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Availability Evaluation of the Smart Phone Application for the Topographic Surveying

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Abstract
Recently, using the satellites due to the development of GNSS (Global Navigation Satellite System) surveying was able to get fast and accurate results. Particularly, VRS (Virtual Reference Station) which enable to accomplish the real time-base survey have been increasingly popular. In addition, Current surveying and spatial information technology incorporates information and communication technology and is user friendly. The advancement of smartphone has made it possible for all people to use spatial information service easily. It's required to build correct spatial information in order to use spatial information service easily. The classical RTK survey system requires GNSS receiver and controller. There is a high price and inconvenience of the mobility. In this study, Smartphone application was applied to the topographical surveying. Topographical surveying using VRS which has serviced by NGII (National Geographic Information Institute) was performed for utilization assessment of smartphone application. And the application was compared to general controller. As a result of surveying the topographical points in study area, deviation comparing with dedicated controller appeared to have been under 1cm in average. Such a result was what within the tolerance specified in topographical surveying, which indicated the possibility of smartphone application for surveying field. The smartphone application should increase user convenience and the operational capability of the GNSS in the field.

Keywords: Smartphone Application, Topographic Surveying, Network RTK, GNSS, VRS, Applicability Evaluation

Introduction

As the demand on the precise positioning for the moving objects has been increased in the various industry fields, many studies have been conducted to analyze real time kinematic technique and its practical usage[1][2]. Network-RTK GPS positioning technique based on national CORS (Continuous Operating Reference Station) and wireless internet access as like VRS was developed to overcome the limitations of traditional RTK technique[3][4]. In Korea, NGII (National Geographic Information Institute) provides VRS service based on CORS and mobile internet network since 2007[5][6]. VRS system, a network of reference stations can be used to isolate the components of these systematic errors and use the resultant corrections to create Virtual Reference Stations at any location within the network[7][8]. Use of a VRS significantly reduces the effects of systematic errors and improved accuracy. In addition, current surveying and spatial information technology incorporates information and communication technology and is user friendly[9][10]. The advancement of smartphone has made it possible for all people to use spatial information service easily[11][12]. It's required to build correct spatial information in order to use spatial information service easily. The classical RTK survey system requires GNSS receiver and controller. There is a high price and inconvenience of the mobility. In this study, android based VRS surveying application was applied. Smartphone application that candisplay surveyed data on a map and the current survey results through a connection between a GNSS receiver and smartphone using a Bluetooth wireless communication device. In addition, topographical surveying using VRS which has serviced by NGII (National Geographic Information Institute) was performed for utilization assessment of smartphone application. Figure 1 shows study flow.

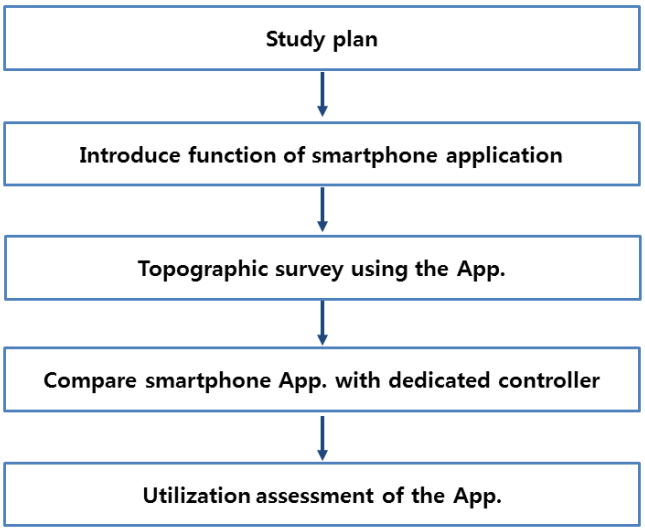

Figure1: Study flow

Function of Smartphone Application

In this study, "Smart Topo 2" application was used topographic surveying. The application is real-time satellite

surveying programs for Android-based mobile devices and it accepts the signal from the GNSS receiver by NMEA (National Marine Electronics Association) format. NMEA is a combined electrical and data specification for communication between marine electronics such as echo sounder, sonars, anemometer, gyrocompass, autopilot, GPS receivers and many other types of instruments[13]. It has been defined by, and is controlled by, the National Marine Electronics Association. NMEA is widely supported by navigation and mapping software. "Smart Topo 2" provide intuitive icon-based interface and can use large background maps such as CAD drawings, SHP files, aerial photographs and internet map service etc. Main function of Smart Topo 2 is point measurement, stake out and site calibration for cadastral surveying or local coordinate. Table 1 shows function of Smart Topo 2 and Figure 2 shows main screen and its description of Smart Topo 2.

