

Transition of Urban Landscape with Kyo-machiya in Virtual Kyoto

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Virtual Kyoto is a historical virtual geographic environment of the historical city of Kyoto, which is 4D-GIS including a time dimension to the conventional three dimensional building and terrain models. It is capable of storing a variety of geo-spatial information of different time slices. This unique feature has been crucial from the outset as the goals of the Virtual Kyoto project were focused on depicting the history of the city, as well as reconstructing the past urban landscape of the city. We have used cutting-edge technologies for 3D modeling, GIS, VR (virtual reality) and Internet dissemination, as well as new geo-spatial information of Kyoto from a wide variety of geo-referenced historical materials and field surveys.

There is a large number of historical buildings such as temples, shrines, Kyo-machiya (traditional wooden townhouses), and western-style buildings of the pre-war period still remaining in Kyoto. These architectural heritages contribute to the city's historical urban landscape. However, these Kyo-machiya and modern western-style buildings have recently been confronted with a crisis in that their number is decreasing rapidly due to on-going property alteration and urban development. In order to preserve such important historical architectures, the Kyoto City Government has established several measures such as the new Kyoto Landscape Policy 2007 based on two city center surveys conducted in 1995-1998 and 2003-2004. This has greatly helped the City Government to grasp the overall situation of these buildings.

We have thus constructed a GIS-based Monitoring System for Kyo-machiya with the aim of supporting the government's efforts towards preserving traditional architectures. The system is based on the "Kyo-machiya Community-building Survey," for which the Kyoto City Government, Kyoto Center for Community Collaboration, Ritsumeikan University, volunteer architects and citizens have been working together since October 2008 to March

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2010. In this large-scale field survey, we have used the Mobile GIS (ArcPad) in PDA to capture exact geo-spatial information on Kyo-machiya in addition to their photographs. The Kyo-machiya survey entries include: its type, its condition, design elements of the façade, and whether or not it is vacant. Through this survey we have identified around 48,000 Kyo-machiya in the whole of Kyoto city. By making the most of the Kyo-machiya survey data, we can now visualize changes in the urban landscape of the city through Virtual Kyoto.

In order to create automatic 3D models of a large number of Kyo-machiya, we have developed a computer program that enables us to easily generate townscapes comprising of these structures based on the GIS database. Using this program, we can create multiple Kyo-machiya 3D models automatically based on field surveys. Similarly, using Virtual Kyoto, we can also illustrate changes in the urban landscape arising out of changes in Kyo-machiya.

Keywords: Virtual Geographic Environments, 4D-GIS, field survey, Kyo-machiya, Kyoto

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從虛擬京都中的「京・町家」看都市景觀的變遷

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「虛擬京都」乃涵蓋古城京都歷史發展之虛擬歷史性地理環境，採用 4D-GIS 系統，即以傳統 3D 建築物與地形模型搭配一時間軸，能夠儲存不同時間切面上的各種地理空間資訊。此項特色對著眼於描繪城市歷史與重建都市景觀的「虛擬京都」計畫來說，從初期就扮演非常關鍵的功能。我們採用尖端科技來進行 3D 模型化，也運用了地理資訊系統（GIS）、虛擬實境（virtual reality）和網路傳播等技術，並從廣大多樣的京都歷史資源與田野調查成果找出地理座標，建立新的地理空間資訊。

京都現存不少歷史建築物，像是寺院、廟宇、「京・町家」（日本傳統木製城鎮住宅）、戰前西式建築。這些建築歷史遺產構成了京都的城市地景，然而，「京・町家」與西式建築物最近因持續財產轉換與都市發展計畫，面臨到數量大幅減少的危機，為了保存這些寶貴的歷史建築，京都市政府已經制定幾項因應措施，例如根據 1995 至 1998 年間與 2003 至 2004 年間兩次問卷調查，制定出《2007 京都市的景觀政策》，有效地幫助市政府掌控這些歷史建物的整體狀況。

因此，為了協助政府保存傳統建築，我們製作出一套以地理資訊系統為基礎的監控系統，過程採用《「京・町家」社區規劃調查之結果》，此調查於 2008 年 10 月至 2010 年 3 月間實行，共同參與者有京都市政府、京都社區合作中心、立命館大學、志願投入的建築師與一般市民。在這次大規模的田野調查中，我們運用 PDA 的行動地理資訊系統（Mobile GIS, ArcPad）來捕捉「京・町家」的地理空間資訊與照片，調查項目包含「京・町家」的種類、現況、外觀設計元素及有無住戶等。在這次的調查中，我們確實記錄了京都市約 4 萬 8 千個「京・町家」，運用此調查結果，我們得以在「虛擬京都」中描繪出京都市景觀的改變。

為了要建立大量家的自動化 3D 模型，我們利用 GIS 資料庫，設計了一套能讓人輕鬆地勾勒出城鎮景觀的程式。透過這個程式，就能建構出多個 3D「京・町家」模型。同樣地，透過「虛擬京都」的模擬圖示，我們得以藉由「京・町家」的變動描繪出城市景觀的變化。

關鍵字：虛擬地理環境、4D-GIS、田野調查、「京・町家」、京都

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