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Inspector Positioning Tablet Pilot Project

Real time GNNS positioning for ODOT construction inspectors

1 March, 2016

Problem

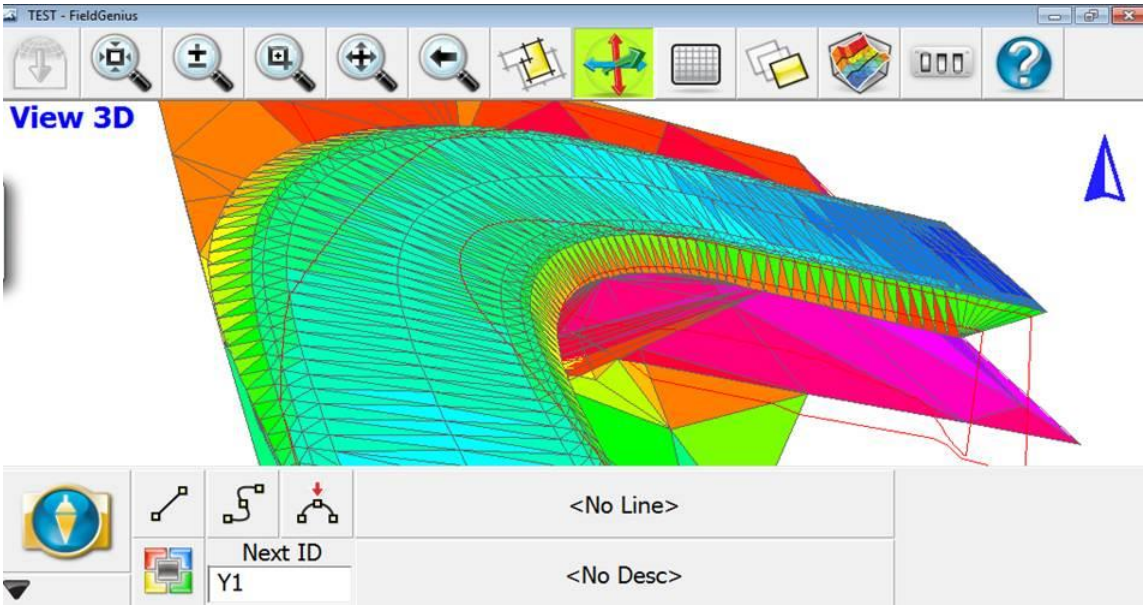
With the increased use of Automated Machine Guidance (AMG) by contractors, Oregon Department of Transportation (ODOT) construction inspection staff has fewer traditional hubs/stakes to check position, line and grade on job sites. With a shortage of ODOT construction survey personnel, inspectors were essentially operating blind or forcing contractors to place hubs/stakes for inspection only. A need for some type of equipment to allow inspectors to check line and grade was identified as a critical need. At the same time, ODOT design staff has been rapidly improving the development and transmittal of 3D design data to the contractor community. With the critical need for a tool identified and the 3D design data available, the missing piece was an actual tool to use the 3D design data in the field for positioning. A survey grade GNSS based tool was the desired solution as inspectors may not always have the time or skills to set up a total station.

Hardware

After a great deal of research and testing, a unique tablet platform was selected that has built in dual frequency, survey grade RTK GNSS. ODOT selected the DT Research model DT391GS, an off the shelf item with an embedded Hemisphere GNSS module and antenna. DT Research has been in the technology market for over 20 years building industrial, medical and military tablets and digital signage. The DT391GS model is their first survey grade positioning tablet. The DT391GS is a 9” touchscreen tablet running Windows 7, built to an IP65 rating for water and dust resistance and is MIL-STD-810G rated for general ruggedness. The tablet also includes a 5 megapixel camera, cellular sim card slot, Wi-Fi, Bluetooth, hot swappable batteries, USB ports and an external GNSS antenna cable connection.

