

GreenWalker: connecting biotope field information with three layer image data format using GPS of F505i

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Abstract: We propose a real-time field monitoring software with digital watermarking based interface and plug-in DLL for storing biotope information coordinated by GPS of generic mobile phone. In proposal system, the latitude and longitude is translated to the coordinates of image on display, which makes it possible to store the field information as digital watermarking. On the field, the researchers send the device send the coordinates and field information to ASP (Active Server Pages) with plug-in DLL which provides the arbitrary socket connection through the web browser of cellular phone. On the server side, field information is embedded into images as digital watermarking, which provide the quick graphical search without spatial database operation. For the effective analysis on server image, the three-layer image data format that makes it possible to synthesize two kinds of related images and analysis information in one image data size is presented. In this paper we made a prototype of plug-in DLL of ASP. The proposal system is tested by using GPS of generic mobile phone F505i.

Keywords: real-time field monitoring, connecting GPS with watermark image, graphical search of the remote field information, plug-in DLL for ASP, GPS of F505i.

1 Introduction

Recently the rapid advance of technologies of GIS and GPS, a new paradigm have been come out for field information collection based on the ability to integrate distributed geo spatial data resources in hand-held computer environment. With the convergence of Internet, wireless communications and ubiquitous devices, field computing have become the attractive topic to nowadays mobile computing. There are many researches and commercial services of integrating GIS/GPS with relational database management systems and WEB services. However, it is not reasonable for all field workers to utilize these systems. In this paper we propose a handy and simple remote site analysis system with real-time measurement. In the proposal system, field workers do not need the devices specified for field computing. We can construct the environmental field computing system with household cellular phone and lightweight of PWS and IIS that Windows equips default. This paper presents the novel field computing software with generic server application and mobile phones.

1.1 Site analysis

In this paper we attempt to fasten environmental site analysis by tracking the output information of field computing on real-time. Site analysis evaluate the suitability of a specific piece of target area

accounting into the factors such as economical, biological, physical categories, social-cultural and infrastructural categories. Among these categories we focus on biological and physical categories, that is environmental categories. Site analysis usually output the value by statistical calculation from many items with weighting. The calculation itself is not so complicated itself (excluding the cost of collecting data of social-cultural and infrastructural categories). Focusing on biological and physical categories, site analysis could be real-time by applying some kind of field computing methods.

1.2 Field computing

With the recent advances of mobile information devices and systems, field computing, based on the concept that computing can occur anywhere is immediately becoming attractive field as complement for GIS and GPS system. Accompanied with wireless devices, field computing is combined with GIS, GPS and remote sensing system with the help of Web and RDBMS technology. That is, as the internet and wireless communication is converged, field computing can be complement these geographical research system with real-time information providing. In this paper we propose a method to integrate field computing with GIS for real-time natural resource monitoring.

1.3 Biotope

Sustainability is one of the most important problems in 21st century. Among many approaches for realizing ecological system, we focus on biotope which is the area environmentally stable with inhabited by many kinds of animals and plants and microorganisms. “Bio” means life and “Tope” means place originated from Greek word. Biotope is also designed on a human concept to achieve sustainability and diversity for the target area.



Figure1. Biotope (artificial)

2 Proposal system

Proposal system consists of three components, digital watermarking based GIS software, GPS of mobile phone and server side scripting technology which connecting these two GIS and GPS components.

2.1 Active Server Pages

ASP(Active server pages) is an ISAPI (Internet server application programming interface) extension which is compile free application environmental. This server side scripting technology in which you can use HTML, scripts, and ActiveX components to create dynamic pages. ASP is browser independent, so we can connect HTML generated on this technology by any kind of cellular phone.

Figure2 shows the structure of Active server pages. ASP.dll is core engine of this technology. ASP.dll is loaded when the application object is created, in order to find what kind of scripts are needed. Scrobj.dll is loaded and constructs a dynamic IDispatch object according to the source code.

