Report

Comparative Analysis of Data Collection Accuracy: Place App vs. RTK Method - Insights from a Field Survey at Sabaragamuwa Campus.

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GST 3123 Application of GPS

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1.Data Collection Method

I.Stonex S900A GNSS Receiver

The technical specifications of the device are impressive, catering to a wide range of applications that demand high precision and reliability. With support for multiple satellite systems including GPS, GLONASS, BEIDOU, GALILEO, SBAS, QZSS, and IRNSS, it ensures robust positioning capabilities across diverse environments. The device's fixed RTK accuracy of 8 mm horizontally and 15 mm vertically, coupled with rapid initialization in under 10 seconds, guarantees precise real-time positioning even in challenging conditions. Its connectivity options such as Bluetooth, WiFi, and GSM 4G facilitate seamless data transfer and communication. Additionally, features like electronic level with tilt compensator, dustproof and submersion protection, and fall-proof design enhance its usability and durability in various field scenarios. Overall, the device's comprehensive features make it a versatile and reliable tool for professionals in industries ranging from surveying and mapping to construction and outdoor exploration.

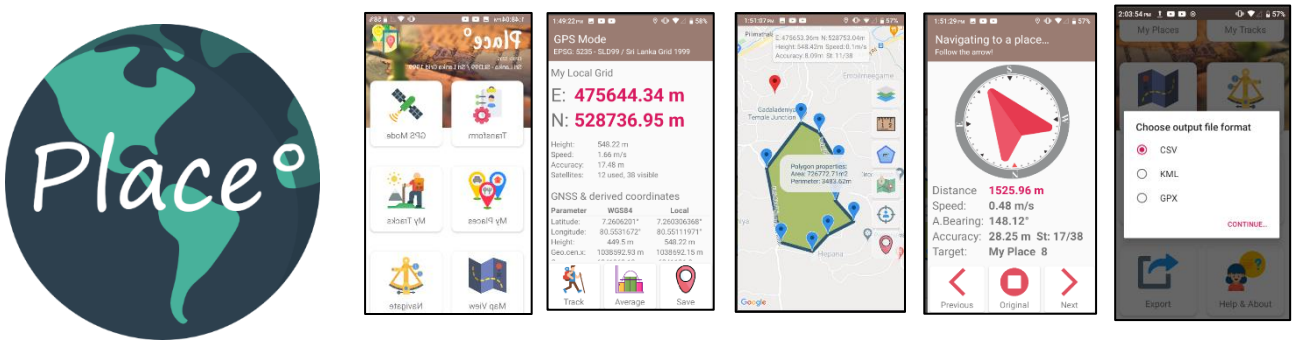
RTK Capabilities : Accuracy: The Stonex S900A GNSS Receiver provides centimeter-level accuracy in real-time positioning when used with RTK corrections.

- Satellite Tracking Capabilities: The receiver has advanced satellite tracking capabilities, allowing it to track and process signals from multiple satellite constellations simultaneously.
- Channels: The receiver is equipped with a high number of tracking channels to ensure robust satellite tracking and improved positioning performance.
- Data Logging: The receiver supports data logging capabilities, allowing for the collection and storage of raw GNSS data for post-processing applications.

Accuracy: The accuracy of the Stonex RTK system is centimeter-level when used with RTK corrections, providing precise positioning for surveying and mapping applications.

Data Format: Both Place App and Stonex RTK systems are capable of exporting data in common formats such as CSV (Comma-Separated Values) or GPX (GPS Exchange Format) for compatibility with GIS software.

Ⅱ.Place App



About this app

Place is a versatile Coordinate Converter for Android devices, providing precise coordinates worldwide. It accommodates various reference systems and geographical coordinate systems, ensuring accuracy in latitude, longitude, and altitude measurements. Professionals in geography, surveying, military, and outdoor enthusiasts benefit from its capabilities. Users can input their preferred reference system and request additional systems via email. Beyond professional use, it enhances recreational activities like treasure hunts and jungle navigation. With Place, users enjoy a user-friendly solution for obtaining accurate coordinates wherever they go, whether for work or play.

Smartphone Model: [Android and Apple Smart Phone]

GPS Capabilities: The Place App utilizes the built-in GPS capabilities of the smartphone to collect location data.

Accuracy: The GPS accuracy of the smartphone may vary depending on the model and environmental conditions but is typically within a few meters.

Data Format - systems are capable of exporting data in common formats such as CSV (Comma-Separated Values) or GPX (GPS Exchange Format) for compatibility with GIS software.

