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An Application to Compare the Past and Present of Townscapes

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Abstract

Townscapes change from one instance to another, and the data of change, like photos and maps, is kept and archived in museums and libraries. In this research, we focus on archived photo data and, by developing a smartphone application, provide an environment to allow people to experience the change of townscapes in real towns. This smartphone application gives people the opportunity to learn about the history of cities and to consider the townscapes. After showing the results of the project at Matsushige Rock Gate,which is a cultural heritage site in Nagoya, Japan, we propose to apply it also to the city of Graz.

CCS Concepts

•***Human-centered computing*** → *Smartphones; Empirical studies in ubiquitous and mobile computing;* •***Applied computing*** → *Digital libraries and archives;*

1. Introduction

Townscapes of cities around the world change from one instance to another by rebuilding and renovating. The design of buildings depends on their surroundings, such as climate and soil, regulations, proposals from designers, and construction cost. Townscapes are configured by designed buildings based on geographic and social factors like these. Considering changes of townscapes leads to considering the background of society and history.

Some of the changes of townscapes are kept and archived as data of photos and maps. Although we can see such photos and maps in museums, we often have to follow the necessary procedures for private inspection or use because of the protection of precious data.

The number of photos of townscapes taken by private citizens has dramatically increased because of the spread of mobile phones and smartphones with camera. Although some of these personal photos are uploaded to the internet and are, thus, open to the public, most of the photos are kept on the individual devices or accounts. Yet, these photos have the potential of becoming precious data of townscapes in the future.

There are three purposes of this research. The first is to provide people with the opportunity to learn about histories of architectural heritages in the city and to make people conscious of the townscape. The first step is that people confirm the change of townscapes with their own eyes. We think that this first step leads people to become aware of the importance of the townscape as a whole. The second is to make practical use of the data and photos from the time of construction. The third purpose is to attract users to both architectural heritages and museums.

This paper presents the result of the experiment using an application (below-mentioned) in Nagoya, Japan, and propose to apply it also to the city of Graz.

2. Method

We developed an Augmented Reality (AR) application with geolocation by using archive data of old photos kept in museums, libraries, and management organisations. This application provides the environment that enables the users to experience the change of townscapes in real towns. AR is a variation of Virtual Reality (VR). VR technologies completely immerse a user inside a synthetic environment. While immersed, the user cannot see the real world around him. In contrast, AR allows the user to see the real world, with virtual objects superimposed upon or composited with the real world [Azu97]. In this research, we focused on user experiences that users walk around to find architectural heritages and look the change of townscapes using an application in real towns. Therefore we adopted AR technology.

There are mainly two ways of techniques used in AR technology. The one is location based AR. This technique show information using geolocation information acquired by GPS. The other is vision based AR. This technique show information analyzing image data by object recognition. We adopted location based AR to attact users to architecrual heritages.

We examined whether this application is effective for learning about heritages and attracting to heritages and museums by demonstration experiments and questionnaires.

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3. Related Cases

There are many cases that digital technology, like AR and VR, apply for cultural heritage. For example, there is an AR application that reconstructs ancient buildings by using computer graphics at Osaka Museum [Osa] in Japan. Some companies [MOP] [UNI] provide VR applications to visualize ancient lost buildings for Greece cultural heritage, like Acropolis and Olympia. In museums, AR application is often used for the navigation. Tohaku-Navi [Tok] shows visitors tour course and explanations about display items. This application uses both vision based AR and location based AR through measuring techniques using Wireless LAN [Koo].

These applications are very useful to show and give information to people about cultural heritage. However, we focus on existing buildings in towns and our goal is making people conscious of the townscape.

4. The Project at Matsushige Rock Gate in Nagoya, Japan

4.1. Target of the Project

First, we implemented the project done for Matsushige Rock Gate (Figure1) and Nagoya Urban Institute (Figure2) in Nagoya, Japan. Matsushige Rock Gate was built in 1932 for the purpose of water level adjustment between two canals. Though it is preserved as a cultural heritage, only a few people are aware of its existence and understand its historical importance. Nagoya Urban Institute is the organization dedicated to supporting the urban planning of Nagoya city. There are many records and data of Nagoya's urban planning. Its exhibition space is quite large and the library has a huge collection.

Figure 1: *Present photo of Matsushige Rock Gate*

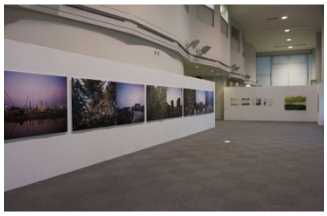

Figure 2: *Exhibition hall of Nagoya Urban Institute*

4.2. Application and Exhibition

We developed an AR application for iOS. Additionally, we exhibited photos, documents, and books related to Matsushige Rock Gate at Nagoya Urban Institute. When the users' location is far from Matsushige Rock Gate, the application indicates the distance and the direction (Figure3). Users approach Matsushige Rock Gate, follow the directions on the display, and walk around. When the distance and direction are met, the application shows old pictures (Figure4). Users can learn about the history of the building and compare the old photos with the present situation. When users tap the information button, texts about the history of the heritage is displayed. The photos taken by the application are uploaded to the server with exif data and are immediately added to the exhibition at Nagoya Urban Institute. The new photos are then exhibited together with old photos in time series. Uses can interactively operate the exhibition (Figure5). We make users feel they contribute to the history of Matsushige Rock Gate by adding their photos at the end of the exhibition.