Software

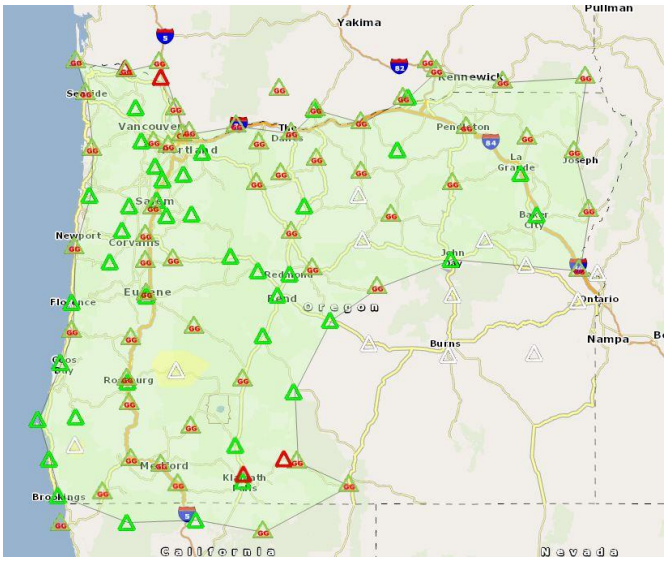
With the desired tablet selected, a software platform was needed to interact with the 3D Design data. The software needed to be compatible with the tablet, provide an RTK GNSS solution, use Landxml files directly, have the ability to use the Oregon Coordinate Reference System (OCRS) map projections, and be simple enough to use that a non-surveyor could operate it. ODOT selected MicroSurvey FieldGenius software as it meets all of the desired criteria. FieldGenius is an off the shelf product that required no customization or modifying. FieldGenius is a complete field surveying software that has been around for over 10 years. The software has the ability to provide real time station and offset, elevation, and cut/fill to a surface model. It can also be used for point checking and survey data collection. The software is designed for easy operation and has a very user friendly interface.



MicroSurvey FieldGenius Software – Surface model displayed in 3D mode

RTK Network

The RTK corrector is another critical piece to the puzzle. Traditionally, contractors have used on site radio base stations for AMG operations. To provide a truly independent GNSS check, ODOT decided to not use the contractor's base station corrector as part of its inspection process. Thankfully, ODOT manages the Oregon Real Time GNSS Network (ORGN) which provides GNSS RTK solutions over the internet. The ORGN is well established and well tested; ODOT survey crews have been using the system for years. The ORGN geographically covers three quarters of the state and can be used in any zone a cellular data connection can be made. Accuracies of +/-0.04' horizontally and +/- 0.08' vertically are achievable, in real time, with a solid RTK corrector and a dual frequency GNSS receiver.



ORGN Station and Coverage Map

Implementation

ODOT made the decision to deploy the tablets like a standard surveying tool. Surveying equipment is centrally managed by the Engineering Automation Section. Purchasing, training, and technical support for the whole Agency can be provided consistently through one office. Ten complete tablet kits were purchased. The kits included all of the hardware, software, accessories, survey rod, and a case to store and carry it all. A one day (8 hour) training course was developed where construction inspectors and office support staff would be trained in using the tablets. A heavy emphasis of the training is basic GNSS fundamentals, quality control, when to use the equipment, (and when not to use the equipment), project setup, and the role of the inspector in surveying and data collection. The training is 60% classroom and 40% field exercises. Class size was kept to 8-10 people per class so everyone could have a tablet for the hands-on field portion. No tablets were issued to field crews until after the first round of training was complete to ensure enough tablets were on hand for training.

Five construction offices were selected for the pilot project phase resulting in about 40 people attending training. All of the initial training was completed in a two month period. The tablets were very well received and the participants acquired a solid working knowledge of them. During open discussion at the training, the participants came up with quite a few uses that had not been envisioned when the project was being developed. If a question was asked and a solution was not available, the instructor followed up with an email or phone call after the training. The training staff worked with the software and hardware vendors to resolve any issues that came up during the training, providing additional learning opportunities.

