DEVELOPMENT OF 3D GUIDANCE SYSTEM FOR CLIMBING

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ABSTRACT ... This paper introduces the result of a 3D climbing navigation system development which is based on PDA. In the visual viewpoint, this system is better than conventional systems that were developed 2D based. In addition, the proposed system was developed so that it could become compatible with these systems. In this paper, we will illustrate as the functional viewpoint than technical description about the system development.

KEY WORDS: 3D spatial data, Climbing, Navigation

1. INTRODUCTION

In the current society, the leisure activity population is constantly increased every year. Especially, according to the effect of the walking movement, it is the trend that the person climbing mountains for the health increases. For those people, the navigation terminal for an outdoor is actively developed by the growth of the GPS technology.

However, the terminal for an outdoor which is used for climbing is altogether developed based on 2D map or digital map. Almost the terminals or software for climbing utilizes the GPS information for understand its own location in a mountain, but a topographical map is not easy to read and one has to prepare the corrected map before climbing a mountain.

In this paper, we introduce the climbing guidance system which is based on PDA. This system does not utilize the 2D map which is used to conventional guidance system, and we can easily understand the climbing course because the system express trail of a mountain in 3D with realism. Moreover, it can be easily utilized in formulating the plan about the climbing course and climbing course can be stored after climbing.

This climbing guidance system that expressed 3D image on PDA can be easily implemented if the DEM and raster images such as satellite imagery are prepared. We can navigate to all climbing course before climbing a mountain, and understand distance to destination point in advance as well. The function of the system is similar to car navigation, but the system will be only used in a mountain.

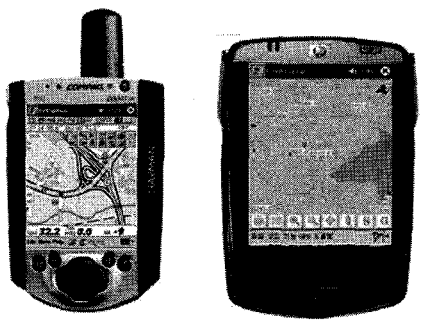
2. 2D CLIMBING SYSTEM

Prior to explain the proposed system, we discuss previous systems that have the same function with our system.

The climbing guidance product for outdoor is divided two types: one is a dedicated terminal, another is a combined terminal. In general, the former is built-in GPS or may have a digital map. The product of the Magellan and the Garmin companies represent the dedicated system.

The latter is almost PDA-based system. It have to install the climbing software, and most of them requires a map with geographical coordination.

(a) Magellan Merdian (left) Garmin 60 CSx(Right)



(b) OziExplorerCE (Left), Roadmountain(Right)

Figure 1. Conventional Navigation System for outdoor

Figure 1(a) shows the main product of Magellan and the Garmin. Figure 1(b) shows the OziExplorerCE which is the PDA-based navigation system of the OziExplorer co., and the RoadMountain of the GisSoft in Korea, respectively. All of them support 2D graphic for indicating a mountain.

The climbing guidance system of this paper corresponds to the combined GPS and supports 3D graphic.

3. 3D CLIMBING SYSTEM

3.1 System Overview

The whole block diagram of a system implemented in this paper shows in figure 2. The DEM, satellite image or topographic and vector data for mountain trail are used as element data for generating 3D map which would be used in PDA. The generated data is inputted through 3D climbing guidance program to PDA and is used in climbing.

And the various information, climbing trail or principal point, which is obtained while a climbing is stored as the determined format. By using the commercial software after a climbing, the information processes or can utilize. Moreover, it can be shared with other people.

