A STUDY OF URBAN SPACE HISTORY USING COMPUTER GRAPHICS TECHNOLOGY

Illustrated Though the Historical Data of Yura, Sumoto City, Hyogo Prefecture, Japan

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Abstract. The application of computer graphics technology in urban space history research was demonstrated in the present study by illustrating the current and historical data of Yura, Sumoto City, Hyogo Prefecture of Japan. The images of urban space in different historical periods were compared and the changes in environmental design were analyzed.

1. Background

Studies of urban space history can serve as references to predict possible changes of urban space in modern society. Such research is particularly important for planning major projects of urban construction. It is increasingly interesting to visualize the history of urban space by using the computer graphics technology. The major advantage of this technology is that it enables the evolution of urban space development over the time to be illustrated graphically. The technology is also easy to be mastered and can be used by both experts of urban design and ordinary residences concerning about the development of their cities. Everybody involved is therefore able to evaluate urban space study. Computer graphics technology plays increasingly important roles in studies of urban space history, the related culture responsible for the history, and future urban development that will preserve the history and the culture.

The key task in studies of urban space history is to extract the fundamental elements that compose a city, and then restore historical urban space visually. Application of computer graphics technology improves the efficiency in these studies because it provides the possibility to rapidly inspect the restorations of three dimensions from different prospects and construct different models based on historical literatures. The final restoration is the closest reflection of history as all the possible models have been
restored and compared. The present paper demonstrates the application of this technology in urban space history study by illustrating the current and historical data of Yura, in Sumoro City, Hyogo Prefecture of Japan.

Yura is a traditional Japanese fishing port town. From the historical point of view, it has been an important military base. Its geographical location makes Yura uniquely important because it is an entrance point to Kansai that is the area with hub of Osaka. The currently under-planned project, Kitan Bridge that will be the biggest bridge in the world, will start from Yura. So this project will greatly affect the future development of Yura. Therefore, we construct a database that will represent the historical and present urban space of Yura in three dimensional models. It can be visualized from any view point. Comparisons between models during different time periods are presented to explore the reasons that made the Yura to change or not to change. The results can be used as a base to predict how Yura will evolve in the future.

2. Representation of the Urban Space of Yura by Computer Graphics

2.1. THE BASIC INFORMATION OF YURA

Yura is located at the east side of the Kashiwara Mountain on the Awaji Island. It covers 17 square kilometers. Located at the southeast corner of Awaji Island, the ocean separate it from Kishu and Senshu. Surrounded by the forest on west side mountain, the long narrowed Tomoga Island stands in the mouth of Osaka Gulf on the east side of Yura.

The population of Yura is 5434 (Census of 1990). The average age of the people tends to increase and, the population decreases steadily. Fishing industry is the main economy, along with retail stores, ship manufacture, and agriculture, etc.

2.2 THE HISTORY OF YURA

Yura was one of the important forts on the Nankaido, the only way from the capitals of ancient Japan, Heijoukyo and Heiankyo (now Nara and Kyoto) to Sikoku. In the ancient Ritsuryo era, Yura had been a castle town(Jokamachi) holding a dominant position in Awaji island. Yura was very prosperous because it was a major transfer point of timber from Awa (the production region) in Sikoku to Hyogo Port. In Kane era, Yura Castle
was abolished and the entire area was transferred to Sumoto City. From then on, Yura has been a port for fishing ships. Two entrances, Shinkawaguchi and Imakawaguchi, were constructed because it was difficult to enter when there was a storm from east or south. More recently, Yura was also a military fort. An army headquarters had been operating here until the end of World War II.

Figure 1. The Situation of Yura in Kansai

2.3 TRANSFORMATION OF ENVIRONMENTAL INFORMATION INTO IMAGE

Visual environmental information is an efficient method for studying urban space composition, and it is necessary to reconstruct the visual images of a town and its evolution over the time. Compared with the conventional methods, computer graphics technology helps to intuitively understand images of urban space and provides the possibility to study the larger suburban area.

The necessary images for studying the entirety of Yura was obtained by the following procedure of producing computer graphics.

2.3.1 Data collection

The characteristics of Yura

- The port town
  Yura is a typical Japanese port town. Residential area is located on the sea shore. Temples are at the bottom of mountains. Streets and roads are built according to its geographical shape.

