3차원 지도에서 파노라마 전경 표현을 위한 단위 블록 디자인에 관한 연구*

Block Unit to Present Panoramic View in 3D Map

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Abstract

This study aims to develop a 3D map which allows users to better understand the overall topography and to memorize the general concepts of the current location for tourists. The Map also utilizes different forms and color codes of the block units in the panoramic view. First, in preparation for making the road block unit, 28 types of roads presented in common map were defined. Based on the definitions, 12 dominant groups were formed. In designing each form, visual correlation was considered. Second, 42 types of terrain features presented in normal maps were defined for making the panoramic block unit. Then, 2 dominant groups, each contains 5 subgroups, were made according to the assemble pattern and the size of area. On the basis of the grouped units, the panoramic block units were produced with 3D pole line graphics maintaining integration. Lastly, each panoramic block units were categorized by color classes such as blue, green, gray and brown class. The overall color combination of the work was evaluated as well harmonized since the Moon&Spencer's Aesthetic measure value exceeds 0.5.

Keywords: 3D Map, Block Unit, Panorama View

요 약

본 연구의 목적은 관광을 위하여 전체적인 지형을 쉽게 이해하고, 전반적인 위치를 암기하기 쉽게 하는 3차원 지도 개발이다. 이를 위하여 파노라마 전경의 블록 유닛 형태 그리고 파노라마 블록 유닛 전경의 색채 계획에 관하여 논하였다. 우선 도로 블록을 제작하기위하여 28 종류를 정의하였고, 이를 기초로 12종류의 주요 그룹을 제작하였다. 그리고 파노라마 블록 유닛을 제작하기 위하여 지도에 표현된 지형 42 종류를 정의하였다. 후, 조합되어지는 방식의 유사도 따라서 5종류의 그룹으로 분류 하였고 그리고 표현되어지는 면적의 크기에 따라서 5종류의 그룹으로 분류 하였다. 이를 기초로 파노라마 블록 유닛을 3차원 그래픽 구조물의 형태로 디자인 하였다. 마지막으로 파노라마 블록 유닛 각각을 5가지의 다른 색깔 클래스로 구분하여 색채를 계획하였다. 색채 계획의 타당성을 조사하기 위하여 문 스팬스의 미적 측정 값을 조사하였다. 결과 값은 0.5보다 크므로 제작된 칼라의 조합은 잘 조화된 것으로 평가되었다.

주제어: 3차원 지도, 단위 블록, 파노라마 전경

1. Introduction

1.1. The Background of Research

In the past, maps were used only for military or commercial subjects. These days, various types of maps are used especially for tourism in accordance with the increasing interests in leisure time. On that point, it is necessary for the nonprofessional map reader to have an easy map to understand and to find out the accurate location.

The advancement of computer related media technology enlarged its sphere of variety in contents. Compared with the old-fashioned map which consists of text, 2D symbols and graphics, present technology allows materializing more interactions on the map with advanced text, graphic, sound, animation and video technology. Drawing understandable and comprehensive map is a state-of-the-art media and presentation technology. Because of that, the digital 3D map is able to expand its territory and expect more and more in the future.

There are several researches examining elements of 3D map such as intersections, artificial structures, or topographical lexicons. On the other hand, researches about the panoramic view including the shape of road are still insufficient. Panoramic view helps user read the overview of the map easily. With the panoramic view applying the caricature style emphasis and omission techniques, itis handy for user to get to the point or to memorize specific point or characteristics in an instance. So, this study covers the shape and the color plan for the overall panoramic view production.

1.2. The Range and Methods of Research

This study deals with shape of panoramic view and the color plan for the panoramic view. Everything produced here shall be limited to the work of 3D pole lines. Volume and color matters derived from the mapping technique shall not be considered. In general, drawing specific roads or general view takes large part of the map graphic. Legends and texts take only small part of the map. That is the reason the color plan is required. In this study, RGB color shall be the basic color. Then, through the CMC 2007 software, transformed to Munsell's HC/V color shall also be used.

