DIGITAL MODEL DATABASE AND PROFESSIONAL SERVICE FOR TAIWAN CITY AND ARCHITECTURE

The 3D refined data

CHING-HUI HUANG, YU-LI CHANG AND YU-TUNG LIU
Graduate Institute of Architecture, National Chiao Tung University, Hsinchu, Taiwan.
b3017987@ms22.hinet.net

Abstract. The objective of this research is to explain major procedure of creating the digital model database, and to discuss the future studies and applications of the results. We also describe some detail working process and results of one of the cities within the project. As a result, the digital model database includes three Taiwan cities, as well as sixty-four architecture models around the island. The significance of digital archive is not simply a collection, but critical for additional research and application. The outcomes of the project pointed out several implications.

1. Introduction

Recently, digital content industry, which is based on creativity and integrates cultural resources and advance technologies, has been arising rapidly. This new type of economy not only creates innovative patterns of production and consumption, but also promotes that of the conventional one into the renewal socio-economics values. By employing the technologies of net representation and communication, digital content database also become one of the most important resources in this digital age, providing shared-knowledge of humanity, art, technology, nature, and so on. For this reason, in Taiwan, the National Science Council (NSC) has launched the “National Digital Archives Program” (NDAP) since 2002. Its objective is to promote and coordinate content digitization and preservation at leading museums, archives, universities, research institutes, and other content holders in Taiwan (NSC 2006). This program is unique in that it combines humanities with information technology. The first phase of this program is a 5-year plan for
the period 2002 to 2006. Applications of the NDAP include five major scopes: digital museum, value-added, design of business transaction platform, operation of business transaction platform, and marketing. We participated in two projects of NDAP from 2002 to 2004: “The 3D digital museum of Taiwan city and architecture” and “Digital model database and professional service for Taiwan city and architecture”.

The first one was a digital museum project which attempted to build a virtual museum for Taiwanese city and architecture through the past four hundred years. In addition to providing two-dimensional data, such as text, drafting, and pictures, we incorporate new 3D web technology onto the digital museum so that people could experience the space, rather than simply browse the spatial information.

On the other hand, the second one was a value-added project which intended to further apply the digital contents of the previous one. The major characteristic of this project was collaborations between academy and private enterprise. The collaborative framework of digital model database project is consisted of three parts: 3D refined data, digital knowledge database, and architecture professional service (Figure 1). We were responsible for refinement and integration of the 3D raw data of 3D digital museum project into high quality models which achieved the standards of commercial use. Apart from the refinement, we also made new digital models of architecture and city for the database. For the education and social culture purposes, based on the digital model database, the aim of digital knowledge database was to publish an interactive VCD of traditional Taiwan architecture and city by both a content design corporation and a publishing company (Figure 2). At the same time, in order to further research and application of the digital model database, architecture professional service intended to study the latest techniques of the 3D scanning by a research institute (Figure 3). However, this paper focuses on the 3D refined data. The objective of this research is to explain major procedure of creating the digital model database, and to discuss the future studies and applications of the results. We also describe some detail results of one of the cities within the project.
2. Methodology

2.1 CLASSIFICATION OF THE DIGITAL MODEL

Method of categorization of the digital models was based on the hierarchy of region, city, and architectural types (Figure 4). We separated Taiwan into four regions: north, central, south, and east. There are many major cities of Taiwan in these regions, such as Taipei and Hsinchu in the north, Taichung in the center, Chiayi and Tainan in the south, and Ilan in the east. Some of our previous projects included both Hsinchu and Tainan cities (Chang et al. 2002, Huang et al. 2001, Liu 2000). As to Chiayi, the city government has invited us to join their digital projects since 2002. Thus we selected these three cities for the database. After that, we also chose architecture from eight cities of
Taiwan. The selected buildings were classified into four types: private house, public building, commercial building, and religious building. Only one religious building of the eastern part of Taiwan included in the digital model database. In terms of Taiwan history, we separated these architecture into three periods: Ming and Ching dynasty (1684-1895), the Japanese occupation period (1895-1945), and 1945 to present.