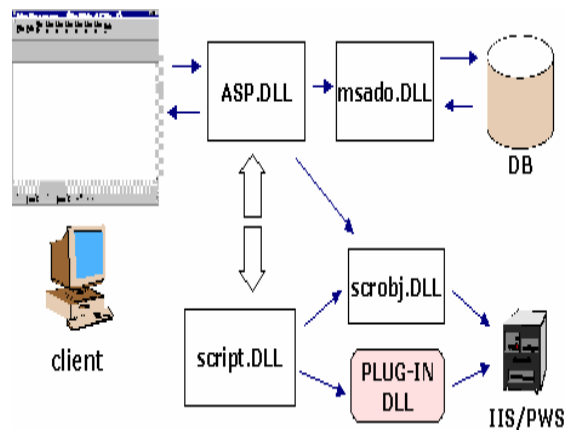


Figure2. Active Server Pages

2.2 F505i

In this paper we use F505i as GPS devices. This cellular phone was released in 2003. F505i is the first device to equip fingerprints instead of passwords or code number to grant access to users handsets. Although F505i is not the newest mobile phone, this model takes advantages that we can get the value latitude and longitude directly. This phone is rare in that the raw value of longitude and latitude can be gained. In the newer model to this one, the coordinate value is not showed to users, but referred another component such as GIS application.



Figure3 F505i

2.3 Bitplane decomposition

The digital image consists of pixels. Pixel is a computer term, meaning picture element. A digital color image pixel is a RGB data value. All colors are represented by the combination of three numerical RGB components. Three 8-bit bytes (one byte for each of RGB) is called 24 bit color. Each 8 bit RGB component can have 256 possible values, ranging from 0 to 255. In the case of 2 binary system, an 8 bit byte can contain one of 256 numeric values ranging from 0 to 255, because 2 to the 8th power is 256, as seen in the sequence 2,4,8,16,32,64,128,256. In this paper, we call planes [128,64,32,16] upper layer and [8,4,2,1]

lower layer. Although the lower layer of the synthesis image are distributed, the resulting image is perceptually equivalent to the original. It enables us to store the information of two images and its notes into size of a single image without the loss of visible quality of each image.

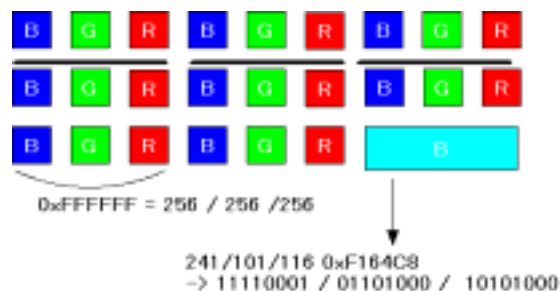


Figure4 Bit plane decomposition

	Bit Plane	Frequency
Resolution	High	low
Robustness	Low	high

Table1 Comparison of bit plane and frequency

Table1 illustrates the comparison of two kinds of decomposition: frequency transforms and bit plane based. Although bit plane technique is not so robust of filtering images like DCT in JPEG, the high resolution is available in possibility of retrieving several matrix from one image data.

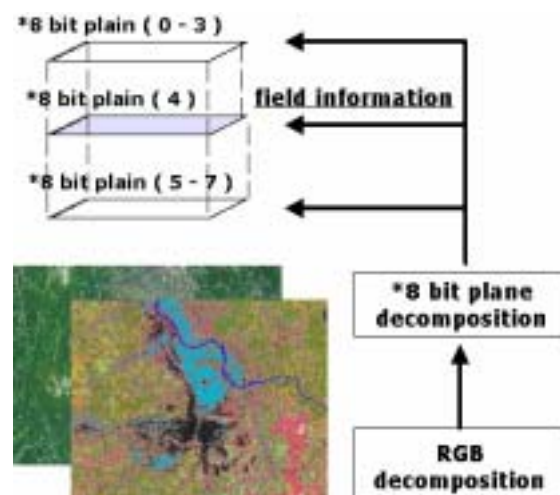


Figure5. Three layer image data structure

2.4 Three layer image data structure

Three layer image data structure is watermark based technology which embed two images and

