Longitude: 116.313603

Tracker3 Latitude: 39.965723 Longitude: 116.319246

Tracker4 Latitude: 7.881982 Longitude: 98.395303

Tracker5 Latitude: 40.0090199 Longitude: 116.3461016

Tracker6 Latitude: 39.8593933 Longitude: 116.2574083

Tracker7 Latitude: 30.4786783 Longitude: 114.3551716

Tracker8 Latitude: 39.265255 Longitude: 113.574234

Tracker9 Latitude: 39.984522857 Longitude: 116.323522032

Distances

Distance travelled by Tracker0: 456.0m Distance travelled by Tracker1: 72.0m

Distance travelled by Tracker2: 245.0m Distance travelled by Tracker3: 0.0m

Distance travelled by Tracker4: 328.0m Distance travelled by Tracker5: 722.0m

Distance travelled by Tracker6: 8.0m Distance travelled by Tracker7: 490.0m

Distance travelled by Tracker8: 581.0m Distance travelled by Tracker9: 1157....

Filtered List

Tracker0 Latitude: 39.97541 Longitude: 116.329522

Tracker1 Latitude: 39.98099 Longitude: 116.329158

Tracker2 Latitude: 39.969906 Longitude: 116.313603

Tracker3 Latitude: 39.965723 Longitude: 116.319246

Tracker4 Latitude: 7.881982 Longitude: 98.395303

Tracker5 Latitude: 40.0090199 Longitude: 116.3461016

Tracker6 Latitude: 39.8593933 Longitude: 116.2574083

Tracker7 Latitude: 30.4786783 Longitude: 114.3551716

Tracker8 Latitude: 39.265255 Longitude: 113.574234

Tracker9 Latitude: 39.984522857 Longitude: 116.323522032

Longitude/Latitude Control Panel

Minimum Latitude

-90

-90

Maximum Latitude

90

90

Minimum Longitude

-180

-180

Maximum Longitude

180

180

Set Defined Range

To test the normal use of this application, we can choose a tracker to filter out. For example, choosing to filter by latitude to show tracker4 as it is around 7 compared which is different from the others:

GPS GUI

GPS Management

Last Tracker Updated

Tracker5, 40.0084366, 116.36931, 07/11/2022 02:37:36

All Trackers

Tracker0 Latitude: 39.981118 Longitude: 116.327676

Tracker1 Latitude: 39.980954 Longitude: 116.329165

Tracker2 Latitude: 39.977755 Longitude: 116.310714

Tracker3 Latitude: 39.966233 Longitude: 116.325571

Tracker4 Latitude: 7.883777 Longitude: 98.392853

Tracker5 Latitude: 40.0084366 Longitude: 116.36931

Tracker6 Latitude: 39.86359 Longitude: 116.25997

Tracker7 Latitude: 30.4783849 Longitude: 114.3443683

Tracker8 Latitude: 39.23975 Longitude: 113.56449

Tracker9 Latitude: 39.986524521 Longitude: 116.384629129

Distances

Distance travelled by Tracker0: 964.0m Distance travelled by Tracker1: 108.0m

Distance travelled by Tracker2: 1046.0m Distance travelled by Tracker3: 0.0m

Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 2718.0m

Distance travelled by Tracker6: 143.0m Distance travelled by Tracker7: 1451.0m

Distance travelled by Tracker8: 2749.0m Distance travelled by Tracker9: 4539.0m

Filtered List

Tracker4 Latitude: 7.882574 Longitude: 98.395302

Longitude/Latitude Control Panel

Minimum Latitude

6

6

Maximum Latitude

8

8

Minimum Longitude

-180

-180

Maximum Longitude

180

180

Set Defined Range

We can see the other trackers disappear as they are not in the range of the control panel.

If we want to filter based on longitude, we can choose the trackers that fit in the 116 range.