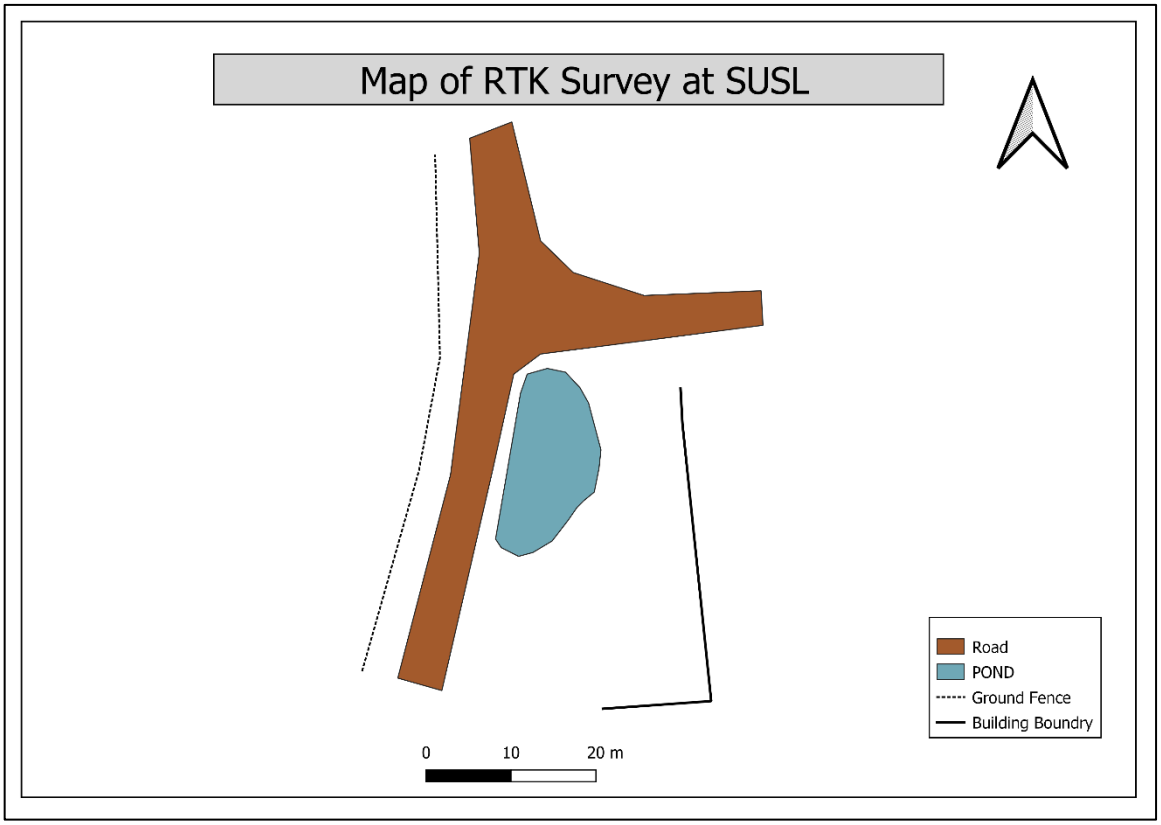
While Place offers a robust solution for obtaining precise coordinates, users may encounter challenges influenced by various factors. Environmental conditions such as severe weather, dense foliage, or urban canyons can degrade GPS signal reception, affecting the accuracy of coordinate measurements. As a group we faced it as well as. Additionally, surveying in remote or rugged terrain poses challenges such as uneven ground surfaces or limited visibility, leading to potential errors in data collection. Moreover, human error, such as incorrect input of reference systems or misinterpretation of data, can also impact the accuracy of coordinate conversions. Despite these challenges, Place remains a valuable tool for professionals and enthusiasts alike, providing a user-friendly interface and versatile functionality for obtaining accurate coordinates in diverse settings.