2. The Range and Types of the Developed Block Units

There are a numerous type of maps. Military maps focus on the accuracy and reality. For children, simple graphics concentrated on comprehensiveness and understanding the general concepts of coastline and other important sites are preferred. In this study, improved abstractness has more priority than mere realistic description. In a certain position on the map, natural and artificial objects are presented with their names. The ways of presenting them are diversified by target users, functions and objects. The explanation note, color and text style of the map should be easy to recognize. When taking a picture above the earth, everything isjust a plat view. However, by its content related to context, user and media, it is able to be recognized with different shapes, colors, lexicons, interfaces, symbols and graphics. The map aimed to develop in this study is the color-oriented map which reflects the 3D structures and terrain features in friendly 3D space. Instead of excessive reality and accuracy, easy understanding and comprehensiveness is the main goal in this work.

3. Development of Area Block Units

On the present soil maps, geologic maps, climatic maps, vegetation maps, zoning maps, land-use maps, road maps, and many other types of maps, there are miscellaneous ways to present the panorama block. In particular, the height of mountain is represented by different chromatic levels depended on who drafted the map as well as the downtown area. On most maps, there are no uniform cords to distinguish sea from the ricer or reservoir and to draw the park.

Panoramic block seemed originally to be a type of legends. In this study, however, panorama block was considered as a new-type block for presenting area images. After setting up the panoramic block types among collected maps, the range of expression was defined. Six experienced experts were involved in the work and once each block was defined, the chief of this research was responsible for that how far and what it covers. At the end of the first procedure, 30 types of panorama block were defined and later, with the experts' opinion who urged more since it was the first block for presenting area images, 42 types were finally made. Then, 3 designers took charge of each different group of block. Among them, the simplest one was chosen to step forward for color adjustment and harmonizing procedures.
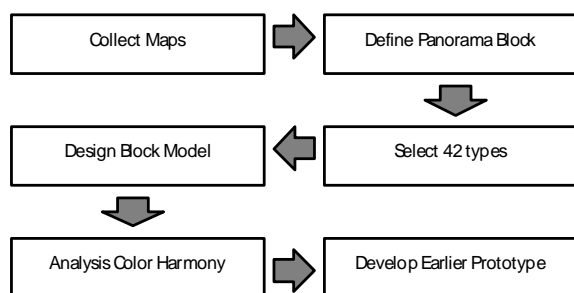

Fig 1. Process of developing Panorama Block

3.1. Shape of Panorama Block

Many maps use the shape or pattern mark, shown as [Figure 2], to express the terrain features. Size, shape, tone, value, texture, orientation, and hue are very common features on the map as well as point symbol, line symbol, and area symbol. These shapes are mostly used for the 2D maps. On 3D map, the shapes are used with different mapping techniques. Instead of that 2D like way, the main focus of panoramic block in this study was on the 3D structures. Rather than the mere description, abstract symbol which has more cognitive value was aimed to draw as the goal. For that purpose, as some shapes of [Figure 2], difficult for average users were boldly omitted.
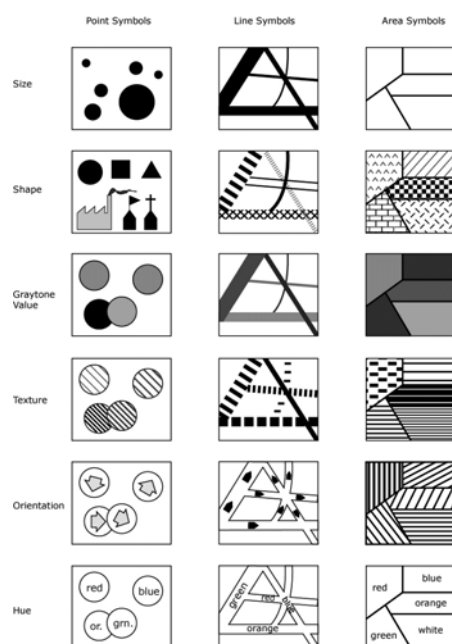

Fig 2. A selection of Shape or pattern style for presenting special area on map[1]

This study suggests 3D graphic shapes in considering user-oriented idea. To make a 3D panoramic block, 42 types of panoramic blocks that were already defined were grouped. [Figure 3] shows the 5 most dominant groups. A type contains looped(closed) contours. The coastline or fence surrounds the terrain. It is better to prepare at least 9 block designs for drowning that type of close terrains. Depends on the situation, reserving multiple designs for the middle block is good for the various effects. B type blocks require at least 4 blocks and each uses differently patterned 3D graphic shape designs as other blocks. In the C type blocks, a sense of direction when putting the 3D graphic shapes on the map is considered as an important element. For example, a river-flow and its outer boundary must maintain the same directions; and the incline of cliff should be distinguished from the bottom. D type is merely an event-like 3D graphics block in a large area. Seagulls flying in the sky or the yachts on the sea are the examples. E type requires a sense of height. To give users the information about the height of certain mountain, differentiated colors are needed.

