AN EFFECTIVE REALTIME UPDATING OF ROAD FACILITY DB USING DIGITAL CAMERA WITH A BUILT-IN BLUETOOTH AND DGPS

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ABSTRACT

Recently, with the growing need for construction and updating road facility DB, many studies has been carried out to efficiently collect road related spatial data. In this study, the complicated and various road facilities DB were constructed by digital camera with a built-in Bluetooth and DGPS. In result, precise positioning of road facilities were performed by DGPS and various field information such as shape and status of road facilities were obtained by Digital Camera. It will be able to effective realtime update and management of road facilities such as creating, repairing using digital camera and DGPS.

Keywords: Road Facility DB, Digital Camera, DGPS, DB construction, Realtime Update

INTRODUCTION

As construction of GIS database is lively proceeded and demand of database is increased in variety of fields including urban planning, environment, and transportation, interest in maintenance of database is increasing. But steadily updating database is a hard task, actually utilizability of the constructed database is decreasing because database update system is incomplete. Because road facility is various and is deeply related with safety of driver, It is necessary to manage systematically, and for this, it must be followed study to increase the efficiency of construction and update of road facility database. A site situation for creation and repair of road facility is judged by topographic map, interpretation of aerial photograph and site image. But it is difficult to grasp accurate situation of road facility through reference of existing database, aerial photograph and topographic map, additional cost is incurred in site survey. Therefore if image data about road facility is collected with location data, it is able to prevent loss of various resources on site visit and survey. In this study, construction of complicated and various road facility DB were conducted using digital camera with a built-in Bluetooth and DGPS, which obtain location and image of road facility. Obtained location information and digital image will be able to utilize effective realtime update and management of road facility such as creating, repairing using digital camera and DGPS.

DATA ACQUISITION

In this study, Chungnam National University was selected the study site and positional information and imageries about facilities were acquired to construct road facilities database. Where has many facilities like parking gates, traffic signs and roadside trees. Figure 1 shows the study site and table 1 lists specification about DGPS and digital camera used in this study.

Figure 1. Study site.

Table 1. Specification about DGPS and digital camera used in this study

DGPS	GIR 1600
Frequency	L1(1575.42MHz)
Channels	12 Channels (10GPS/2BAS)
Position Accuracy DGPS	Sub-meter (flat surface, 2σ)
Update Rate	1Hz (Option : 2Hz, 10Hz, 20Hz)
Camera	Ricoh 500SE
Image Pickup Element	Total 8.30 million pixels (effective pixels 8.13 million), 1/1.8" primary-color CCD
Lens	3.0×Optical Zoom Aperture: F2.5(Wide-angle) to 4.3 (Telephoto)
Focal Length	5.8 to 17.4 mm(equivalent to 28 to 85 mm on a 35 mm camera)
Digital Zoom	4.0 times
Screen Size	2.5"
Communication Method	Bluetooth standard Ver. 2.0 +EDR
Output	Bluetooth standard Power Class 2
Communication Range	Approx. 10 m(line of sight)
Supported Bluetooth Profiles	BIP, OPP, SPP
Frequency Band	2.4GHz(2.4 GHz-2.4835 GHz)

Positions about facilities were decided by DGPS and images about facilities were also acquired together by digital camera with Bluetooth. Figure 2 shows sight about facility surveying.

Figure 2. Sight of facility surveying.

CONSTRUCTION OF ROAD FACILITY DATABASE

Road facilities mean adjuncts to the road like a signpost, fence, street lamp, and it contains facilities related to the road. The management targets about road facilities that is attached or related to the road and it maintains effective use and safety of roads by check.

In this study, positions of facilities were marked with symbol acquired by using 1:1000 digital topographic map to construct database of road facilities. Figure 3 shows the 1:1000 digital topographic map about study site.

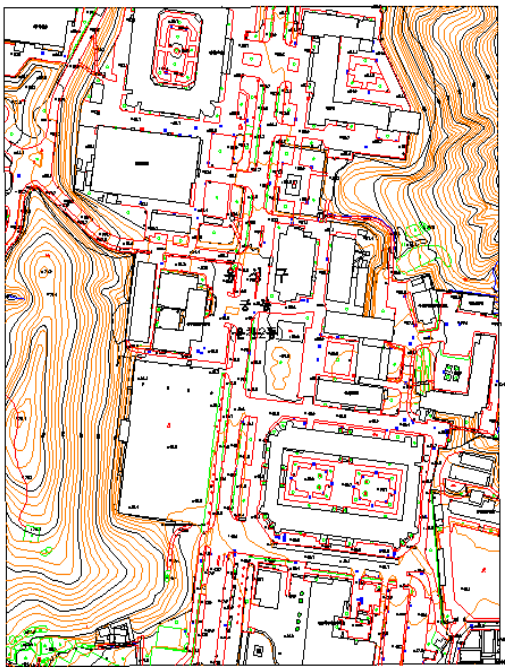

Figure 3. Digital topographic map about study area.