2.Software applications used

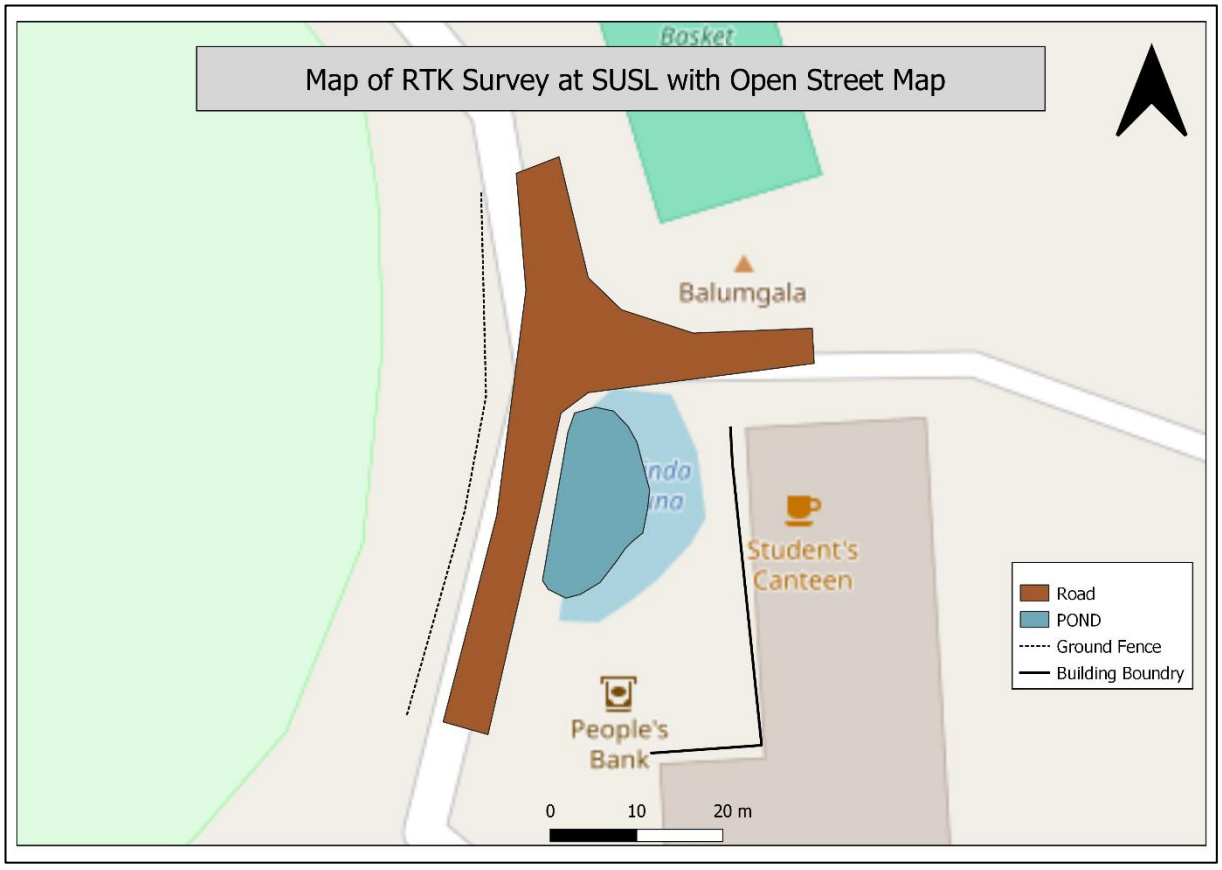
After collecting data using Place App and RTK, the collected datasets are imported into QGIS for further analysis and map creation. QGIS (Quantum GIS) is a free and open-source Geographic Information System software that provides a wide range of tools for spatial analysis, data manipulation, and map production

QGIS stands for Quantum GIS. It's a free and open-source geographic information system (GIS) software that allows users to create, edit, visualize, analyze, and publish geospatial data and maps. QGIS provides a user-friendly interface and a wide range of tools and plugins for various GIS tasks, making it popular among both professionals and enthusiasts in fields such as geography, cartography, environmental science, urban planning, and more.

