Smart Surveyors: Ensuring Land Rights for all through Innovative Surveying Approaches

Stephanie MICHAUD, Canada, and Melissa HARRINGTON, New Zealand

Key words: Geospatial Data, Augmented Reality, Smart Surveyors, Innovation, Positioning-as-a-service, Geomatics, GNSS

SUMMARY

Surveyors are increasingly required to tackle new projects with ever changing circumstances; whether it be remote location, changing budgets, diverse workforce and/or climate change. Innovative approaches to solving these challenges, such as positioning-as-a-service and augmented reality, are essential to the toolkit of the modern day smart surveyor. This paper seeks to present recent technological advancements and through real world examples, demonstrate how smart surveyors can leverage these technologies to facilitate land rights for all.

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1. INTRODUCTION

Surveyors are increasingly required to tackle new projects with ever changing circumstances; whether it be remote location, changing budgets, diverse workforce and/or climate change. Innovative approaches to solving these challenges, such as positioning-as-a-service and augmented reality, are essential to the toolkit of the modern day smart surveyor. This paper seeks to present recent technological advancements and through real world examples, demonstrate how smart surveyors can leverage these technologies to facilitate land rights for all.

2. POSITIONING-AS-A-SERVICE

Positioning-as-a-service introduces flexible and on-demand access to high quality RTK positioning for mapping, navigation, and visualization workflows powered by a low cost GNSS antenna paired with your smartphone. From sole operators, through to organizations wanting to equip entire field teams, the power of RTK-quality GNSS field workflows is now more accessible, more affordable, and more flexible than ever before.

2.1 Trimble Catalyst Digital Antenna

The Trimble Catalyst DA1 Antenna is a lightweight digital antenna capable of achieving high accuracy positions by transferring GNSS signals and satellite corrections to the Trimble Catalyst soft-GNSS receiver operating on the user-supplied Android mobile phone. By decoupling the antenna from the soft-GNSS receiver, the Catalyst system is incredibly versatile, lightweight, and low cost.

Figure 1:Catalyst DA1 Antenna

2.2 On Demand Subscription Access

Access to positioning correction sources, such as cellular or satellite delivered virtual reference stations, is managed through unique login information, providing the user with a multitude of options for customizing subscription accuracy, duration, and usage rate. With the introduction of on-demand access subscriptions, usage can be distributed and tailored across an entire organization to active users, on an hourly basis, from a project 'bank' of time.

3. APPLICATIONS OF POSITIONING-AS-A-SERVICE

In humanitarian work, sometimes the need for high accuracy data collection solutions is immediate, urgent and unexpected. In Haiti, a team of volunteers actively worked over a month long period to catalogue new settlement areas to confirm drone and aerial imagery as part of a post-earthquake disaster management initiative. These new settlement areas were part of a recent relocation from disaster areas in Port Au Prince, and the flexibility of positioning-as-as-service was utilized to quickly verify control points and boundaries for distribution to other groups ahead of coordinated work efforts.

By having small, lightweight Catalyst antennas that could easily be activated with the appropriate accuracy subscription, and deployed with compatible software applications on an Android device, a large workforce was readily empowered without significant start up delays. Citizen volunteers were capable of lending a hand when conditions were dire, and applying local knowledge alongside survey work to ensure proper documentation was achieved.

4. AUGMENTED REALITY

Positioning-as-a-service also provides the foundational component of outdoor augmented reality systems. By making a smaller, lightweight, and cost effective antenna, and pairing it with inertial sensors and cameras already embedded in smartphones, accessible augmented reality for survey and mapping applications becomes more feasible. Augmented reality has proven to be a useful tool for visualizing complex 3D data sets, monitoring project progress, and collaborating and informing key project stakeholders. Presenting detailed geospatial data in context, outside, and onsite further enables citizen engagement, allowing the surveyor to articulate project needs and drive better discussion around data, especially when it pertains to non-visible boundaries.

Trimble SiteVision is one such high accuracy augmented reality system. The combined hardware and software solution leverages technology available in consumer based Android Mobile phones, and positioning as a service, to accurately overlay 2D and 3D data in real-world environments. SiteVision enables users to visualize, explore and understand complex information and BIM models with high accuracy positions in the real-world.

4.1 Hardware: Integrated Positioning System

The Trimble SiteVision Integrated Positioning System (IPS) integrates a Trimble Catalyst DA1 Antenna, Electronic Distance Measurement (EDM) rangefinder, and power management into a lightweight, handheld unit that mounts a user-supplied Android mobile phone.

Figure 2:SiteVision Integrated Positioning System

The Trimble Catalyst DA1 Antenna enables the SiteVision system to achieve high accuracy positioning of visualized data points and models in space.

The built-in Electronic Distance Measurement (EDM) or laser rangefinder enables users to capture remote measurements for inspection and better understanding of how their data fits on site in real time.

The power management system provides power to the Trimble Catalyst DA1, the EDM, and Android mobile phone running the SiteVision application.

The final component of the hardware is a user supplied Android mobile phone, supporting a minimum of Android 9 Operating System. This mobile phone provides the host platform and computing power for calculating accurate positions and the SiteVision Application.

4.2 Software: Cloud processing, Data Management, and User Interface

A fundamental component of the Trimble SiteVision solution is the Trimble Catalyst technology. The digital antenna is a component of the Integrated Positioning System, and the GNSS receiver completely integrates with the Google Play Services for Augmented Reality (AR) in a custom application on a consumer based Android Mobile Phone, providing high accuracy positioning-as-a-service with accuracies of a few centimeters.