Positions of road facilities acquired by DGPS were marked in the digital topographic map using layer codes and symbol. Figure 4 shows positions and images of road facilities acquired by DGPS and table 2 lists codes and symbols about road facilities.

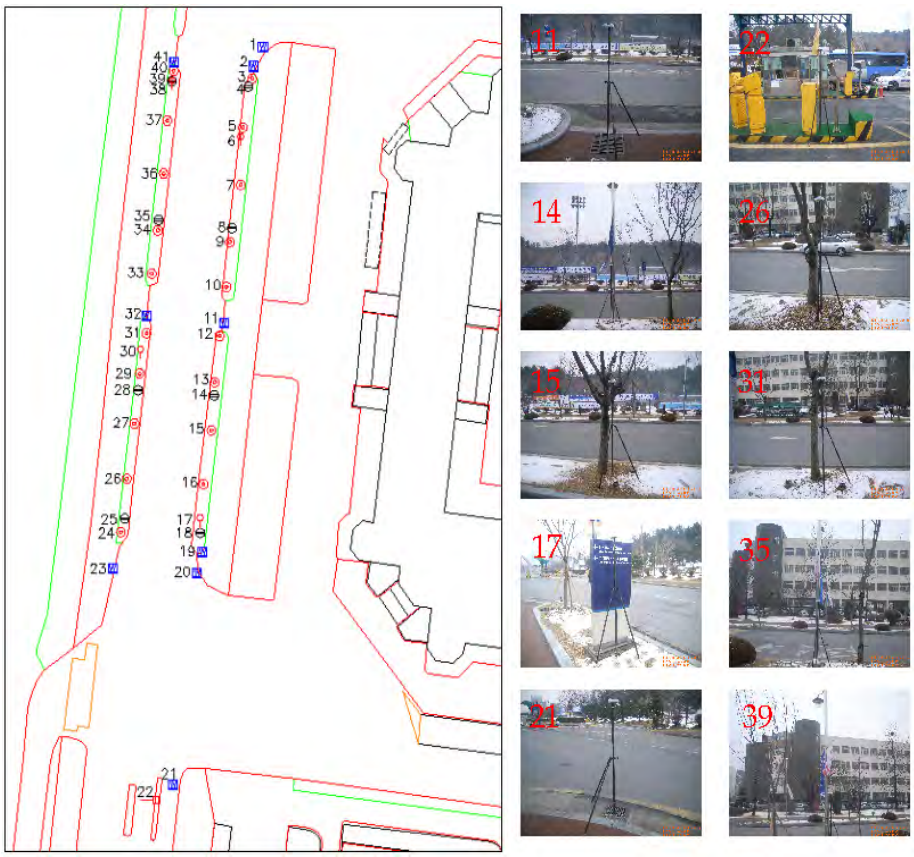

Figure 4. Positions and images of road facilities.

Table 2. Layer codes and symbols of road facilities

Road Facility	Layer Code	Symbol
Parking gate	AE140	
Indicating sign	AEC003	
Regulation sign	AEC004	
Roadside tree	AE170	
Security light	AZ0204	
Sewer manhole	AZB013	

Database construction and update of road facilities using DGPS and digital camera which can grasp the condition of facilities without additional field survey because positions and images about facilities are able to acquired simultaneously. It will be able to reduce the additional expenses for field visit and survey because it is able to judge location and situation of the damaged road effectively which is illustrated in figure 5. Also, acquired images are able to be utilized in GIS software and GIS system because coordinates about acquired images are inserted. Figure 6 shows that acquired images uploaded in Google Earth and it is able to add positions and images about facilities effectively.