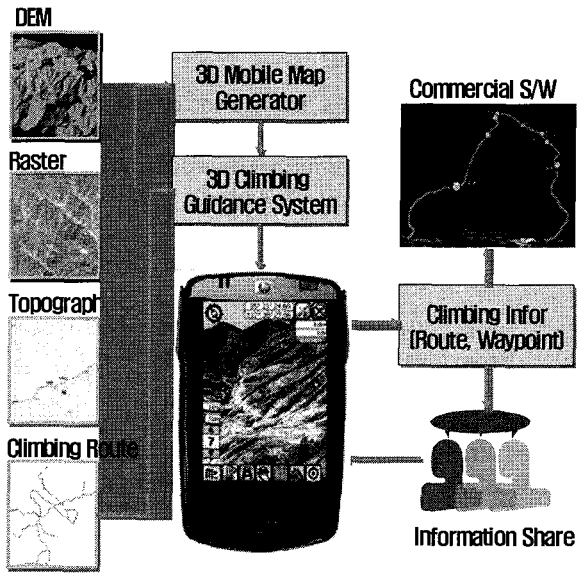


Figure 2. System Overview

3.2 3D Mobile Map Generator

In this system, the satellite image and DEM was made with the integrated file which is the data structure of being divided into Parcel. Therefore, the data can be used in PDA which has low processing CPU.

3.2.1 Construction of DEM

DEM data is the geographic information including the height information and is generated by using DXF data. TIN is produced through filtering and coordinate conversion by using the DXF File information. By using generated TIN, DEM is produced.

Data in each level of Parcel is integrated, divided and edited by using the DEM. In this way, the DEM which is divided to the Parcel unit have a gap that appeared the neighboring Parcel. In this case, the gap is processed in order to be connected blandly by using the neighboring Parcel DEM.

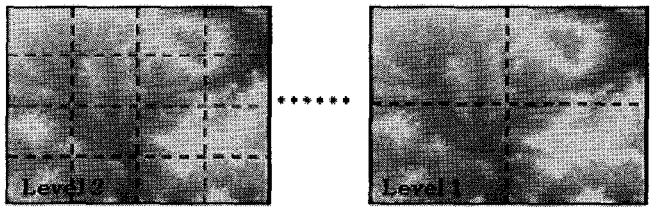


Figure 3. Multi-level DEM

3.2.2 Viewing of 3D map

3D spatial data and 2D vector data consist of various data format. Moreover, in order to display a lot of graphic files corresponding data is loaded through the related import module.

3D climbing guidance system on PDA supports the various kinds of file format as follows:

- Vector data file(*.shp, *.shp, *.dbf)
- DEM file(*.dns)
- Raster Image file(*.rns)
- Climbing trail(*.gtm)

3D spatial modeling modules change, and manage to 3D spatial data structure for real-time visibility by using 3D spatial data and 2D vector data.

If all of data is changed to 3D spatial data, the related data , Parcel data is stored including the multi-layerd information and Parcel information.

In this system, the function of visualizing data based on the OpenGL ES on a real-time basis is performed.

3.3 3D Climbing Guidance System

3D climbing guidance system is initiated after 3D mobile map which is introduced in 3.2 section is loaded.

The minimum requirement specification for the climbing guidance system implementation is as shown in Table 1.

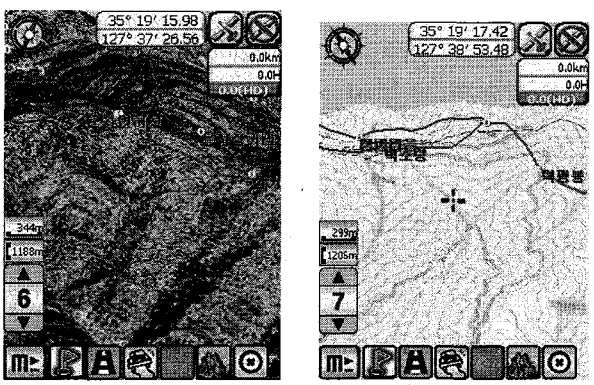
Table 1. Requirement for climbing guidance system

Functions	Description
Display	Automatic movement of the current position operating with GPS
	Zoom, Tilt and various movement
	Longitude and latitude coordinate, the altitude, and the compass function
Climbing	Save of the current position, climbing trail.
	Load of The previous trail
	Destination setting function
Additional	A distance to the destination and guide.

	The distance display according to the Zoom function.
	Automatic navigation according to the trail

Of course, the additional requirement except the listed function in the upper part need for the perfect guide system. However, the above functions are the requirement surely needing for a climbing.