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1) John Krygier, Denis Wood, (2005), Making Maps: A Visual Guide to Map, Design for GIS, The Guilford Press
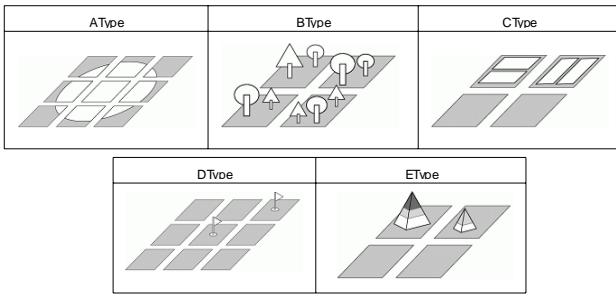
Fig 3. Panorama block type according to assemble pattern

■ A Type:

Lake, Ranch, Development District, Reservoir

■ B Type:

Forest, Plain, Stone Mount, Sand Plain, Stone Plain, Gravelly Field, Grassplot, High Building, Civil Constrict, Public Park, Rice field, Sparsely Village, Vegetable Garden, Cottage, Tree Garden, Apartment, Villager's House, Hot Spot, Middle Building, Traditional House, Farm, Graveyard, Shopping Area, Parking Lot, Camp Area,

■ C Type:

Terrace Land by River, Foreshore, Cliff, River,

■ D Type:

Ocean, Golf Area, Island, Plaza, Vacant Lot, Breakwater, Vinyl House

■ E Type: Mountain, Hill

And shown as [Table 1], panoramic block can be divided into five groups according to the frequently used area size. When the size of areais on top in large area, blocks are piled up repeatedly. This type of block must be produced with minimum 3D pole lines as well as low level concentration. When the size of area is on the down level, everything is limited to that small area, except for that the area has some special, culturally or socio-regionally, characteristics. That is something like legend on the map. The only difference between them is that the blocks show the area in contrast of that the legend shows certain point. In addition, high brightness can use more pole lines. Many other blocks come under the middle-down size of area.

Table 1. Panorama block type according to size of area

Size of Area	Panorama Block Name
Top	River, Ocean, Mountain, Lake
Top–Middle	Foreshore, Plain, Fores
Middle	Development District, Stone Mount, Sand Plain, Stone Plain, Island, Hill, Gravelly Field, Grassplot
Middle–Down	High Building, Golf Area, Civil Constrict, Public Park, Plaza, Rice field,Terrace Land by River, Sparsely Village, Vegetable Garden, Cottage, Tree Garden, Apartment, Villager's House, Hot Spot, Reservoir, Cliff, Middle Building, Traditional House
Down	Vacant Lot, Farm, Graveyard, Ranch, Breakwater, Vinyl House, Shopping Area, Parking Lot, Camp Area

3.2 Color of Panorama Block

Shown as the [Figure 4], colors used for map are mainly divided in 2 functions. The left picture shows the water consuming amount per parcel. Date for water used per parcel demonstrates light-to-dark colors that parallel low-to-high date ordering. In this case, ranked classes rather than numerical date ranges are shown on the map. The right side of the picture shows the qualitative date of minority group with highest percent of county population excludes white, not Hispanic in USA. Varying the brightness or saturation of color from 0% to 100%, it is possible to express sequential date on the map effectively. Same as the hue value for qualitative date. Between the similar categories, colors which have close hue values help user to read the overview of entire map easily.
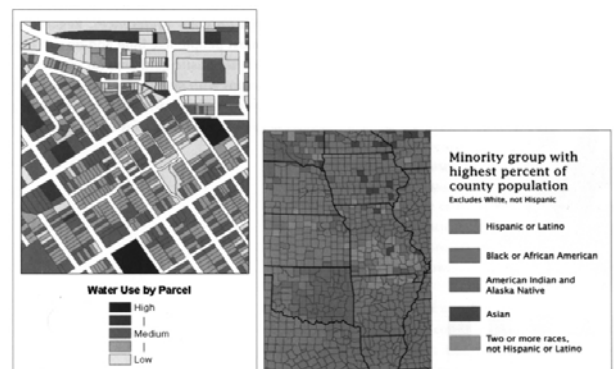