Trimble SiteVision utilizes positioning as-a-service to provide users access to Trimble Corrections Hub which includes Trimble VRS Now™ networks and Trimble RTX™ technology globally. The service reduces the need for configuration and provides the best available position, depending on the users location, and enables all users from varying backgrounds to use SiteVision with ease on their project sites.

In addition to Trimble Catalyst, another service used by Trimble SiteVision is Trimble Connect. Trimble Connect is a cloud-based data management and collaboration platform that allows users to view, share, and access project information over the internet from anywhere at any time. Trimble Connect stores and optimizes the 2D and 3D models, prepared in a user's office software, that are to be viewed in SiteVision and provides tools for collaboration from the SiteVision application to the office via task management, also known as "ToDo's."

Trimble SiteVision integrates with Google Play Services for AR, a platform for building augmented reality experiences. Using a mobile phone camera, Google Play Services for AR can sense its environment and understand the real world through motion tracking, surface identification and light estimation. This enables Trimble SiteVision, in combination with Trimble Catalyst GNSS technology to accurately and seamlessly overlay data with the real world.

The final component of Trimble SiteVision, is the Trimble SiteVision application, a custom Augmented Reality application downloaded from the Google Play Store. The Trimble SiteVision App is the location where all of the above technologies combine, allowing users to view their 2D and 3D data accurately, and understand it at a greater level.

5. APPLICATIONS OF AUGMENTED REALITY OUTDOORS

High accuracy Augmented Reality, enabled by Trimble SiteVision has proven to be a useful tool for visualizing complex datasets, monitoring project progress and collaborating and informing key project stakeholders. Trimble SiteVision has been used by Skanska UK, on a large corridor widening construction project in England, known as the A14 Motorway Project. The project comprised of 34 kilometers of road improvements, 70 structures, a 750 meter long bridge, and a 19 kilometer bypass around the town of Huntingdon.

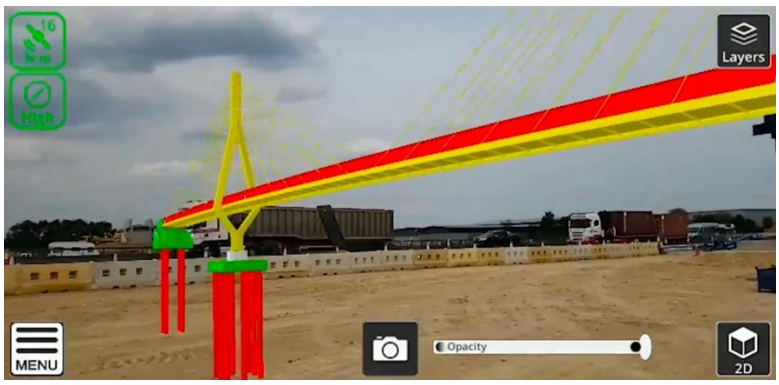

Figure 3:SiteVision visualization for the A14 Motorway Project

The vast size of the project required many stakeholders to be involved in various stages of the process, all needing to understand the proposed improvements. Skanska UK, the A14 project contractor, used SiteVision to provide real-time, in field visualization of new routes and structures for local residents, landowners and construction teams. By leveraging augmented reality to display the proposed construction plan in high accuracy to municipality stakeholders and concerned citizens, it was possible to achieve buy-in for the project quickly, and effectively, with clear understanding where the project would be impacting existing infrastructure. Citizens who had no geospatial experience or context were immediately able to understand how a project would impact their public access and in some cases, property lines.

In addition to stakeholder engagement, Trimble SiteVision has been used on the A14 project for depicting the location of underground utilities and pipelines. Objects that are not easily seen or represented on plans can result in significant health and safety concerns on site. The combination of accurate underground utility information and SiteVision have helped contractors on site verify information, check construction progress, increase accuracy and reduce time and cost in locating and protecting buried assets on site.

Figure 4:SiteVision for Underground Utilities

The Skanska team have used Trimble SiteVision to interact and communicate designs in a new way. Progress on site is tracked and communicated in new ways. Georeferenced augmented reality photographs, as well as video recordings using third party applications, are used to complete as-built checks, communicate the design, and the progress of construction on site. The integrated positioning system allows the measurement of positions, lines and cut/fill values using a combination of GNSS, Electronic Distance Measurement and AR from any angle or position on site, allowing them to complete calculations in-real time. An innovative solution that encourages participation and engagement at all levels and phases of the project.

6. CONCLUSION

Surveyors have an increasingly challenging role to play in documenting and ensuring land rights worldwide. By incorporating innovative surveying approaches, smart surveyors can future proof their business and simultaneously incorporate diverse stakeholders in a collaborative approach to mapping people and places, worldwide.

CONTACTS

Mrs. Stephanie Michaud, P.Eng.
Trimble Inc.
10368 Westmoor Drive
Westminster, Colorado
USA
Tel. +1 303-466-3647
Email:stephanie_michaud@trimble.com
Web site: www.geospatial.trimble.com

Mrs. Melissa Harrington
Trimble Inc.
10368 Westmoor Drive
Westminster, Colorado
USA
Tel. +1 303-828-7924
Email:melissa_harrington@trimble.com
Web site: www.sitevision.trimble.com