After the climbing program is enforced, if a user selects the acid desiring a climbing, 3D mobile map which is combined a satellite imagery and DEM will be loaded on PDA screen. The result shows in Figure 4.

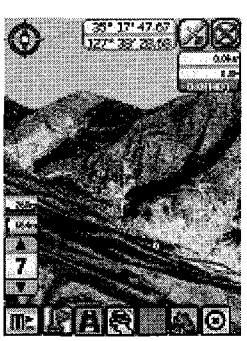
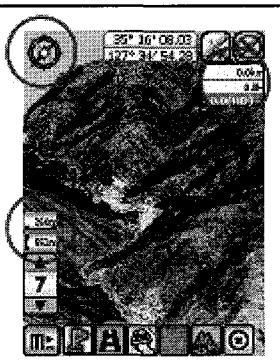


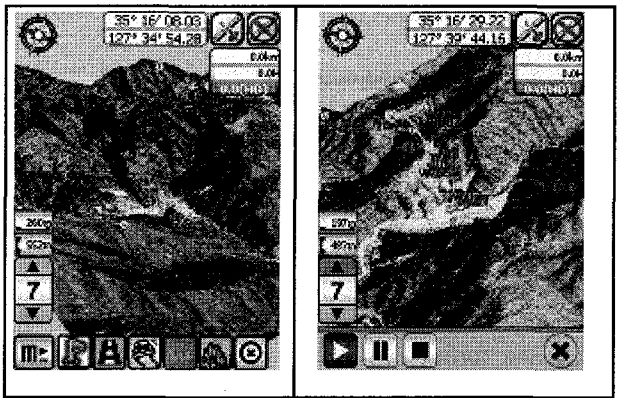
(a) Satellite Imagery (b) Topographic

Figure 4. Load of 3D Mobile Map

The table 2 illustrates the general main contents among the function listed in the table 1 with a screen.

Table 2. Genaral main functions

3D Map	Easy screen configuration
	
It automatically moves to current position if 3D map is loaded.	Compass, GPS status, altitude can be easily known
Easy screen manipulation	Simulate Driving



Rotation, translation, zoom functions are able to manipulated with one button.	The simulate driving available along the previously climbing trail

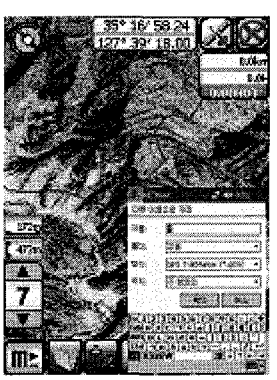
The table 3 shows the main items among the function which is directly associated with climbing. Climbing trail can be saved to .gtm file format in order to be compatible with dedicated terminal for climbing.

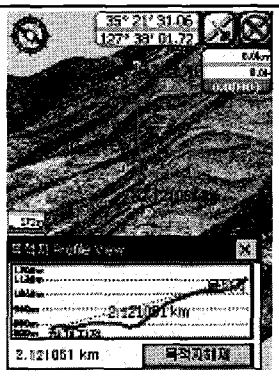
The destination setting mode can classify into 3.

- From a waypoint in Previously saved trail
- From a geographical coordination
- From the 3D map

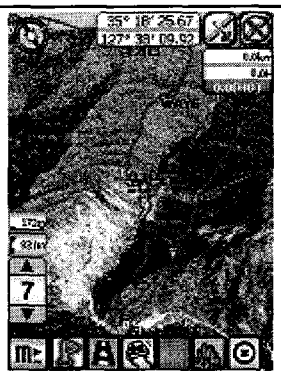
The straight distance to the destination location and altitude of the section can be confirmed if the destination setting is done.

Table 3. Climbing functions

Trail saving	Destination(setting)
	
The principal point and trail of climbing course can be saved with .gtm file format	Setting from .gtm file, geographic coordination and 3D map
Destination(information)	Application of .gtm file



Altitude profile to the destination



GTM file is utilized for a climbing

One of the major properties of this system is that one can refer to a climbing by using a trail which is obtained with the other man. Anyone can enjoy climbing without deviate from path up a mountain if GTM file is referred to.