Fig 4. Color usage for presenting special area on map[2]

Colors for 42 panorama blocks are designated with consideration of sequential data or qualitative date schema. Particularly, E type panoramic block of [Figure 4] contains sequential date, so brightness (V) or saturation(C) values are considered. [Table 2] shows the 42 panoramic blocks' color division. In the process of research, bringing the most natural color took priority of the work as well as the size of area. In [Table 2], Cottage, Graveyard and Camp Area has different colors according to social or cultural background. High and middle building area are normally colored with green; and shopping area blue. It is a kind of language of color which helps to distinguish Industrial area is shown as yellow. The Simcity game developed by Maxis in 1992 adopted same color system. the living area from the commercial blocks.

Each panoramic blocks shapes, assemble patterns, area ratios, main colors, sub colors and special colors were arranged in a format as [Figure 5]. Main color took the main role on the map; sub-color brought variation to the shape of panorama; special color highlights some specific points.

Table 2. Panorama block color division according to characteristic

Color division	Panorama Block Name
Blue class	Ocean(T), River(T), Lake(T), Reservoir(M), Shopping Area(D)
Green class	Mountain(T), Forest(TM), Plain(TM), Grassplot(M), Hill(M), Island(M), Rice field(MD), Vegetable Garden(MD), Golf Area(MD), Terrace Land by River(MD), Cottage(MD), High Building(MD), Middle Building(MD), Tree Garden(MD), Farm(D), Ranch(D), Graveyard(D)
Gray class	Foreshore(TM), Stone Mount(M), Stone Plain(M), Development District(M), Gravelly Field(MD), Development District(MD), Civil Constrict(MD), Hot Spot(MD), Villager's House(MD), Apartment(MD), Parking Lot(D), Breakwater(D), Vacant Lot(D), Vinyl House(D)
B r o w n class	Sand Plain(M), Cliff(MD), Public Park(MD), Plaza(MD), Traditional House(MD), Sparsely Village(MD), Camp Area(D)

(T)=Top, (TM)=Top & Middle, (M)=Middle, (MD)=Middle & Down, (D)=Down

2) Source: ESRI ArcGIS sample Maps data.

			Main Color	
			RGB =0.153.255 HVC=4.3PB 6/14	
			Sub Color	
			RGB =0.153.51 HVC=1.3G 4/8	
River Area	Objects	Tree	Special Color	
	Type of Block	B type		
	Text Present	Low		
	Area ratio on map	TM		

Fig 5. A sample of color definition for panorama block

Then, the G.D Birkhoff[3] function was used to allot the aesthetic measure for the color format. By the idea of G.T Fechner[4] that the beauty is expressed as unity among variety, G.D Birkhoff suggests a function which regards the color as a volume one and is able to apply to Moon&Spencer[5] color system.

$$\text{Aesthetic Measure (M)} = O\ /\ C \qquad (1)$$

M; Aesthetic Measure

O; the number of elements of order

$$O = \text{Identity} + \text{Similarity} + \text{Contrast} \qquad (2)$$

At first, combine colors in pairs. Then, examine the color property value in Identity, 1st ambiguity, Similarity, 2nd Ambiguity, Contrast, or Glare. Lastly, after multiplying the value by Aesthetic factors a shown in the [Table 6.4], sum upresults.

C; the number of element of complexity

3) G..D. Birkhoff, Aesthetic Measure (1933), Harvard University Press, Cambridge, Massachusetts

4) A German physicist, psychologist (1801~1887), as the founder of experimental psychology, he established the law of Fechner based on the qualitative relationship of stimulus/response. G.T. Fechner, Vorschule der Aesthetik (1876), Leipzig

5) Parry moon, Domina Eberle Spencer, Aesthetic Measure Applied to color Harmony (1944. April) Journal of the Optical Society of America, Vol 34, No. 4, page 234-242

C = (No. of colors) + (No. of pair of colors having Hue difference) + (No. of pair of colors having value difference) + (No. of pair of colors having chroma difference) (3)

An achromatic color shares no chromatical relationship with other colors. So, only brightness does count, plus coefficient of achromaticity (G)=1. About the function, Moon&Spencer said "when the value of M exceeds 0.5, it is reached to the general level of the beautiful.