Table 1: Function of Smart Topo 2

Function	Description
Preparations	GNSS receiver Connection
	VRS configuration
	Survey style configuration
	Select coordinate system
Job management	Create Job
	Open/delete job
	Import/export job
	Background configuration
Surveying	Transmit job file
	Receive job file
	Line/polygon connection
	Code surveying
	Layer management
	Site calibration
	Stake out
	Curve definition
	Road survey

Figure 2: Main screen of Smart Topo 2

The advantages of Smart Topo 2 are background map and easy surveying job management using the internet. Vector map and aerial image can be used at background map. Figure 3 shows background map.

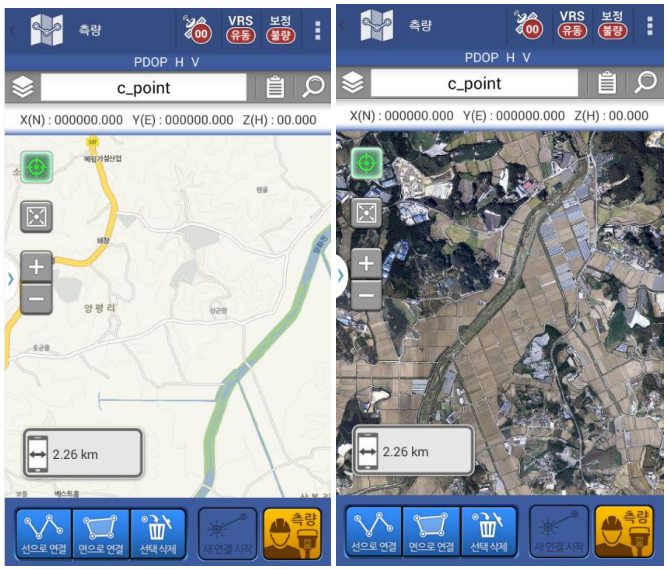

Figure 3: Background map

Applicability Evaluation

For the applicability evaluation of smartphone application, topographic surveying were performed using Smart Topo 2. Surveying was performed on roads and facilities of Hansu-myeon area. It was selected as the study area because there were varioustopographic features in the area. Figure 4 shows study area.

Figure 4: Study area

Topographic Surveying was performed by VRS service and background map was used internet portal map service. Figure 5 shows surveying results.

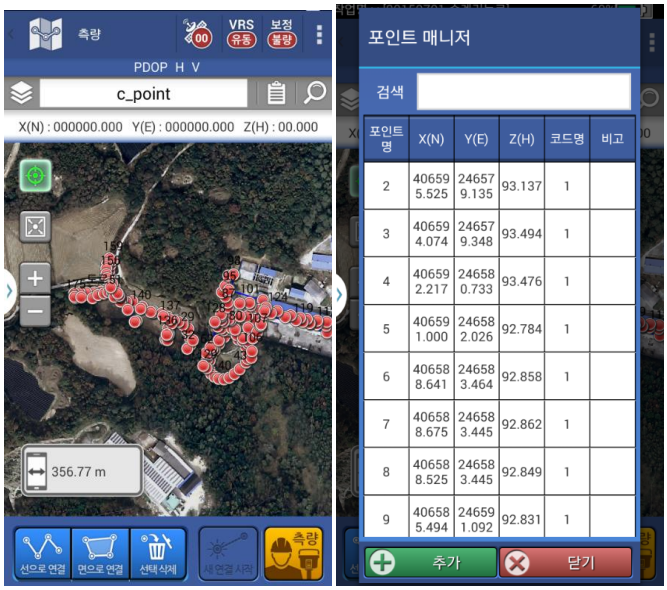

Figure5: Survey results

As shown in Figure5, back ground map based on internet portal service helps intuitive understanding about the surveying site. And user can create topographical map in real time using draw line option. In addition, surveying job could be transmitted by internet using mobile device on the surveying site. Since it is possible to export the shp or dxf format, it could be save the time and cost about topographic surveying. Figure 6 shows example of exported data.