2.2 REFINEMENT OF THE DIGITAL MODEL

We defined method of refining digital models according to the requirements of the private enterprises (Figure 4). There are three levels of the refinement: high, medium, and normal. This classification was based on the degrees of accuracy, material mapping, and spatial atmosphere of the digital model. For instance, the private enterprises selected both The President Hall in Taipei and the old city of Fongshan in Kaoshung County. These two places were the highest level of the digital model database. The medium level of models was the buildings situated in the three selected cities: Hsinchu, Chiayi, and Tainan. The rest models belong to the normal level. However, some of the models were not good enough to meet the quality of the normal level. In this case, we reproduced them. Furthermore, after integration of files of the digital models, we sent the selected buildings to private enterprisers, and demonstrated the results by designing computer animations and a website (http://3dvrlab.sd.ksut.edu.tw/3dmuseum/3dmuseum-index.htm).

3. Results

As a result, the digital model database includes three Taiwan cities: Hsinchu, Chiayi, and Tainan, as well as sixty-four architecture models around the island: seven private houses, thirty-two public buildings, twelve commercial buildings, and thirteen religious buildings. In the representation of results, we produced six animations: one for entire project, the other three for the cities, and another two for the architecture. In the website, we not only provided images and text for each architecture and city, but also created 3D web presentations of selected buildings. In the follows, we use Chiayi City as an example to discuss some detail working process and results.
3.1 THE ROLES OF COMPUTER SIMULATION IN CHIAYI CITY

Chiayi City is located to the north of Tainan City in southern Taiwan. The city has become an important political and economic center around the region since the eighteenth century. Thus there are many cultural heritages in the city, such as traditional architecture, national industrial factories, and urban spaces. Several locations were restored, and some of them were under planning and reconstruction. We found these projects scattered around the city, and lacked of an integrated planning guiding all projects. We proposed the method of computer simulation to the Chiayi City Government. It was not only a good solution for integrating and demonstrating relevant urban projects, but also illustrating the future, namely, visions, of the city. Therefore, digital modeling will become one of the major policies to plan and to carry out urban designs and managements.

The scope of computer simulation included investigations of architecture and urban spaces, city and architecture modeling, as well as urban visions. The investigation of architecture and urban space was the basis for city and architecture modeling. We reviewed much detail information of urban space development about Chiayi City including books, photographs, city maps, project reports, 2D digital files, and so on. The other purpose of this step was to integrate all information as the foundation for future urban developments. As a result, we chose fifteen places and three major urban areas for city and architecture modeling (Figure 5). The fifteen places included one private house, twelve public buildings, and two religious buildings. The urban areas were consisted of railway station area, city government area, and cultural center area.

Figure 5: Locations of architecture and city modeling in Chiayi City.
3.2 CITY AND ARCHITECTURE MODELING OF CHIAYI CITY

The entire working process of city and architecture modeling is shown in Figure 6. This project started from working plan which clarified scope, methodology, and selection of urban areas and architecture. After that, we collected related data including city maps, architecture drawings, photographs, and other information of Chiayi City. Next, we categorized the contents of file system which was composed of five major items: 2D drawings, city or building photographs, 3D model, texture, and rendered images. In the city modeling, after collection of street and elevation photographs, we decided the height of digital model. Then we began to map and to edit the elevations of the city models. On the other hand, in the architecture modeling, apart from drawings, the key task was texture mapping which determined representation quality of each building. Finally, after integration of files, we added the results of Chiayi City into the digital model database, and demonstrated the consequences by computer animations and the website.

*Figure 6: Working process of city and architecture modeling.*
We represented the results of city and architecture modeling by designing computer animations and the website (Figure 7). We produced three animations for Chiayi City. The first one explained the historical development of the city from ancient to present. The second one described the selected fifteen places. The third animation depicted the three major urban areas. On the other hand, in the website, we demonstrated the results of Chiayi City by dividing them into five categories: city, private house, public building, commercial building, and religious building. In addition to providing texts, images, and 2D drawings, we represented selected architecture by 3D web technology so that people can experience spaces rather than simply browse the spatial information.

![Figure 7: Representations of Chiayi City: computer animations and the website.](image)

### 3.3 URBAN VISIONS OF CHIAYI CITY

There are three types of space in the digital models of Chiayi City: existing, near future, and visionary. In this project, we not only simulated the selected architecture and urban areas, but also actually designed some of the urban spaces. During the modeling period, there were many existing architecture and city places, such as Historical Relic Museum (Figure 8). However, a number of buildings and open spaces were under restoration and planning stage, such as Ren-wu temple. We defined this type of space as near future. Moreover, the spaces we proposed were classified as visionary space of the city, such as Railway station plaza.