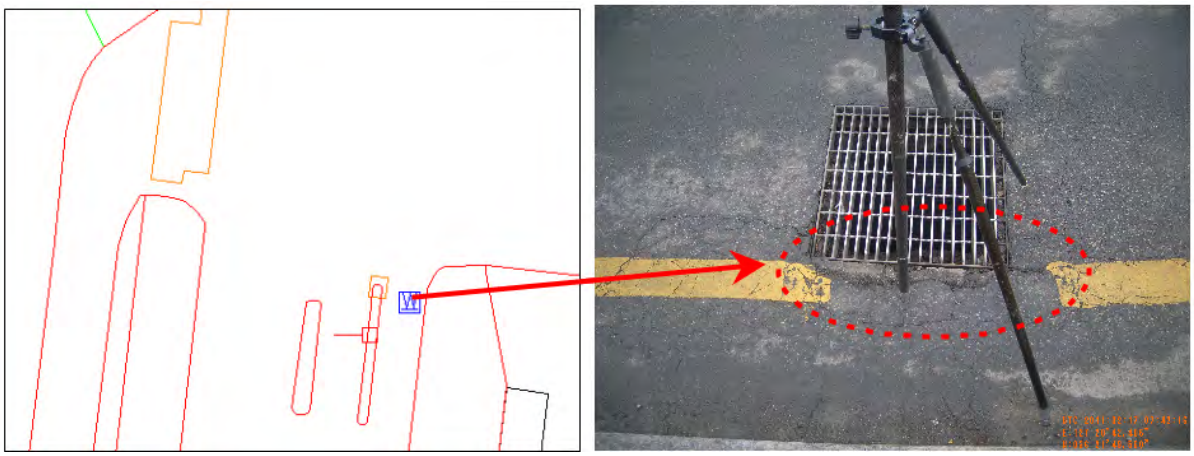

Figure 5. Location and status of the damaged road.

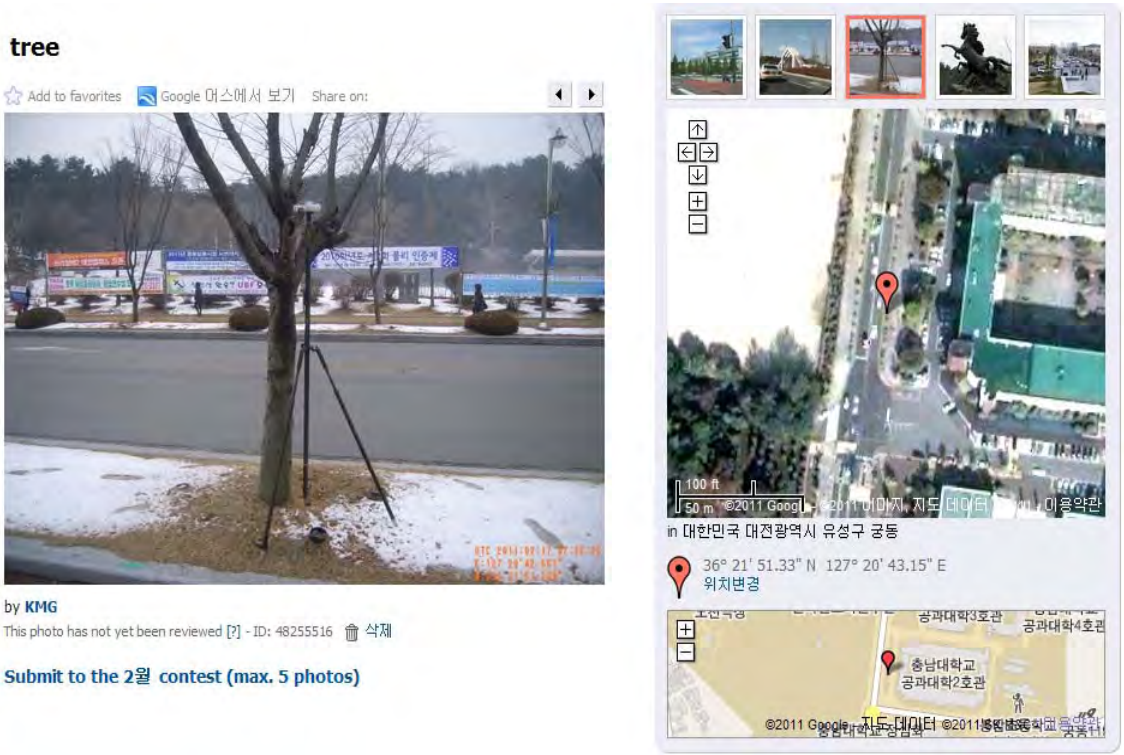

Figure 6. Image uploaded in Google Earth.