- The military fortress
Due to the geographical location, Yura had been military strategic fortress since Meiji Era, however, it was never involved in any wars. During Nisin and the Second World War, it accommodated a very important military base. Nowadays, its military importance has vanished.

- The street scene of Yura

Awaji Island is famous for its porcelain and tiles. Yura is one of the ports in the Island. Its buildings has the characteristics of Awaji. The photographic data at the beginning of Showa Era (1940’s) clearly showed the traditional wood structure of the buildings with the roofs built of the Awaji tiles. However, the traditional wood building structure has been replaced by the concrete-cement structure, resulting in different outlook of the buildings and the Yura town.

2.3.2 The construction of the urban space and the buildings in Yura

The construction began with selecting representative objects. Base on studies of images at all angles of the town including all the surroundings over historical periods, the major elements were chosen to be represented by computer graphics. In this paper, the images of Yura’s urban space at early years of the Showa Era and at the present time were illustrated.

- The present urban space of Yura

Modern Yura was formed under the influence of the modern industry, agriculture, tourism and wars.

- The urban space of Yura at the early years of Showa Era

Yura was a typical Japanese fishing village before the World War II. It had the characters of a fishing port. In addition, Yura also accommodated significant military facilities due to its geographic importance.

2.3.3 Simulation model of the entire town and surrounding environment

Data were extracted from the above information as following: the information including the surroundings was input into a database, then computer was employed to process the data according to the requested viewpoints, and finally the results were presented by computer graphics.

2.3.4 Analysis and verification of the results.

The procedure for generation of computer graphics is to collect necessary information, then to analyze the collected data and finally to convert it into graphics. When historical urban space images are not available, graphical data collection is therefore impossible during restoration. Under such circumstances, the analysis can only be undertaken based
on the existing collectible information and many hypotheses have to be proposed. After comparing all the hypothetical models, the most likely one is selected and represented by computer graphics. The materials used in the present study for this process were as follows:

- Maps and historical paintings
  Based upon the present maps, most data including surroundings could be input into computer correctly. The historical paintings were served as image references to generate a basic form of the urban space.

- Photographs
  The photographs taken from airplanes and inside the town were employed to revise the data generated solely based on the maps. The historical pictures were used whenever possible as they represent the real urban space history.

- Literature
  Due to lack of the historical graphical information about Yura, most data in the present study were obtained from the historical literatures and other relevant articles.

3. Analysis and Revision of the Yuar urban space model

3.1 COMPOSITION OF THE ENTIRE URBAN SPACE

To represent a broad landscape including the surroundings by computer graphics model, three-dimensionally graphical expression was generated. This leaded a clear understanding of the basic composition of Yura urban space.

![Figure 2. The Entire Composition of Yura Town.](image-url)

Yura town is situated between Yura gulf and Mount Sato. Its long narrow shape is about 100 meter wide from east to west, and 1 kilometer long from south to north. Like any other port town in Japan, the west coast side below the 4 meters altitude is
residential and commercial area, and the east side along the mountain above 10 meters altitude is sacred region of temples, etc.

Yura is centered on a main street (4~8 meters wide) with buildings on each sides. There are also a number of smaller roads (1~2 meters wide) with the characteristics of typical Japanese port town’s. None of these roads is dead end. The one parallel to the main street was used as military road. The main street reaches sea shore at the north and Mount Maru at the south.

3.2 DISTRIBUTION OF BUILDINGS ACCORDING TO THEIR USAGE

![Figure 3.](image1.png) ![Figure 4.](image2.png)

The Model for Urban Space the Present  The Model for Urban Space at the Early Years of Showa Era

The evolution of the urban space composition and scenes can be seen in Figure 3 and 4. The changes in the urban space is quite clear.

- Commercial Zone

Most of the constructions along the roads are business buildings such as grocery stores, department stores, etc. These commercial constructions also form the boundaries on the both sides of the roads. This kind of space formation is typical for a Japanese town. The so called connection road style commercial zone can be clearly seen on the image of early years of Showa Era. However, the zone has changed to the few points
shape as shown on the image of the present time, which indicates that the businesses had been shrinking over the time.