![Figure 8: Three types of architecture and urban space.](image)
In the visions of the city, we made a few suggestions of urban design to the city government. In terms of city scale, density, population and transportation, we proposed the concept of “a walking health city” for Chiayi City. There are four major design principles. First, the city government could expand the depth of pedestrian pavements, which will accommodate more activities of economic, citizen, and tourist. Second, we suggested more plantings and urban furniture on the expanded pedestrian pavements along the main roads. Third, the city required a new urban signage system which integrated transportation and tourist locations. Finally, the three design principles mentioned above could combined with the short-term shuttle bus. Thus citizens and tourists will be attracted to navigate throughout the whole city.

In addition, we recommended several future developments and applications for the digital model database: “Towards Digital Chiayi City”. In the database aspect, more architecture and city of the city can be developed into digital forms. In order to avoid argues among government, architect, and construction company, text-based specification can be visualized by utilizing the digital models. Chiayi City can take advantage of the database to develop digital content industry, such as the game design which includes history, city, architecture, and people of the city. Digital learning is also a promising way to improve the local education of the city in the primary and secondary schools. In the digital city aspect, digital models become the foundation of future urban design. The city government can check the design details in the digital model to enhance management qualities. After the models online, architects can download the information of design site and check building regulations by themselves, such as building ratio and building coverage. Digital navigation system will also be constructed by applying the online models.

In summary, digital modeling is a good solution for integrating, demonstrating, and envisioning architecture and urban spaces of Chiayi City. There are three types of simulated space in the digital models of the city: existing, near future, and visionary. Therefore, digital modeling will become one of the major policies to plan and to carry out urban designs and managements. However, although we have made several suggestions to the city government, Digital Chiayi City has not online yet. We will discuss the issue of the so-called digital city in the follows.

4. Discussions and Future Studies

However, what is the digital city? There are two major aspects of the definition. First, digital city is the future of real cities, which combine the functions of traditional city and virtual places to form a new urban typology, and present a phenomenon of spatial interaction (Mitchell 2000; Huang et al.
Second, digital city is an urban simulator, which provides online urban information, and creates public spaces for lay people (Aurigi 2000; Ishida 2000). Aurigi and Graham (1998) also indicate two preliminary forms of these ongoing digital cities: real city as interface and metaphor to group together Internet users around the world and contents actually relate to the developments of real cities. Although developments of digital cities have many problems and challenges (Aurigi 2000), the studies of the digital city attract many researchers’ attention. For instance, Ishida (2000) introduces goal, architecture, technology, and organization of the digital city by comparing four existing examples: America Online Digital Cities, Digital City Amsterdam, Virtual Helsinki, and Digital City Kyoto. In addition, Peng and Blundell Jones (2004) suggest an interactive urban design approach, which emphasizes representation methods and applications of the digital city: Virtual Sheffield.

The three digital cities in the digital model database: Hsinchu, Chiayi, and Tainan, represented the future of the real cities. Their initiatives were based on architecture and urban design which depicted existing, near future, and visionary conditions of the cities. At the same time, although they have not on the line yet, there are urban simulators which provide urban spatial information related to the developments of real cities. In conclude, the three cities of the database have got the preliminary form of the digital city. We might call them the pre-digital cities.

The significance of digital archive is not simply a collection, but critical for additional research and application. The results of the project indicate several implications. First, during data collection of the working process, a number of architecture drawings were incomplete, or some buildings were under restoration. In this case, we deal with both real and virtual spaces by referring to the same types of architecture. Thus this project portrayed three types of space: real, virtual, and net. Relations between them become a research topic. Second, although this project only completed some core areas of the three cities, they were in the preliminary form of the so-called digital city. The city governments can take this advantage to develop their cities in the net. Third, this project also implies pedagogical meaning. In the digital model database, more than forty architectures are our listed building. We can use the 3D models of cultural heritage as the instruments in the teaching of 3D courses. Finally, in the digital content industry, the interactive entertainment platform has been developed increasingly because it is an important leisure in our daily life. In general, the interactive entertainment includes five types: arcade game, PC game, on-line game, TV game, and mobile entertainment. We will further employ the city models to develop an interactive entertainment platform of the arcade game in the near future.
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References