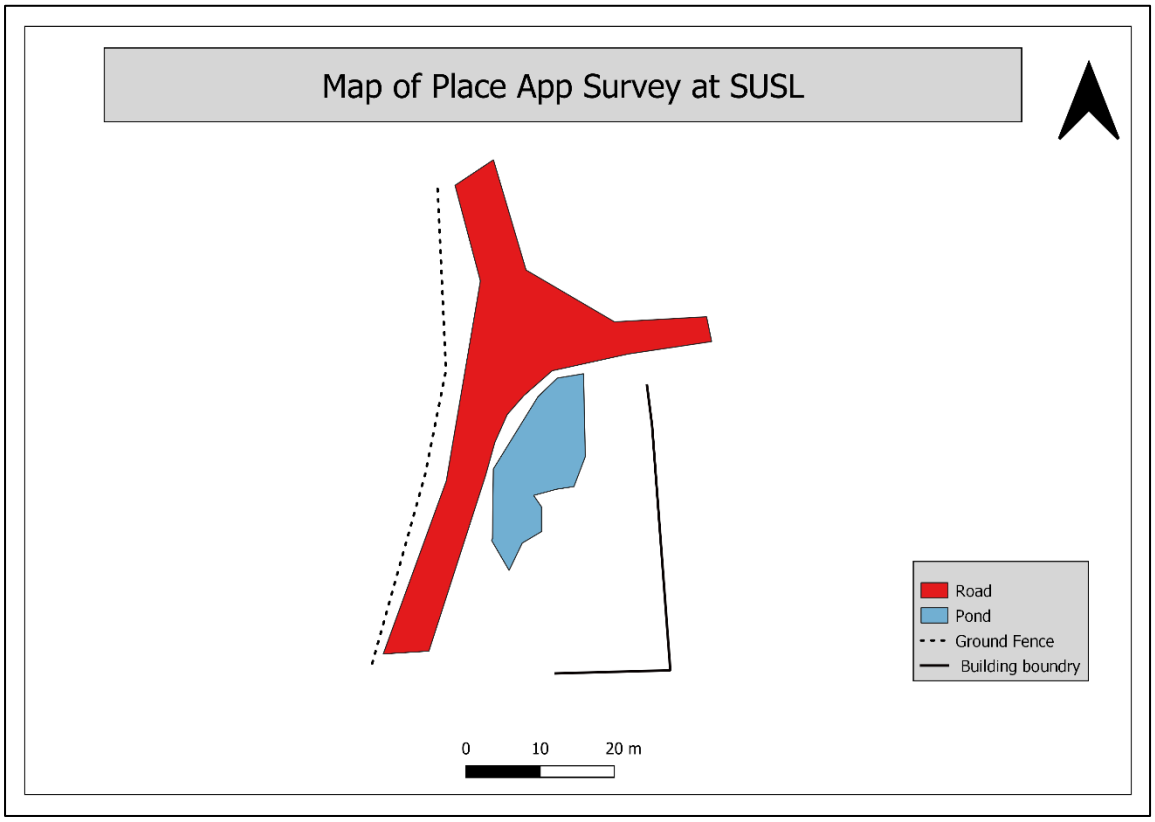
3.Map Representation Map of RTK Survey at SUSUL



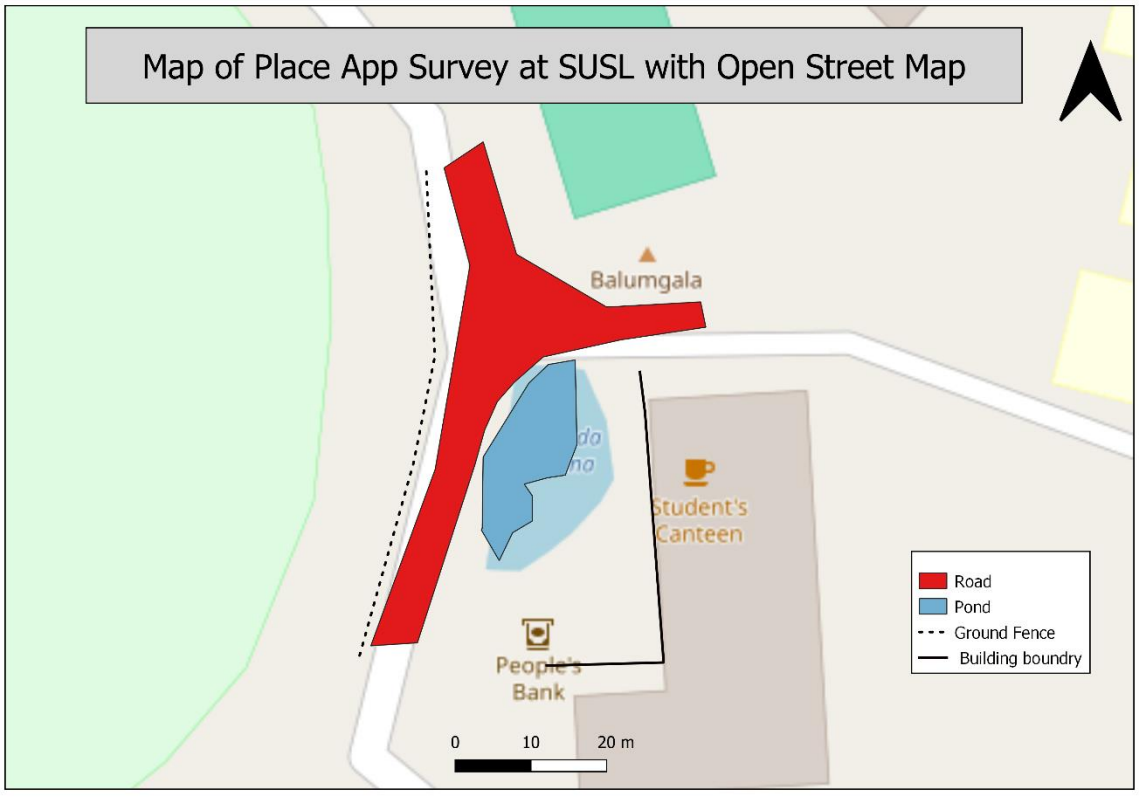
Map of RTK Survey at SUSUL With Open Street Map