- Residential Zone

In Yura, from 1 Chome to 4 Chome (the name of residential district) are clusters of residential buildings. Compared the past image with the present one, the scale of these residential buildings clusters virtually remains the same. Within each condensed cluster are individual single-family houses. It is almost impossible to find the connected structures (Nagaya) like the ones found in the commercial zone. A survey has indicated that the number of old decayed and empty houses is quite great. The current population is only half of that at the early years of Showa Era. Many people have moved from Yura to Amagawa and Uchita districts, north of the Yura town, and converted from fishing to farming. The main economy in Amagawa and Uchita is agriculture. Comparing with Yura, the houses and lots here are much more spacious. There were very few residential houses in these regions before the war. Recently, the residential population has increased almost five times over that before the war.

3.3 LANDSCAPE SIMULATION

The following figures show the examples of stimulation at the peak point of Yura town towards the ocean at different time.

Figure 5. The Simulation at the Present time.
Visible difference of scenery image can be observed from our computer graphics illustration: the view taken from the temple, the peak point of the town, looking towards the ocean. This different is due to the following reason. In the past, the most houses were low buildings and connected to roadside, therefore, the view seems more spacious. However, with the number of modern high-rise buildings continuously increase, the view over the town appears to be more crowded. Our computer graphics are effected correspondingly.

3.4 OVERALL CHARACTERS

The usage, height and the outlook of the buildings in Yura have changed dramatically with time. The traditional views of the town can be experienced through the restored outlook at Showa Era based on the past space images generated by computer graphics. Current outlook of the town obviously exhibits new flavors but it is a little inharmonious.

3.5 SUMMARY

- Yura at the early Showa Era:
  Compared with farming villages, fishing villages generally have smaller, lower and denser residential houses of traditional Japanese style. The restored Yura model at early Showa Era suggests that Yura was a typical fishing town.
Yura at the present time:
The decreasing population leads the dramatically changes of Yura’s outlook. In addition, residents’ occupations and family styles are not identical. Many apartments, office and commercial buildings have been built. Therefore, the town is losing the unity of characteristic style. It is difficult to define to which type the current outlook of Yura belongs.

The possible development in the future:
Yura will be starting point of the Kitan Bridge, a large under-planed project. The impact of such a big project will be our future research topic. What we have presented through the application of computer graphics indicates that the use of this technology will provide an expected and effective method for town planning in the future.

4. Conclusion

4.1 ADVANTAGES
In the present paper, we demonstrated the use of computer graphics technology in studying urban space of Yura. We found the following advantages of employing this technology:

- Computer graphics can transform various information of urban space into image. A present urban space can be shown along with historical and future ones even if the later do not exist currently.

- The characters of the changes from past to now can be observed easily by directly comparing the images of urban space at difference periods. This is helpful in prediction how the urban space will change in the future.

- In addition to an overall urban space, computer graphics technology enables the details to be imaged as well by transformation of various other information such as topography data, information of the surround environment, traffic condition, scale and volumes of installations, details of the buildings, plants, shadows, and activities of people.

4.2 FUTURE RESEARCH
In order to show a wide area or many detailed objects, in urban space study, large amounts of data have to be input. This is very time consuming. In the case of Yura, we took many months for inputting the data of surround environment. In addition, although many topographical data are available from Geographical Survey Institute (GSI) nowadays, the information is usually not detailed enough for a particular town. Improvement of the methods and tools for collecting and inputting data rapidly is one of our future research directions.

The future urban space for planned but not constructed projects is to be studied and evaluated.

Computer graphics can describe particular objects of image simulation of a town. The 3-dimensional data obtained by one group or for one object can be used effectively by others through computer network. Establishing a loosing connection of these data is another direction of our future research.

In recent years, our research group has continuously striven to generate a number of new results by using computer graphics. These results have provided intuitive information about many kinds of urban space layouts for the general public. The methodology described in this paper, which uses the 3-dimensional graphics to represent the traditional urban cities and their architectural history, enables ordinary people to understand their own cities and their characters. It will become a very important tool for town planning in the future. By applying this technology, the views and the outlooks of cities will be emphasized more in the planning and designing procedures.

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