Once the first round of training was complete the tablets were issued to the ODOT construction offices. On-site training to support actual projects was offered when the tablets were delivered. On-site training allows the inspectors to use real project data under real project conditions to test the equipment with support staff along for guidance. To date, on-site support has been provided to four of the five construction offices. Along with on-site support, the Engineering Automation Section provides support for initial project setup, coordinate transformations, general tech support, and trouble shooting. The construction offices are able to provide their own project files and complete any data conversions necessary for the tablets. Processing of any data collected on the tablets is also handled directly by the construction offices.

Inspection

Construction inspectors are now using the tablets for various tasks in the field. The software allows the inspector to work with multiple alignment files enabling them to know their exact station and offset to any alignment at any location on the job. They are also able to work with 3D surface models to determine their cut or fill at any point on the model. If they have a surface model for a road, they can check the contractors work to the accuracies of GNSS. Points can be collected as well as lines and area features. If an area is collected, the area calculations can be displayed immediately for use on field notes or to support pay notes. The software also allows the ability to add pictures and audio recording to point data, so a picture can be taken or a voice note recorded and linked to a stored point. The goal is to allow

inspectors to efficiently do their core duties by utilizing the tablets as a more effective tool. The tablets are currently being used on four projects with four to six additional projects set to begin this spring.

Conclusion

The inspector positioning tablets have been proven to work in all-weather conditions from 20 – 100 degrees, sun, wind, and heavy rain. The touchscreens have been proven to react correctly when wet, an improvement over older touchscreen technology. The tablets have had no hardware issues to date even though they've been tested by dropping them, kicking them and stepping on them. The GNSS accuracies of the tablet have been tested against ODOT's survey grade Leica GS14 GNSS units. The results are well within the tolerances of RTK GNSS. With the Windows 7 operating system, the tablets are compatible with ODOT's internal network and enterprise applications and could be built to ODOT computer standards and function like a laptop in the field.

The MicroSurvey FieldGenius software is very forgiving and if accidently closed or crashed, can be restarted and a project reloaded in about 45 seconds. Most users have been able to get to a comfortable level of operation in about one hour. We've worked with MicroSurvey tech support on issues that have come up and all items have been handled very quickly. MicroSurvey quickly developed an interim software update to specifically handle the GNSS unit in the tablet. The ability of the software to read and display Landxml files (alignments and surfaces) has been the most critical feature of the software.

At this point, the tablets have been very well received by ODOT inspectors. Many inspectors have been hoping for something like this for a long time. The system is easy enough to use that inspectors can pick up the tablet after not using it for a few weeks/months and get right back to work. At this phase of the project we are just hitting the tip of the iceberg for the many uses of tablets on the job. The real test of the tablets will be this summer during the heart of our construction season. At the end of the construction season, feedback will be collected from all of the tablet users and the project will be reviewed and a plan developed for moving forward.

Project Time Line

March 2015 – Need for a tool identified at ODOT Experienced Inspector Symposium

March to April 2015 – Hardware, software, and vendor research and demonstrations

April 2015 –Engineering Automation Section tasked to find a solution for inspectors

April 2015 – MicroSurvey FieldGenius software first demonstrated

May 2015 – DT Research tablet first demonstrated

June 2015 – Ten tablet packages ordered

June 30, 2015 – Equipment received

July to September 2015 – Equipment tested and training developed

October 2015 –Tablets presented to State wide ODOT Survey Leadership team

October to November 2015 – Training and tablets delivered to five construction offices

November 2015 – Tablets presented to Region 1 tech center engineering and design staff

December 2015 to February 2016 – On-site support and refresher training provided

February 2016 – Five additional tablet packages ordered

February 2016 – Tablets presented at FHWA/Caltrans 3D Design Peer Exchange

March 2016 to May 2016 – Additional training and on-site support planned

Summer of 2016 – Full time use by inspectors on AMG projects

Fall of 2016 – Project review, collect feedback and debrief with tablet users

Winter 2016 to Spring 2017 – Phase Two, develop a plan for the future