one archiving information header into a single image. In Figure5, vegetation map and field information is watermarked into the aerial image. This method relies on HVS (Human visual system) watermarking which is supposed to be invisible for human eyes and undetectable without information to detect. Aerial image and biotope map is usually analyzed by human experts. Consequently, it is possible to synthesis two images and its archiving header into one image without loss of effectiveness of analysis. As shown in figure, three layer image is decomposed into 8 layer as follows:

Layer[0]-[3] : assigned for aerial image data

Layer[4] : field information

Layer[5]-[7]: assigned for biotope map data

Based on HVS watermarking techniques, users can analyze these two image while maintaining reasonable quality for analysis. Besides, it is possible to retrieve logs to process and archive without database and searching.

3 Client software

This software is expected for the analysis of GIS images such as aerial photographs, remote sensing data and biotope map. This software is now under improving and we provide a part of prototype as open source software.



Figure6. Client software: GreenMarker

The components of our system are

- [1]Console window (main images to be clipped)
- [2]Writer (watermarking information)
- [3]Reader (retrieving information)
- [4]Thumbnail window (to display biotope map and aerial images)

[5]ProgressBar (to show the decomposed image and progress)

Now we are developing GreenMarker version 3. Only limited version (including Writer and Reader) is available because some images are confidential and the current version is planning to be opened when the next version 4 is completed.

4 Implementation

In this section we present the proposal system implantation. The component prototype is plug-in component of server side technology and bit-plane decomposition based image processing.

4.1 Plug-in component

On F505i, we can implement JAVA applet called iAPPLI. This series has the format of PDC. It follows that users cannot use sockets with pointing the certain number of port. It also mean that iAPPLI is only of the use in domestic. To solve this problem, we prototype the plug in DLL for Active server pages. As we discussed before, on ASP, HTML is generated dynamically by the server side engine such as ASP.dll, scrobj.dll. By using our plug-in DLL, field workers can use the socket connection and execute arbitrary script by using their generic cellular phone.

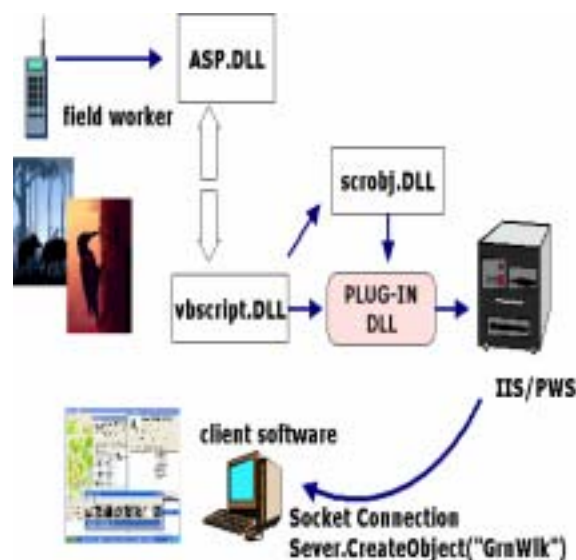


Figure7. Proposal system

4.2 Image synthesis

After obtaining the process log and field information, it becomes possible to embed these into one image file with two images. The image

file consists of three layers assigned to eight planes in hexadecimal expression: 0x01.0x02.0x04.0x08, 0x10, 0x20, 0x40, 0x80. By the operation discussed in the next section, we can retrieve each layer from one image file.