And more M valve guarantees more harmony." Moon&Spencer also tried to make a scientific explanation about the principles of color harmonizing through setting up the cubical color dimension which brings standard color coordinates. The regions variation of identity, ambiguity, similarity and contrast value of hue, value, and chroma are shown on [Table 4]

Table 3. Aesthetic factors

	Iden-tity	1st Ambi-guity	Simi-larity	2nd Ambi-guity	Con-trast	Glare
Hue(H)	+1.5	0	+1.1	+0.65	+1.7	
Value (V)	−1.3	−1.0	+0.7	+0.2	+3.7	−2.0
Chroma (C)	+0.8	0	+0.1	0	+0.4	
Gray (G)	+1.0	–	–	–	–	

Table 4. The regions variation of identity, ambiguity, Similarity

Variation from Chosen Color	Iden-tity	1st Ambi-guity	Simi-larity	2nd Ambi-guity	Con-trast	Glare
Hue (H)	0 ~ 1jnd*	1jnd ~ 7**	7 ~ 12	12 ~ 28	28 ~ 50	
Value (V)	0 ~ 1jnd*	1jnd ~ 0.5	0.5 ~ 1.5	1.5 ~ 2.5	2.5 ~ 10	>10
Chroma (C)	0 ~ 1jnd*	1jnd ~ 3	3 ~ 5	5 ~ 7	> 7	

* Just noticeable difference
** Division into 100 from Munsell Color Table

Table 5 No. of the regions variation of identity, ambiguity, Similarity

	Iden-tity	1st Ambi-guity	Simi-larity	2nd Ambi-guity	Con-trast	Glare
Hue(H)	29	143	106	315	312	
Value (V)	55	58	194	162	313	
Chroma (C)	73	193	119	116	356	
Gray (G)	9	–	–	–	–	

The Aesthetic Measure used in this study is as followed. Eq. (1) is M=O/C

C = 40 + 905 + 782 + 857 = 2584

O= 823.5 + 1158.1 + 212.7 = 2194.3

M = 2194.3 / 2584 = 0.849

Since the Aesthetic Measure (M) value exceeds 0.5, the color combination seems to be harmonious.
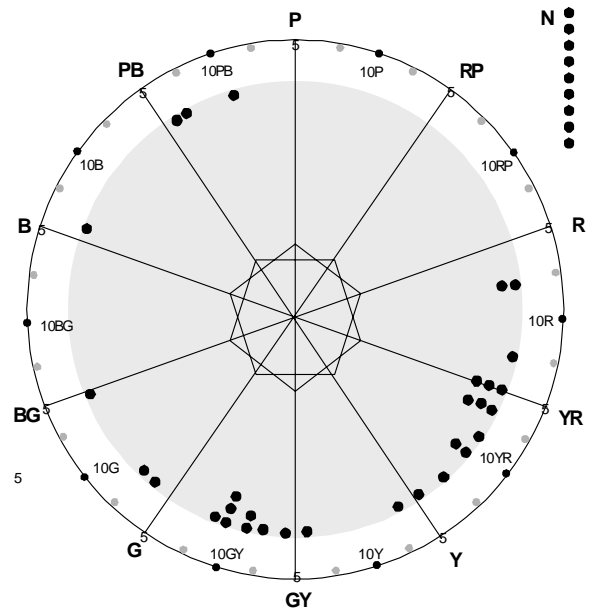

Fig 6. The color of block units on Munsell color table

4. Conclusion

To draw the panoramic view in 3D map, road block units and terrain feature block units were made. Each block units were built with 3D graphic pole lines

which had RGB color on top of location point layer. 28 types of roads on the map were first defined to make the road block units. Then, the 12 dominant groups according to the Name of road, Road Type, Road Sign, Traffic Signal Sign Machine, Pedestrian Road Type and Aided Stuff for Road were formed.

Through survey, the most key values in drawing 3D pole line graphic among various factors such as importance of cognitive, color paint, display of name, presentation with similar geometry form and presentation with material were found out. 42types of terrain features were defined to make the panoramic block. Then, according to assemble pattern, looped curve line was put on the A type; repeated pattern on B type; directional pattern on C type; small event in the large area on D type; and altitude like pattern on E type. The blocks were divided into 5 groups according to size of area. And based on the division, the 3D pole line graphic constructions were designed.