GPS GUI

GPS Management

Last Tracker Updated

Tracker6, 39.8640149, 116.2675833, 07/11/2022 02:38:42

All Trackers

Tracker0 Latitude: 39.983062 Longitude: 116.327696

Tracker1 Latitude: 39.980699 Longitude: 116.329225

Tracker2 Latitude: 39.978389 Longitude: 116.311217

Tracker3 Latitude: 39.96629 Longitude: 116.341363

Tracker4 Latitude: 7.883777 Longitude: 98.392853

Tracker5 Latitude: 40.0084399 Longitude: 116.3798883

Tracker6 Latitude: 39.8640149 Longitude: 116.2675833

Tracker7 Latitude: 30.4790833 Longitude: 114.3403016

Tracker8 Latitude: 39.229432 Longitude: 113.573953

Tracker9 Latitude: 39.987052903 Longitude: 116.400773349

Distances

Distance travelled by Tracker0: 964.0m Distance travelled by Tracker1: 74.0m

Distance travelled by Tracker2: 1017.0m Distance travelled by Tracker3: 1894.0m

Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 2950.0m

Distance travelled by Tracker6: 1185.0m Distance travelled by Tracker7: 1319.0m

Distance travelled by Tracker8: 4810.0m Distance travelled by Tracker9: 6097.0m

Filtered List

Tracker0 Latitude: 39.983062 Longitude: 116.327696

Tracker1 Latitude: 39.980699 Longitude: 116.329225

Tracker2 Latitude: 39.978389 Longitude: 116.311217

Tracker3 Latitude: 39.96629 Longitude: 116.341363

Tracker5 Latitude: 40.0084399 Longitude: 116.3798883

Tracker6 Latitude: 39.8640149 Longitude: 116.2675833

Tracker9 Latitude: 39.987052903 Longitude: 116.400773349

Longitude/Latitude Control Panel

Minimum Latitude

-90

-90

Maximum Latitude

90

90

Minimum Longitude

115

115

Maximum Longitude

117

117

Set Defined Range

As can be seen, this example test shows that the control panel works.

Edge Case / Error Handling:

To test that the values do not go over the minimum and maximum values of -90, 90 and -180, 180 for latitude and longitude respectively, we try setting the defined range over.

GPS GUI

GPS Management

Last Tracker Updated

Tracker2, 39.973312, 116.312039, 07/11/2022 02:34:09

All Trackers

Tracker0 Latitude: 39.975442 Longitude: 116.328011

Tracker1 Latitude: 39.980975 Longitude: 116.329108

Tracker2 Latitude: 39.973312 Longitude: 116.312039

Tracker3 Latitude: 39.965723 Longitude: 116.319246

Tracker4 Latitude: 7.882574 Longitude: 98.395302

Tracker5 Latitude: 40.0064949 Longitude: 116.3462133

Tracker6 Latitude: 39.8593933 Longitude: 116.2574083

Tracker7 Latitude: 30.4786266 Longitude: 114.3513233

Tracker8 Latitude: 39.262215 Longitude: 113.568993

Tracker9 Latitude: 39.985068614 Longitude: 116.336193258

Distances

Distance travelled by Tracker0: 553.0m Distance travelled by Tracker1: 80.0m

Distance travelled by Tracker2: 470.0m Distance travelled by Tracker3: 0.0m

Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 992.0m

Distance travelled by Tracker6: 8.0m Distance travelled by Tracker7: 767.0m

Distance travelled by Tracker8: 976.0m Distance travelled by Tracker9: 1996....

Filtered List

Longitude/Latitude Control Panel

Minimum Latitude -9012389 -90

Maximum Latitude 2948924 90

Minimum Longitude -394084 -180

Maximum Longitude 893434 180

Set Defined Range

We can see that it doesn't register anything because it goes over the limit. Only registering the -90, 90, -180, and 180.

We can also test that the minimum can't go over the maximum and will be limited.