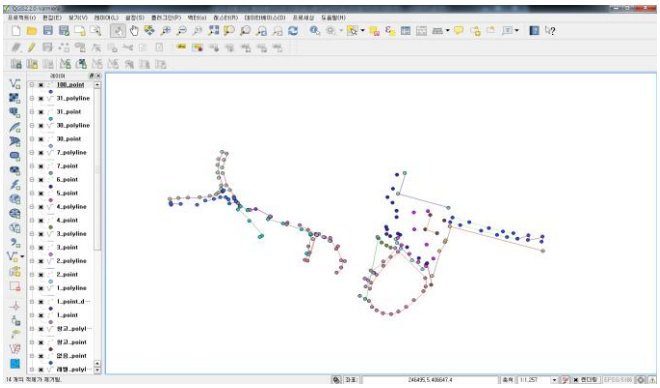

Figure6: Example of exported data

In this study, the application was compared to general controller in surveying working. Comparison was carried out for the survey result and the surveying workflow. Table 2 shows comparison of surveying result and Figure 7 shows comparison of work flow.

Table 2: Comparison of surveying result

No.	General controller			Smart Topo 2		
	X (m)	Y (m)	H (m)	X (m)	Y (m)	H (m)
1	406595. 525	246579. 135	93. 137	406595. 529	246579. 135	93. 131
2	406594. 074	246579. 348	93. 494	406594. 071	246579. 341	93. 500
3	406591. 000	246580. 733	93. 476	406591. 008	246580. 739	93. 485
4	406588. 641	246582. 026	92. 784	406588. 647	246582. 031	92. 789
5	406588. 675	246583. 464	92. 858	406588. 671	246583. 470	92. 851
6	406580. 427	246605. 686	91. 714	406580. 431	246605. 680	91. 721
7	406575. 604	246618. 206	93. 120	406575. 612	246618. 201	93. 128
8	406574. 184	246617. 584	92. 595	406574. 189	246617. 590	92. 588

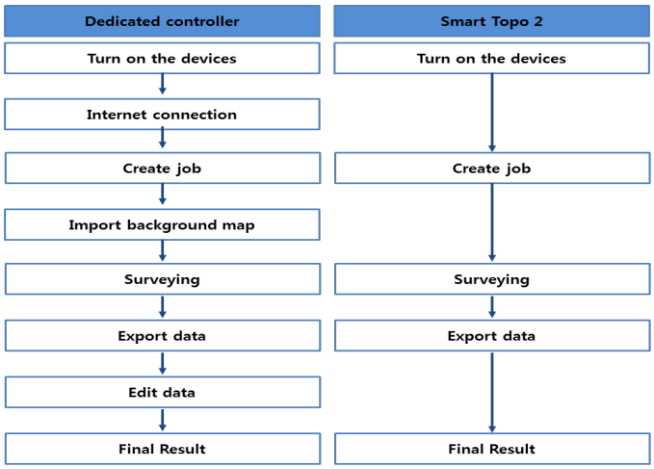

Figure7: Comparison of work flow

As a result of surveying the topographical points in study area, deviation comparing with dedicated controller appeared to have been under 1cm in average and significantly reduced the necessary steps to work. Such a result was what within the tolerance specified in topographical surveying, which indicated the possibility of smartphone application for surveying field. The android based application should increase user convenience and the operational capability of the GNSS in the field.

Conclusions

In this study, Smartphone application was applied to the topographical surveying. The application is real-time satellite surveying programs for Android-based mobile devices and it accepts the signal from the GNSS receiver by NMEA format. The smartphone application provide intuitive icon-based interface and can use large background maps such as CAD drawings, SHP files, aerial photographs and internet map service etc. Topographical surveying using VRS which has serviced by NGII was performed for utilization assessment of smartphone application. For the applicability evaluation of the application, topographic surveying were performed about roads and facilities of study area. The advantages of the smartphone application are background map and easy surveying job management using the internet. Back ground map based on internet portal service helps intuitive understanding about the surveying site. And user can create topographical map in real time using draw line option. In addition, surveying job could be transmitted by internet using

mobile device on the surveying site. And the application was compared to general controller. As a result of surveying the topographical points in study area, deviation comparing with general controller appeared to have been under 1cm in average. Such a result was within the tolerance specified in topographical surveying and that indicated the possibility of smartphone application for surveying field. The smartphone application for GNSS surveying should increase user convenience and it will decrease the surveying time and the cost of device will be saved. Development of IT such as smartphone application will contribute to the development of various surveying areas.

Acknowledgments

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