Map-Based Repository of Image System for Sharing the Photographs in Design Studio

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In the preparation of urban designs, it is important for the designer to understand the space feature of the project district and to obtain the design resource from the site. In our design studio, students take pictures of a point of interest (POI) in the project district and discuss the design concept of the district based on the photographs. To share the photographs obtained by the students during the field survey along with the attribute information and shooting positions, the present authors have developed a Web-based image archive system as an effective resource for a design studio. This system registers the photographs taken in the surveying district on GoogleMap and simultaneously displays the images on a three-dimensional city model. In this paper, we discuss the development of a Map-based Repository of Image (MRI) system to share the photographs of a city. Moreover, we attempt to evaluate its pedagogical effect in the design studio.

Keywords: WebGIS; GoogleMap; virtools; design studio.

1. Objectives

In an architectural design, it is important to discuss the design on the basis of information obtained from the project site and the surrounding area. In particular, students should obtain a deeper understanding of the project through on-site surveys for learning architectural designing. In the past, analogue tools such as paper-based maps and film cameras were often used for site surveying. However, in today’s information age, we are able to share survey information and reuse it more easily. For example, WebGIS that uses Internet technology has been developed. The user can acquire, retrieve, and analyze geographic information through the Web browser at any time. Google Inc. provides a map retrieval service and opened the application programming interface of GoogleMAP to the public in 2005. The present authors developed a system that records photograph data on a map by using GoogleAPI and implemented it in a design studio (Homma 2006). On the other hand, a lot of researches that pertain to three-dimensional (3D) virtual city models have been reported so far (Arponen 2002, Burdi 2002, and Huang 2006). Recently, research has been carried out on constructing 3D city models by using game development software such as Virtools Dev, which enables the user to handle the virtual world.
interactively (Hubers 2005, Richens 2005, O’Coill 2004, and Kaga 2004). Although these researches report on matters concerning productivity and expression technology of virtual architecture, they are not directed toward practical pedagogical methods in architectural education. The purpose of this research is the development of a photograph repository system by integrating GoogleMap and Virtools, which will enable students to share their photographs on both two-dimensional (2D) digital maps and 3D city models. Further, we attempt to verify the pedagogical effect of the “watching and proposal” method, which is implemented for district surveying in the design studio. We are expecting a synergy effect to result from the use of this system since the system enhances interactions between student groups.

2. Understanding a project district in a design studio

2.1. Watching and proposal method
In the design studio at the Department of Architecture, Kumamoto University, we are implementing the “watching and proposal” method to understand the characteristics of the project district in the initial designing stage. This method is a practical method that involves taking photographs at the site, discussing and sharing of the photographs, and understanding the project district from the viewpoint of each participant. The advantage of this method is that it helps students to easily gain spatial awareness, provide design resources pertaining to the site, and analyze the distribution of the survey positions. We execute the method in the design studio of sixth semester students according to the work procedure given below.

1. Confirmation of performing site survey
   The student studies the region beforehand and confirms tasking in the region before surveying.
2. Group observation at the site
   The students walk around the site in groups and observe the town from their own viewpoints.
3. Arranging and classifying photographs
   The students classify and arrange the photographs on the basis of each group’s viewpoints.
4. Recording the photograph data on a digital map
   The classified photograph data is recorded on a common digital map for all groups.
5. Browsing photographs on the map and exchanging opinions
   The students discuss the site while browsing through the photograph data of all the groups.
6. Reusing
   After the discussion, the image data and the contents of the opinion exchange are reused as design material.

2.2. Development of supporting system
We developed the Map-based Repository of Image system in 2006 (MRI2006). The system enables students to share their digital photographs on a two-dimensional Web map and also to display them on a 3D city model. The system is constructed with two major functions. One is a Web-based mapping function for registering a digital photograph along with the survey information on the map (2D mode). Each photograph data has the attributes of file name, comment, title of the comment, category, registrant name, group name, time, latitude and longitude, scale, and password for deletion (fig. 1).

The MRI displays a JPEG file with the abovementioned attributes on GoogleMap. The geocoordinates of the global positions acquired from Global Positioning System (GPS) are recorded in Exchangeable Image File Format (EXIF) as JPEG image data. Further, the MRI enables opinion exchange among the students with regard to their photographs through a BBS function. Another function is the interactive displaying function for photographs on 3D city models by using VirtoolsDEV (3D mode). It enables a user to browse through photographs by walking in a 3D space (fig. 2).
Since the photographs are displayed using a 3D model, a user gains a deeper understanding of the viewpoint of the photograph in comparison with a 2D map. Further, the geographic data for the city investigated in our laboratory so far can be imported to a 3D city model.

Figure 3 shows the data structure of the MRI. The 2D mode of the MRI is developed using API (application programming interface) of Google Maps. The maps and satellite images are offered by Google Inc. through the Internet, and the registration image and text data are managed by XML in the MRI’s Web server. Data is processed in PHP, which is a server-side scripting language for producing dynamic Web pages. The 3D mode of the MRI is developed with VirtoolsDev of Virtools Corporation. In Virtools Dev, a plug-in player is offered, and it achieves real-time rendering on a PC with DirectX API. Moreover, the photograph image and its global position on the Web server are shared between both GoogleAPI and Virtools.