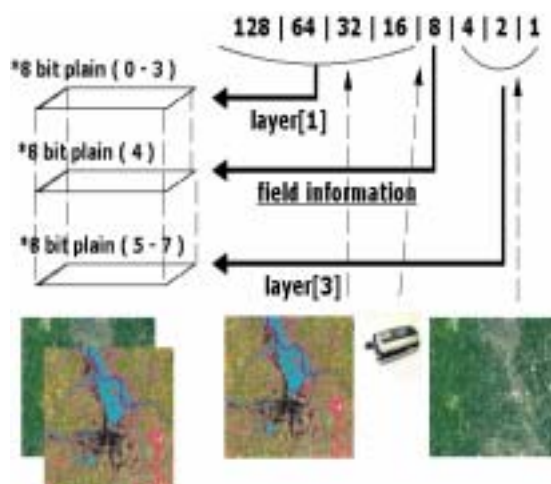


Figure8. Image synthesis of GIS map

Figure8 illustrates the image synthesis, which is divided into these 6 steps:

- Step 1 Decompose the two target image into RGB
- Step 2 Express the RGB value by hexadecimal number
- Step 3 Omit the lower layer (40x01,0x02,0x04,0x08)
- Step 4 Select which images are lighted
- Step 5 Shift operation to hide the images into lower layer.
- Step 6 Insert the archiving layer and synthesize the image

Extraction of image is as follows.

- Step 1 Decompose the two target image into RGB
- Step 2 Express the RGB value by hexadecimal number
- Step 3 shift operation to reveal the images embedded into lower layer.
- Step 4 Shift operation to hide the images into lower layer.
- Step 5 Insert the archiving layer and synthesize the image

5 Experiments

5.1 Measuring Image PSNR

In this section the experimental results are presented in applying proposal image synthesis method. We compared synthesized image with original image by calculating Peak Signal to Noise Ratio.

$$PSNR = 10 \times \log_{10}(255^2 / \sqrt{MSE / (Width * Height)})$$

	Aerial	Reverse biomap
Red / 8 th	32.12	26.506
Red / 7 th	28.067	14.234
Red / 6 th	31.216	13.245
Red / 5 th	30.67	23.435
Blue / 8 th	33.509	30.139
Blue / 7 th	29.782	31.467
Blue / 6 th	32.358	30.987
Blue / 5 th	30.126	23.296
Green / 8 th	33.872	29.873
Green / 7 th	29.347	16.652
Green / 6 th	32.156	17.923
Green / 5 th	30.912	12.398

Table. 2. Aerial Image PNSR.

Table2 depicts PSNRs in insertions of archiving header into each [5-8] bit plane of RGB components. The quality loss of synthesized image is remarkable when we embedded information layer to green layer[] and red layer[]. It is effective to insert archiving header into the layer [5-7] of blue component.

5.2 Function test

In this paper, we prototype the plug-in DLL to embedded filed information into Client software coordinated by GPS value. Plug-in DLL is implemented as ActiveX component and applied in the scripting code as follows.

```
Set objSocket=
Server.CreateObject("GrnWlk.socket")
objsocket.Timeout=N
objsocket.open client_address, "TCP", portNO
objsocket.SendLine longitude
objsocket.SendLine latitude
objsocket.SendLine Field information
```

The protocol between ASP and client software is TCP. The longitude and latitude gained by F505i is sent with field information. We are planning to provide this code as open source software.

6 Conclusions and further work

We propose the real-time field monitoring software with digital watermarking based interface and plug-in DLL for storing biotope information coordinated by GPS of generic mobile phone. In proposal system, the latitude and longitude is

translated to the coordinates of image on display, which makes it possible to store the field information as digital watermarking. On the field, the researchers send the device send the coordinates and field information to ASP (Active Server Pages) with plug-in DLL which provides the arbitraty socket connection through the web browser of cellular phone. On the server side, field information is embedded into images as digital watermarking, which provide the quick graphical search without spatial database operation. For the effective analysis on server image, the three-layer image data format that makes it possible to synthesize two kinds of related images and analysis information in one image data size is presented. In this paper we made a prototype of plug-in DLL of ASP. The propasal system is tested by using GPS of generic mobile phone F505i.

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