3.4 Application of climbing information

If a climbing is finished, the trail and the principal point obtained from climbing are stored in PDA as one file. This file is the format supported in the general purpose software called the GPS Trackmaker., and the program calls the Google Earth and can express the three-dimensional trail.

Figure 5(a) is the result that it loads the trail through the GPS Trackmaker program, and Figure 5(b) shows the result that it expresses the trail in Google Earth by using the program.

4. FIELD TESTING

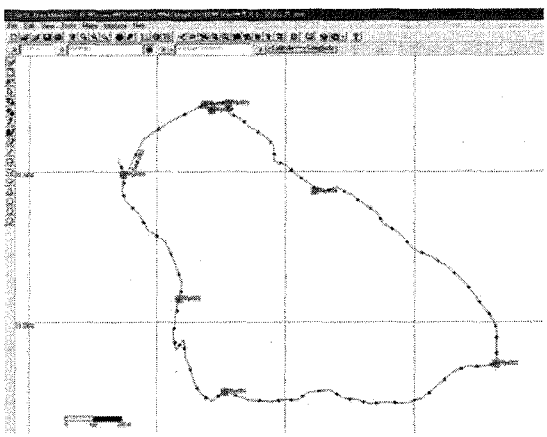
While developing 3D climbing guidance program, the periodic field test was performed. The field test place is the Kyeryong and Jiri mountain national park of the Republic of Korea. The field test of about 7 times was achieved. The program was modified based on the test result

PDA used for the field test is the HP iPAQ 2750, and the GPS used the receiver of the Bluetooth base in which the SiRFIII chip of the SysOnChip corp. is built in.

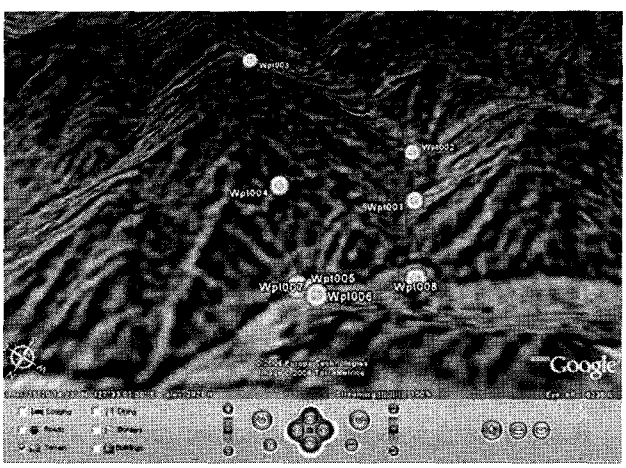
The maximum weakness of the climbing navigation system of the PDA base is the battery problem. However, if the back light of PDA is fitted with the power saving mode, in case of battery with 1440mA, climbing for 7~8 hours is possible. So, in the general climbing, it is determined that it does not have the any problem.

In the thick forest, the result that the performance of the GPS receiver is satisfied was shown. The performance of GPS receiver is considered to be gradually improved in the future.

Because a location can be more accurately determined in case of using the topographical map instead of satellite image, according to a need, it will be helpful to a climbing to altogether prepare for two kinds of data.



(a) Track management in GPS Trackmaker



(b) 3D view in Google Earth

Figure 5. GPS Trackmaker and Google Earth

5. CONCLUSION

This paper introduced the result of the 3D climbing guidance system development which has 3D mobile map and various climbing functions.

The proposed system can overcome the problem that is the 2D map based conventional system had difficulty of the read, and was developed in order to have data compatibility with the other system.

It is expected to provide the superior service to the climbing person through the information sharing of data and realistic climbing map.

6. REFERENCES

Des & Lorraine Newman, OziExplorerCE in http://www.oziexplorer.com, Brisbane, Australia.

D. H. Chung, Roadmountain in http://www.gissoft.co.kr

http://www.garmin.com/outdoor

http://