ACCURACY ASSESSMENT

In this study, results of DGPS were compared with results of total station which is usually utilized for facility surveying to evaluate the accuracy about database of road facilities constructed by DGPS. 20 check points were installed and results of DGPS were compared with results of total station to evaluate the accuracy about position of the acquired facilities. Table 3 lists the results between total station and DGPS, figure 7 and figure 8 show the graph about table 3.

Table 3. Comparison results between total station and DGPS

No.	Facility	Total Station		DGPS		Deviation	
		N	E	N	E	N	E
1	Manhole	318580.65	230987.748	318581.167	230988.380	-0.516	-0.631
2	Manhole	318577.568	230987.071	318578.075	230986.723	-0.506	0.348
3	Tree	318575.98	230986.707	318576.195	230986.604	-0.215	0.103
4	Security light	318574.529	230986.368	318574.895	230985.929	-0.366	0.439
5	Tree	318567.96	230985.637	318568.446	230984.961	-0.486	0.676
6	Regulation sign	318565.147	230985.253	318565.517	230984.572	-0.370	0.681
7	Tree	318559.236	230984.751	318559.380	230984.596	-0.144	0.155
8	Security light	318552.244	230983.645	318552.535	230983.148	-0.291	0.497
9	Tree	318549.738	230983.274	318550.314	230982.807	-0.576	0.467
10	Tree	318542.859	230982.63	318543.191	230982.209	-0.332	0.421
11	Manhole	318537.494	230982.314	318537.457	230981.781	0.038	0.533
12	Tree	318534.87	230981.108	318535.450	230981.040	-0.580	0.068
13	Tree	318528.487	230980.668	318528.111	230980.219	0.376	0.450
14	Security light	318526.227	230980.647	318526.076	230980.126	0.151	0.521
15	Tree	318520.36	230980.058	318520.496	230979.672	-0.136	0.386
16	Tree	318511.733	230978.804	318512.014	230978.307	-0.281	0.497
17	Regulation sign	318505.19	230977.915	318505.200	230977.733	-0.010	0.182
18	Security light	318504.426	230977.829	318504.306	230977.786	0.120	0.043
19	Manhole	318500.846	230977.861	318501.217	230978.153	-0.370	-0.292
20	Manhole	318497.812	230977.553	318497.893	230977.260	-0.081	0.293

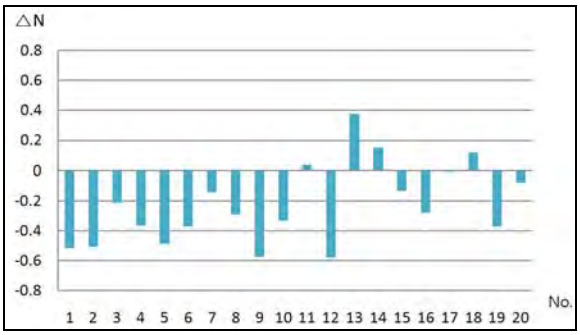

Figure 7. Deviation of X axis.

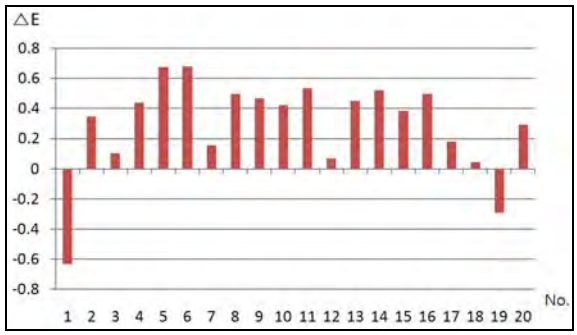

Figure 8. Deviation of Y axis.

In comparison with results, latitude error is -0.229m and longitude error is 0.292m. Also latitude RMSE is 0.354m and longitude RMSE is 0.429. These errors will be able to improve by using precise GPS receiver.

CONCLUSIONS

In this study, the road facility DB was constructed by digital camera with a built-in bluetooth and DGPS, the following conclusions are enumerated.

The first, location and image of road facility were effectively obtained by using digital camera and DGPS.

The second, in comparison with results by total station and DGPS, latitude error is -0.229m, longitude error is 0.292m. However this error will be able to improve by using high precise GPS receiver.

The third, obtained data, location information and digital image, using digital camera and DGPS will be able to utilize effective realtime update and management of road facility such as creating and repairing.

ACKNOWLEDGEMENT

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