3. Pedagogical effect of using MRI in design studio

3.1. Using MRI in design studio
This section discusses the educational effect of the watching and proposal method using the MRI in a design studio. The program in the design studio for undergraduate students in the sixth semester was to design a complex building with a suitable usage and expression for a central district in Kumamoto City. In the initial designing stage, students investigated the project site by forming teams. Moreover, we used the MRI for sharing the survey photographs in the design studio. Using a digital camera, they took pictures to serve as design resources for their design, and they inputted the photograph data in the MRI. The students could access the MRI using any Internet browser and from a studio room or their home. Each team explained their photographs to the other teams and discussed site issues and design resources. A team could use the photographs of other teams in its own design materials. A total of 1341 photographic images were registered in the MRI by 20 students forming 8 teams.

3.2. Effects for enhancing of range of surveying
The geographic scatter of the photographs was different for each team depending on the individual members of the team. This system enables students to understand both a place in the project district that is of common interest for all the teams and a place that is unique from the viewpoint of an individual team. All the teams shared wide-ranging and detailed information on the site; the amount of information obtained was more when compared
with that obtained in a one-team survey. We counted the photographs of each team based on the roads where they were taken and analyzed the range of scatter of the photographs of each team. Figure 4 indicates the nine streets analyzed in the project district. Streets st.1 and st.2 are the central streets in the district, and several photographs were taken from them. We list the teams that registered the largest number of photographs on the basis of the streets as follows: team_a from st.1 and st.8; team_b from st.2; team_e from st.3, st.5, and st.6; team_c from st.4 and st.7; and team_e and team_c from st.9 (fig. 5). As a result, it is clarified that the positions and range of the scattering of photographs by each team is different from those surveyed by the other teams. The sharing of photographs decreases the bias in the range of surveying of each team. Further, the geographical features of the project district could be understood by analyzing the photographs of all the teams.

3.3. Effects for diversification of perspective
We analyzed the type of photographs registered in the MRI. The information in the photographs of each team was classified into the following five viewpoints.

a. Condition: Peculiar condition around the project site
b. Activity: Activity of people and moveable objects
c. Function: Way of use in building and space
d. Shape: Reference for the design source on site
e. Time: Transition of scenery by time

The eight teams took a total of 1341 intention of photographs in the survey. The breakdown is as follows: 71 items (5.3%) under condition, 103 items (7.7%)
under activity, 491 items (36.6%) under function, 531 items (39.6%) under shape, and 145 items (10.8%) under time. We analyzed the difference in the intention of the photograph for each team and verified the results of sharing the photographs. The photographs of each team were classified into five design resources based on the intention of photograph. Figure 6 is a radar chart of the intention of the photograph of three teams with a remarkable tendency. The intention of their photographs showed a different tendency, although team_a and team_b took the maximum number of photographs. In other words, they could access various types of photographs by sharing them. On the other hand, team_g showed a tendency similar to team_a, although the number of photographs that it took was less. Team_g could be compensated with the photographs of team_a for the shortfall in the same type of photographs. As a result, the MRI was able to offer the design source from various aspects between team to the entire studio. The students gained a deep understanding...
of the project site by browsing the photographs of each team contributing to the MRI and by exchanging opinions.

3.4. Student’s evaluation
We distributed questionnaires on the MRI to the 20 students who had participated in the design studio. Eighty percent of the students answered that taking a picture at the site was very effective in understanding the project district. It was observed that 85% of the students gained significant clarity by browsing the photographs of other students. Fifty percent of the students answered that discussions in the group had been activated by using the system. The percentage of students who thought that the system was very effective in learning the concept of designing was 50%. As a result, we clarified that the watching and proposal method along with the MRI effectively activated the design study in the initial designing stage.

3. Technical issue of MRI
The MRI system worked without any serious technical problems during the studio study. We needed to correct the position of a photograph with an error of less than 10 m using GPS and by manual operation. The error margin at a particular position of a photograph was the tolerance in the scale of the city. However, this could be a problem when taking a detailed photograph on a building scale. Further, when the photograph was taken beneath a roof, we could not receive the satellite signal. Therefore, we had to input the global position of a photograph by manual operation.

4. Conclusion
The authors developed a map-based repository of image (MRI) system by using the Web map delivery service and 3D VR technology for sharing photographs. Moreover, we used the MRI in the operating experiment in the design studio in 2006. We clarified the effectiveness of and the issues pertaining to the operation of the system. Sharing photographs using the MRI concluded successfully by the following point in the design studio:
1. Expanding the range of the investigation
2. Increasing the number of investigation points
3. Diversifying the investigation theme
4. Observing a space multilaterally
As a result, each student team has gained much more design source from shared photographs.

The watching and proposal method makes each student’s design resource accessible to the design studio.

The discussion on design resources among the students with each student having a different scope of inquiry and viewpoint enhances their design concepts. It can function as a creative educational technique in the early stages of the designing process. The fact that such discussions may lower individual motivation by exposing the students to the competing viewpoints of other students with regard to the design may be a matter of concern. However, the synergy effect appears in the entire studio as for sharing the design resource. And we expect to improve all students’ motivations by the synergy effect.
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References