For example, in this case:

GPS GUI

GPS Management

Last Tracker Updated

Tracker1, 39.980906, 116.329071, 07/11/2022 02:35:54

All Trackers

Tracker0 Latitude: 39.977563 Longitude: 116.327712
Tracker1 Latitude: 39.980906 Longitude: 116.329071
Tracker2 Latitude: 39.976139 Longitude: 116.310998
Tracker3 Latitude: 39.965723 Longitude: 116.319246
Tracker4 Latitude: 7.883777 Longitude: 98.392853
Tracker5 Latitude: 40.0081066 Longitude: 116.3621966
Tracker6 Latitude: 39.8594983 Longitude: 116.2581566
Tracker7 Latitude: 30.4783099 Longitude: 114.3456299
Tracker8 Latitude: 39.254969 Longitude: 113.556287
Tracker9 Latitude: 39.985836004 Longitude: 116.359494582

Distances

Distance travelled by Tracker0: 821.0m Distance travelled by Tracker1: 101.0m

Distance travelled by Tracker2: 1026.... Distance travelled by Tracker3: 0.0m

Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 2373....

Distance travelled by Tracker6: 77.0m Distance travelled by Tracker7: 1420....

Distance travelled by Tracker8: 2567.... Distance travelled by Tracker9: 4225....

Filtered List

Tracker0 Latitude: 39.977563 Longitude: 116.327712
Tracker1 Latitude: 39.980906 Longitude: 116.329071
Tracker2 Latitude: 39.976139 Longitude: 116.310998
Tracker3 Latitude: 39.965723 Longitude: 116.319246
Tracker4 Latitude: 7.882574 Longitude: 98.395302
Tracker5 Latitude: 40.0081066 Longitude: 116.3621966
Tracker6 Latitude: 39.8594983 Longitude: 116.2581566
Tracker7 Latitude: 30.4783099 Longitude: 114.3456299
Tracker8 Latitude: 39.254969 Longitude: 113.556287
Tracker9 Latitude: 39.985836004 Longitude: 116.359494582

Longitude/Latitude Control Panel

Minimum Latitude

-90

-90

Maximum Latitude

50

50

Minimum Longitude

-180

-180

Maximum Longitude

180

180

Set Defined Range

If we try and set minimum latitude to be larger than 51, we are capped at 50 instead.

GPS GUI

GPS Management

Last Tracker Updated

Tracker7, 30.4785266, 114.3454616, 07/11/2022 02:36:11

All Trackers

Tracker0 Latitude: 39.978636 Longitude: 116.327796
Tracker1 Latitude: 39.980958 Longitude: 116.329098
Tracker2 Latitude: 39.976287 Longitude: 116.310974
Tracker3 Latitude: 39.965723 Longitude: 116.319246
Tracker4 Latitude: 7.883777 Longitude: 98.392853
Tracker5 Latitude: 40.0082549 Longitude: 116.3664616
Tracker6 Latitude: 39.8596299 Longitude: 116.2589083
Tracker7 Latitude: 30.4785266 Longitude: 114.3454616
Tracker8 Latitude: 39.253431 Longitude: 113.5573
Tracker9 Latitude: 39.98600197 Longitude: 116.364494719

Distances

Distance travelled by Tracker0: 964.0m Distance travelled by Tracker1: 108.0m

Distance travelled by Tracker2: 1046.0m Distance travelled by Tracker3: 0.0m

Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 2718.0m

Distance travelled by Tracker6: 143.0m Distance travelled by Tracker7: 1451.0m

Distance travelled by Tracker8: 2749.0m Distance travelled by Tracker9: 4539.0m

Filtered List

Longitude/Latitude Control Panel

Minimum Latitude

51

50

Maximum Latitude

50

50

Minimum Longitude

-180

-180

Maximum Longitude

180

180

Set Defined Range

With the filter list not updating due to the invalid format.

Testing the 5 minute Window: Quick Test

A quick test can be performed to see if there is indeed a window by seeing if there is a fluctuation both upwards and downwards of the distances after 5 minutes.

GPS GUI

GPS Management
Last Tracker Updated

Tracker3, 39.967101, 116.388015, 07/11/2022 02:43:34

All Trackers

Tracker0 Latitude: 39.991152 Longitude: 116.327038
Tracker1 Latitude: 39.980802 Longitude: 116.329071
Tracker2 Latitude: 39.989014 Longitude: 116.309623
Tracker3 Latitude: 39.967101 Longitude: 116.388015
Tracker4 Latitude: 7.908411 Longitude: 98.391283
Tracker5 Latitude: 40.0204799 Longitude: 116.4259133
Tracker6 Latitude: 39.82927 Longitude: 116.2873149
Tracker7 Latitude: 30.4935549 Longitude: 114.3342333
Tracker8 Latitude: 39.188761 Longitude: 113.616594
Tracker9 Latitude: 39.980934418 Longitude: 116.446302328