Finally, color plan for the map started from setting up the color class such as blue, green, gray and brown class in consideration of the size of area. In applying to Moon&Spencer's law, (M) = O/C, the Aesthetic Measure were 0.5. Consequently, the color setting was evaluated as well harmonized.

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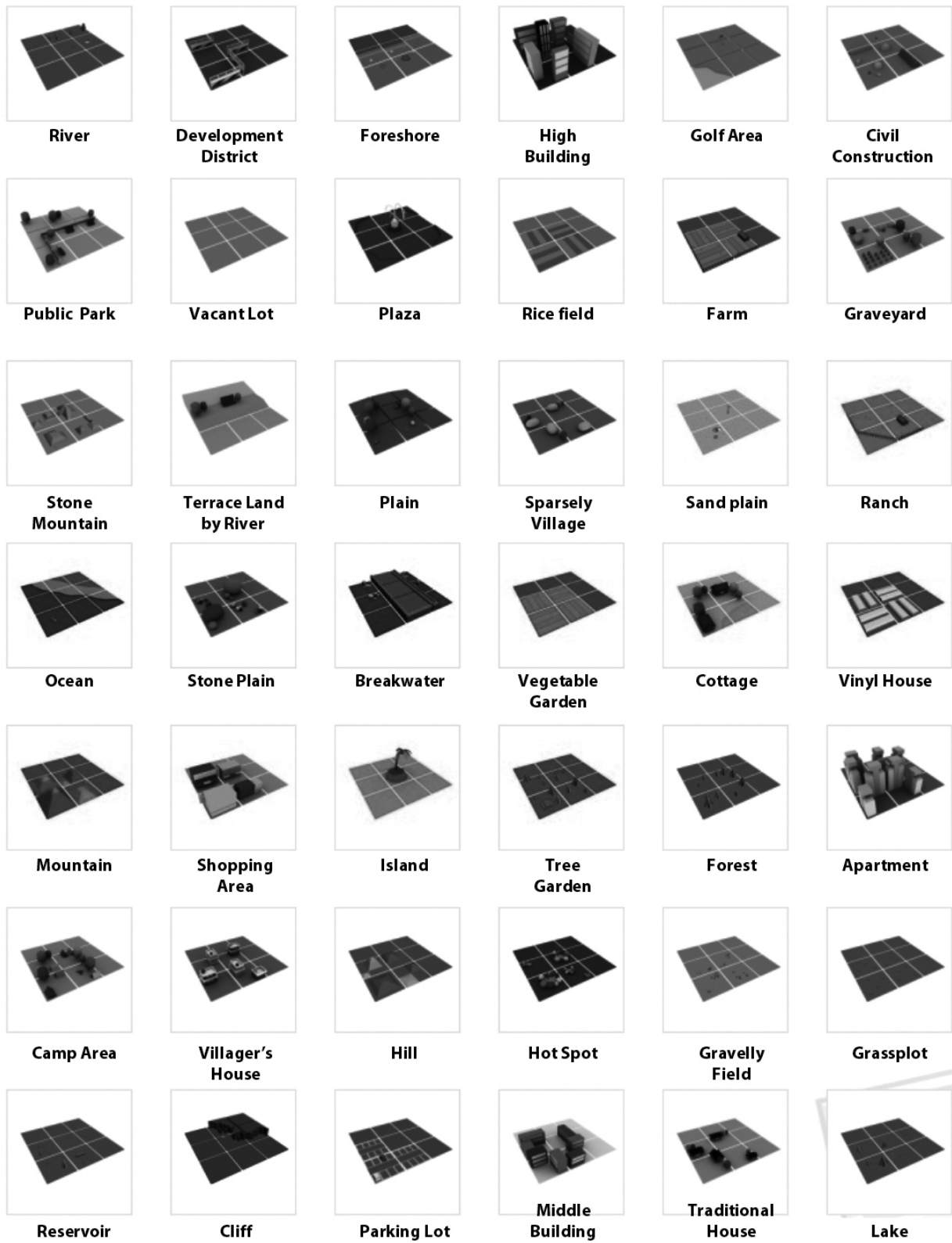- Westrem, S. D. (2001). The HerefordMap: A Transcription and Translation of the Legends With Commentary.

Fig.7. The graphic of 42 kinds of 3D panorama block