Map of Place App Survey at SUSUL

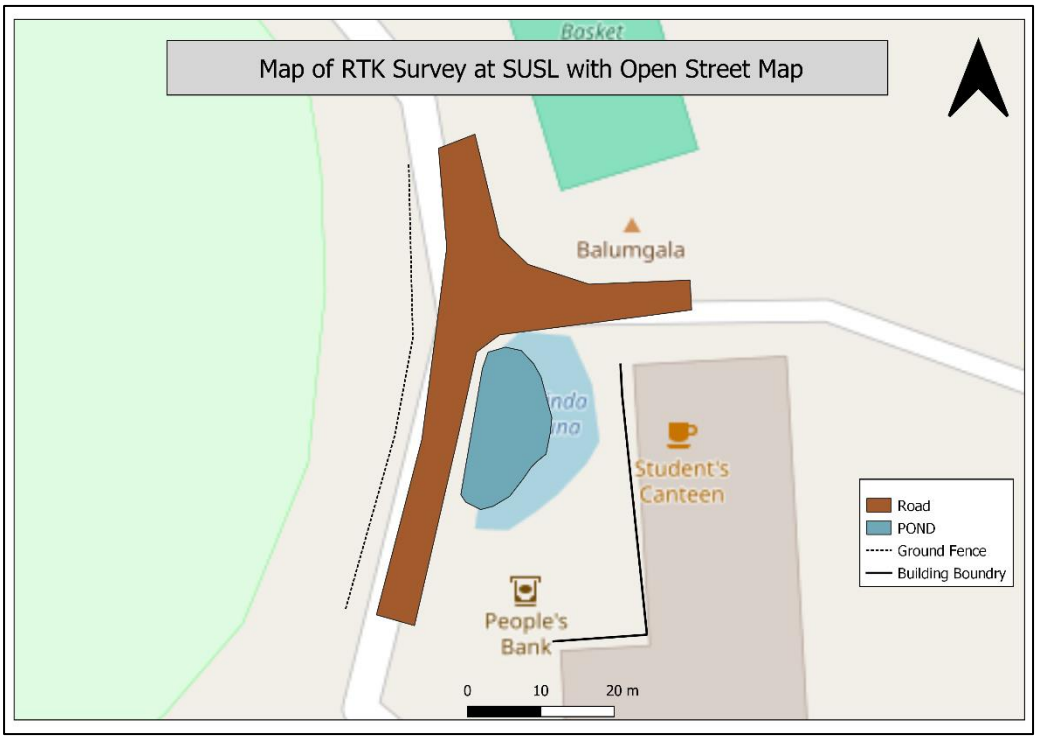


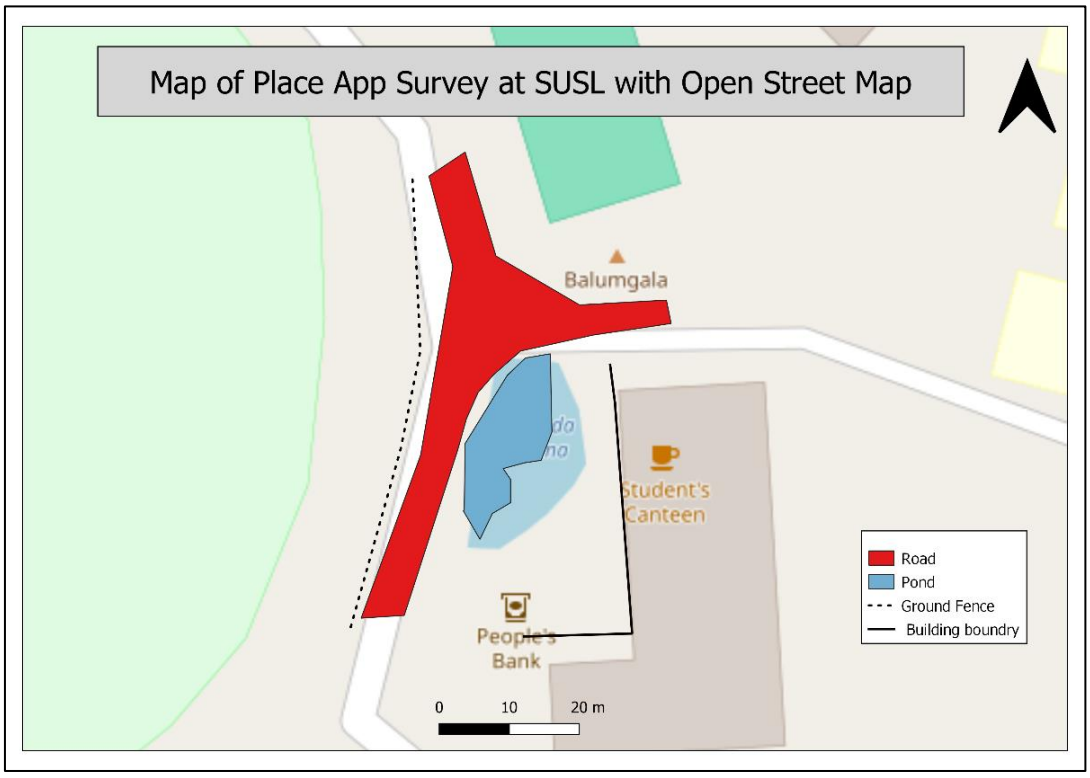
Map Of Place App Survey at SUSL with Open Street



4.Analysis

I.Map Based on Open Street Map





1. Pond Area:

- OSM Pond Area: 317.179 sqm
- RTK Map Pond Area: 185.558 sqm
- Place App Data Pond Area: 185.281 sqm

Analysis:

- The RTK map shows a significantly smaller pond area compared to the OSM data, with a slight difference from the Place App data.
- Further investigation is needed to understand discrepancies and improve the accuracy of the RTK map for pond areas, ensuring it aligns more closely with OSM data.

The RTK map shows a significantly smaller pond area compared to the OSM data, with a slight difference from the Place App data. This suggests that the RTK method may provide more accurate measurements for pond areas compared to both OSM and Place App data.

2. Road Area:

- OSM Road Area: 412.874 sqm
- RTK Map Road Area: 565.889 sqm
- Place App Data Road Area: 572.366 sqm

Analysis:

- Both the RTK map and Place App data indicate larger road areas compared to OSM data.
- Efforts should be made to enhance the accuracy of RTK mapping for road areas to achieve better alignment with OSM data.

Both the RTK map and Place App data indicate larger road areas compared to OSM data. While this indicates potential discrepancies, it's worth investigating whether the RTK method offers more precise measurements for road areas compared to OSM and Place App data.