Distances

Distance travelled by Tracker0: 1109.0m Distance travelled by Tracker1: 96.0m
Distance travelled by Tracker2: 1319.0m Distance travelled by Tracker3: 4148.0m
Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 5838.0m
Distance travelled by Tracker6: 5021.0m Distance travelled by Tracker7: 1319.0m
Distance travelled by Tracker8: 6141.0m Distance travelled by Tracker9: 4328.0m

Filtered List

Tracker0 Latitude: 39.991152 Longitude: 116.327038
Tracker1 Latitude: 39.980802 Longitude: 116.329071
Tracker2 Latitude: 39.989014 Longitude: 116.309623
Tracker3 Latitude: 39.967101 Longitude: 116.388015
Tracker4 Latitude: 7.882574 Longitude: 98.395302
Tracker5 Latitude: 40.0204799 Longitude: 116.4259133
Tracker6 Latitude: 39.82927 Longitude: 116.2873149
Tracker7 Latitude: 30.4789433 Longitude: 114.3413466
Tracker8 Latitude: 39.188761 Longitude: 113.616594
Tracker9 Latitude: 39.980934418 Longitude: 116.446302328

Longitude/Latitude Control Panel

Minimum Latitude
Maximum Latitude
Minimum Longitude
Maximum Longitude

-90
90
-180
180

-90
90
-180
180

Set Defined Range

GPS GUI

GPS Management
Last Tracker Updated

Tracker3, 39.967156, 116.389785, 07/11/2022 02:43:43

All Trackers

Tracker0 Latitude: 39.991236 Longitude: 116.327038
Tracker1 Latitude: 39.980792 Longitude: 116.329067
Tracker2 Latitude: 39.989218 Longitude: 116.309724
Tracker3 Latitude: 39.967156 Longitude: 116.389785
Tracker4 Latitude: 7.908411 Longitude: 98.391283
Tracker5 Latitude: 40.0204099 Longitude: 116.4284666
Tracker6 Latitude: 39.829245 Longitude: 116.2892683
Tracker7 Latitude: 30.4941733 Longitude: 114.3343833
Tracker8 Latitude: 39.186807 Longitude: 113.617516
Tracker9 Latitude: 39.980774646 Longitude: 116.446556576

Distances

Distance travelled by Tracker0: 1097.0m Distance travelled by Tracker1: 95.0m
Distance travelled by Tracker2: 1344.0m Distance travelled by Tracker3: 4116.0m
Distance travelled by Tracker4: 394.0m Distance travelled by Tracker5: 6029.0m
Distance travelled by Tracker6: 5067.0m Distance travelled by Tracker7: 1830.0m
Distance travelled by Tracker8: 6372.0m Distance travelled by Tracker9: 4133.0m

Filtered List

Tracker0 Latitude: 39.991236 Longitude: 116.327038
Tracker1 Latitude: 39.980792 Longitude: 116.329067
Tracker2 Latitude: 39.989218 Longitude: 116.309724
Tracker3 Latitude: 39.967156 Longitude: 116.389785
Tracker4 Latitude: 7.882574 Longitude: 98.395302
Tracker5 Latitude: 40.0204099 Longitude: 116.4284666
Tracker6 Latitude: 39.829245 Longitude: 116.2892683
Tracker7 Latitude: 30.4941733 Longitude: 114.3343833
Tracker8 Latitude: 39.186807 Longitude: 113.617516
Tracker9 Latitude: 39.980774646 Longitude: 116.446556576

Longitude/Latitude Control Panel

Minimum Latitude
Maximum Latitude
Minimum Longitude
Maximum Longitude

-90
90
-180
180

-90
90
-180
180

Set Defined Range

Which can be observed as so, with multiple trackers going down and some going up.