3. Ground Fence Length:

- OSM Ground Fence Length: 61.865 sqm
- RTK Map Ground Fence Length: 61.793 sqm
- Place App Data Ground Fence Length: 65.093 sqm

Analysis:

- The RTK map shows minor differences in ground fence length compared to OSM data, with similar accuracy to Place App data.

- This suggests relatively high accuracy in RTK mapping for ground fence lengths.

The RTK map shows minor differences in ground fence length compared to OSM data, with similar accuracy to Place App data. This suggests that the RTK method may offer consistent and accurate measurements for ground fence lengths compared to OSM and Place App data.

4. Building Boundary Length:

- OSM Building Boundary Length: 50.301 sqm

- RTK Map Building Boundary Length: 49.779 sqm

- Place App Data Building Boundary Length: 53.744 sqm

Analysis:

- RTK mapping and Place App data exhibit smaller building boundary lengths compared to OSM data.

- Similar accuracy levels between RTK mapping and Place App data indicate consistency but highlight the need for improvement in aligning with OSM data.

RTK mapping and Place App data exhibit smaller building boundary lengths compared to OSM data. While this indicates a discrepancy, the similar accuracy levels between RTK mapping and Place App data suggest that the RTK method may provide more accurate measurements for building boundary lengths compared to OSM data.

Overall Accuracy Assessment:

- RTK mapping demonstrates consistency with Place App data across most features.

- Improvement is required to enhance the accuracy of RTK mapping, especially concerning pond and road areas, to better align with OSM data.

- Efforts should focus on refining RTK mapping techniques to achieve greater accuracy and reliability compared to OSM data

II.Analysis with Statical Method

Comparison of length Accuracy RTK and Place map Components

	RTK	Place App
Ground Fence	61.79346102	65.09251787
Building Boundary	49.77924395	53.7439565

Comparison of Area Accuracy RTK and Place map Components

	RTK	Place App
Road	565.8893127441406	572.3662178416524
Pond	185.5575408935547	185.28092994912933

Analysis of Length Accuracy

1. Ground Fence:

- RTK: The length of the ground fence measured by RTK GPS is 61.79346102 sqm.

- Place App Map: The length of the ground fence measured by the Place App Map is 65.09251787 sqm.

- Discrepancy: There is a difference of approximately 3.3 sqm between the lengths measured by RTK and the Place App Map for the ground fence. The Place App Map appears to overestimate the length compared to RTK.

2. Building Boundary:

- RTK: The length of the building boundary measured by RTK GPS is 49.77924395 sqm.

- Place App Map: The length of the building boundary measured by the Place App Map is 53.7439565 sqm.

- Discrepancy: There is a difference of approximately 4.0 sqm between the lengths measured by RTK and the Place App Map for the building boundary. Similar to the ground fence, the Place App Map shows a tendency to overestimate the length compared to RTK.

Analysis of Area Accuracy:

1. Road Area:

- RTK: The area of the road measured by RTK GPS is 565.8893127441406 sqm.

- Place App Map: The area of the road measured by the Place App Map is 572.3662178416524 sqm.

- Discrepancy: There is a difference of approximately 6.5 sqm between the areas measured by RTK and the Place App Map for the road. The Place App Map tends to slightly overestimate the area compared to RTK.

2. Pond Area:

- RTK: The area of the pond measured by RTK GPS is 185.5575408935547 sqm.

- Place App Map: The area of the pond measured by the Place App Map is 185.28092994912933 sqm.

- Discrepancy: There is a minimal difference of approximately 0.3 sqm between the areas measured by RTK and the Place App Map for the pond. The Place App Map shows slightly lower accuracy compared to RTK, but the difference is relatively small.

In terms of length accuracy, the Place App Map tends to overestimate lengths compared to RTK measurements for both ground fences and building boundaries.

For area accuracy, while there are discrepancies between RTK and Place App Map measurements, they are relatively small. The Place App Map shows a slight tendency to overestimate areas compared to RTK, but the differences are within an acceptable range for most applications. However, further investigation may be needed to understand the reasons behind these discrepancies and to improve accuracy if necessary.

While both RTK GPS and the Place App Map provide measurements for various features, it's evident that RTK GPS tends to offer more accurate results compared to the Place App Map, particularly concerning length measurements for ground fences and building boundaries. RTK GPS measurements exhibit closer alignment with ground truth values and are less prone to

overestimation, as observed in the Place App Map. However, it's noteworthy that the differences in area measurements between RTK GPS and the Place App Map, though present, are relatively small and may not significantly impact most applications. Nevertheless, emphasizing the superior accuracy of RTK GPS over the Place App Map underscores its reliability and suitability for precision measurement tasks. Further refinement and validation of both techniques may enhance their accuracy for diverse mapping applications.

III.Ground Truth Verification

When we pay attention to the map created by the data of the rtk device and the map obtained by the data of the Place app, it is clear that we can identify many notable differences here. Especially when we pay attention to the final authors and evidence like the shape and location of these two maps and the location of places, we can identify clear differences. In particular, we went to Sabaragamu University to visit this place through a field. Accordingly, when we compare the data obtained through physical observation and the places shown on the map, it is very clear to us that there is a very noticeable difference in the geographical features marked on this map. When we pay attention to the pond of the two, we can clearly identify the difference in the shape of the pond when we pay attention to the RTk map and the place app map. When we verify the ground truth at a glance about the roads, it is clear to us that the map obtained by Rtk data is correct compared to the map obtained by me.

5.Factors of Accuracy Change

Factors that affect the accuracy difference between RTK (Real-Time Kinematic) and Place App Data during a survey include:

1. Techniques and instruments used in survey method impact accuracy. While RTK relies on specialized GPS with centimeter-level accuracy, Place App Data can use consumer-grade GPS on smartphones. But they are not as accurate as RTK equipment.