Complex Test

A more complex test would be to create a modification to the application as follows:

```
double tempDistTravelled = 0.0;
for (int i = 0; i < rollingWindow0.size(); i++) {
    if (rollingWindow0.get(i).timeAdded > ((ZonedDateTime.now().toInstant().toEpochMilli()
        - 60000)) {
        tempDistTravelled += rollingWindow0.get(i).distanceTravelled;
    }
}
```

Time window only 1 minute

```
s.listen((GpsEvent ev) -> {
    for (int i=0; i < rollingWindow0.size(); i++) {
        System.out.print(i + " + rollingWindow0.get(i).timeAdded+ " , " + rollingWindow0.get(i).distanceTravelled + " | ");
    }
    System.out.println();
}
```

And a different output for tracker 0

The screenshot shows a Java application running in an IDE. The main window displays a list of trackers and their distances traveled. The trackers are listed in a table with columns for Tracker ID, Latitude, Longitude, and Distance traveled. The distances are shown in meters. The application is running on a Windows operating system, and the IDE is showing the source code of the application. The console output window displays a large number of data points, which are the results of the application's execution. The data points are formatted as follows: `TrackerID, Latitude, Longitude, Distance traveled, TrackerID, Latitude, Longitude, Distance traveled`. The data points are displayed in a single line, separated by commas. The application is running on a Windows operating system, and the IDE is showing the source code of the application. The console output window displays a large number of data points, which are the results of the application's execution. The data points are formatted as follows: `TrackerID, Latitude, Longitude, Distance traveled, TrackerID, Latitude, Longitude, Distance traveled`.

+1667752348039,360.1951483730798 | +1667752350051,3.2183154962730525 | +
 1667752352063,9.830530873526278 | +1667752353071,10.961298349330937 | +
 1667752355080,2.9371446044995113 | +1667752357091,4.9443485688851 | +
 1667752359105,5.036990148609137 | +1667752361118,5.28158888447998 | +
 1667752363130,8.20533625745878 | +1667752365133,6.679539870765282 | +
 1667752367142,7.106420773833122 | +1667752369143,7.339004231364292 | +
 1667752371158,5.771824255509578 | | 1667752373168,6.406774824764444 | |
 1667752375181,5.83262669464843 | | 1667752377193,5.925411483731974 | |
 1667752379208,4.433683100499241 | | 1667752381218,3.5350589969025057 | |
 1667752383230,2.0857625938823845 | | 1667752385247,6.717325408744724 | |
 1667752387256,3.867986107804981 | | 1667752389258,5.229830918695513 | |
 1667752391271,4.509404530954889 | | 1667752393274,4.667853283462812 | |
 1667752395288,5.742005778495553 | | 1667752397292,4.207917393099646 | |
 1667752399294,3.9916782804948774 | | 1667752401308,4.320995173007556 | |
 1667752403311,4.613180528152743 | | 1667752405326,5.2162002585200415 | |
 1667752407339,11.640502786701365 | | 1667752409346,6.266414942742005 | |

1667752411356 ,11.219997813281138 | | 1667752413370 ,4.962318929278752 | |
 1667752415385 ,7.273207447539779 | | 1667752417397 ,6.643957550882826 | |
 1667752419407 ,6.399512124687645 | | 1667752421415 ,5.086019691205874 | |
 1667752423426 ,4.643813202357686 | | 1667752425442 ,9.644229710307455 | |
 1667752427455 ,4.591350680720192 | | 1667752429469 ,4.78370085

This meant these sections were the ones added up they would equal ~171

5.7718243		
6.4067748		
5.8326267		
5.9254115		
4.4336831		
3.535059		
2.0857626		
6.7173254		
3.8679861		
5.2298309		
4.5094045		
4.6678533		
5.7420058		
4.2079174		
3.9916783		
4.3209952		
4.6131805		
5.2162003		
11.640503		
6.2664149		
11.219998		
4.9623189		
7.2732074		
6.6439576		
6.3995121		
5.0860197		
4.6438132		
9.6442297		
4.5913507	SUM	
4.7837009	170.2305	

Which is correct when rounding up 170.2305

Meaning that the 1 minute = 60,000 UNIX millisecond window works, which can be generalized to the $5 * 60,000 = 30,000$ UNIX millisecond time window.