2. Environmental conditions: During this field survey we encountered signal blockages, road obstructions and weather obstructions which affect the accuracy of RTK and place app differently. This was particularly effective for the Place App.

3. Data Processing Techniques: RTK uses sophisticated algorithms and corrections while consumer grade GPS uses simpler methods which may be the reason for this.

4. Surveyor Experience: Surveyors expertise affects accuracy. Proper training minimizes mistakes. Many such weaknesses were also seen in our survey team, especially when data was collected by Place APP.

5. Survey Resolution: Spatial resolution and sampling frequency differ between RTK and consumer grade GPS. Higher resolution captures finer details but can introduce more noise.

6. Core data quality: Core data quality such as OSM data affects accuracy assessment. Inaccuracies in baseline data can distort results.

7. Characteristics of the survey area: Terrain and features affect accuracy differently. Challenging terrain posed unique difficulties for accurate measurements.

Considering these factors, optimizing accuracy involves proper calibration, methodology, and data processing. Ongoing monitoring and validation against ground truth data helps identify anomalies.

6.Pros and Cons of RTK and Place App

RTK (Real-Time Kinematic) GPS:

Pros:

1. High Accuracy: RTK GPS offers precise positioning with centimeter-level accuracy, making it suitable for applications requiring precise measurements.

2. Real-Time Data: RTK GPS enables immediate data collection and positioning, facilitating the gathering of accurate spatial information.

3. Ground Truth Verification: RTK GPS measurements can be cross-checked against ground truth data obtained through physical observation or surveyed control points, ensuring the reliability of the data.

4. Professional Grade: RTK GPS equipment is designed for professional use and is typically operated by trained individuals with expertise in geospatial data collection and surveying.

Cons:

1. Cost: RTK GPS equipment and software can be expensive, limiting access for individuals or organizations with budget constraints.

2. Complexity: RTK GPS systems require technical expertise to set up and operate effectively. Training and experience are necessary to utilize the equipment properly and interpret the data accurately.

3. Signal Interference:RTK GPS signals are susceptible to environmental factors such as atmospheric conditions, terrain features, and signal obstructions, potentially affecting accuracy in certain areas.

4. Reliability: RTK GPS may encounter reliability issues in locations with poor satellite visibility or signal obstruction, such as urban areas or dense vegetation.

Place App Method:

Pros:

1. Accessibility: Place Apps are widely available and accessible through mobile devices, making them convenient for a diverse range of users.

2. Ease of Use: Place Apps feature user-friendly interfaces and intuitive tools for data collection and mapping, requiring minimal training or technical expertise.

3. Crowdsourced Data: Place Apps can leverage crowdsourced data from a large user base, facilitating rapid data collection and updates to map information.

4. Cost-Effectiveness: Place Apps are often free or available at a low cost, making them more affordable than specialized GPS equipment for small-scale mapping projects.

Cons:

1. Limited Accuracy: Place Apps may offer lower accuracy compared to professional-grade GPS equipment like RTK GPS, as they rely on less precise positioning technologies and crowd-sourced data.

2. Data Quality: The quality of data collected through Place Apps varies depending on user input and validation processes, potentially impacting the reliability of map information.

3. Dependence on Connectivity: Place Apps require internet or network connectivity to access map data and perform data collection tasks. Poor connectivity can hinder data collection and mapping activities.

4. Privacy Concerns: Place Apps may raise privacy concerns related to data sharing and location tracking, as users' location information and contributions to map data are often stored and shared with the app provider or other users.

In summary, RTK GPS offers high accuracy and reliability but may be expensive and require specialized expertise, while Place Apps provide accessibility and ease of use but may have limitations in accuracy and data quality. The choice between these methods depends on factors such as budget, accuracy requirements, user expertise, and data accessibility.

Certainly, let's conclude the report with a clear statement about the accuracy of the RTK (Real-Time Kinematic) method compared to Place App:

In conclusion, the analysis reveals that the RTK mapping method demonstrates consistency with Place App data across various features. Moreover, in specific instances such as pond area measurements, the RTK method showcases higher accuracy compared to Place App data. This suggests that the RTK method offers more precise and reliable measurements than Place App in certain scenarios. However, further improvements are needed, especially in aligning RTK data with OSM (OpenStreetMap) standards. Thus, while acknowledging the strengths of the RTK method, continued efforts should be directed towards refining its accuracy and reliability to ensure its alignment with established mapping standards.