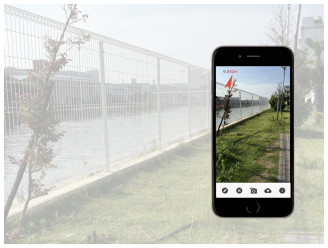

Figure 3: *App displays the distance and the direction.*

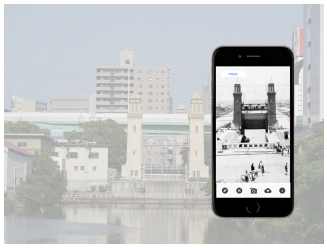

Figure 4: *App displays old pictures.*

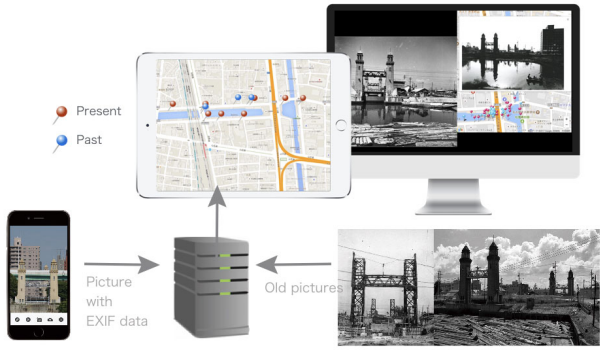

Figure 5: *System image of exhibition*

4.3. Experiment and Result

We did a first demonstration experiment using our system in November 2016. At Matsushige Rock Gate, we presented the application and collected feedback with a questionnaire filled in by 63 people (Figure6). At Nagoya Urban Institute, we made an exhibition and collected feedback with a questionnaire filled in by 26 people (Figure7).

In the results of our questionnaire-based survey, over 80% of the users of our application answered they could learn more about Matsushige Rock Gate (Figure8) and wanted to visit Nagoya Urban Institute to see the exhibition (Figure9). Over 70% of the visitors to Nagoya Urban Institute answered they wanted to visit Matsushige Rock Gate (Figure10) and use the application (Figure11).

Based on these results, we conclude that this project has a certain effect on teaching and attracting people to both Matsushige Rock Gate and Nagoya Urban Institute.

4.4. Feedback from the Project at Matsushige Rock Gate

We received some feedback from our questionnaire-based study related to additional functions, the improvement of the user interface,

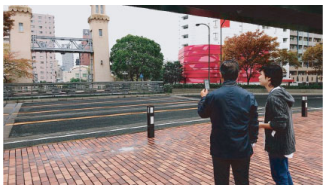

Figure 6: *Demonstration exprriment at Matsushige Rock Gate*

Figure 7: *Exhibition at Nagoya Urban Institute*

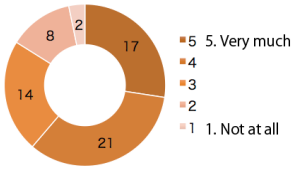

Figure 8: *Q. Could you know more about Matsushige Lock Gate by using this application?*

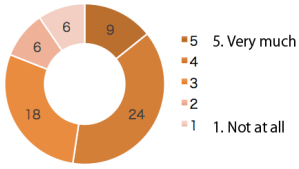

Figure 9: *Q. Do you want to go to the Nagoya Urban Institue to see the exhibition by using this application?*

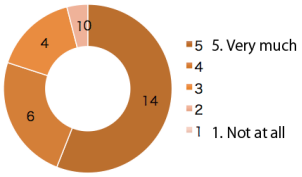

Figure 10: *Q. After seeing the exhibition, do you want to go to Matsushige Lock Gate?*

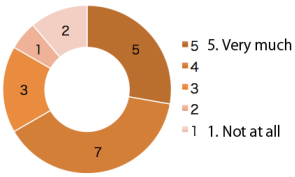

Figure 11: *Q. After seeing the exhibition, do you want to use this application?*

the request for an Android version, and expanding to other areas. We will improve these points and develop a next version based on the feedback. The target of this project was one specific cultural heritage site. We will try to expand the scope to more heritage areas.

5. The Project in Graz, Austria

5.1. Target of the Project

Based on the results of Nagoya, we now focus on the city of Graz, Austria. The historic city center and Eggenberg Castle are registered as UNESCO World Heritage site. Buildings of architectural styles of different ages are harmonised and preserved well in Graz. Yet, townscapes continue to change due to repairing old buildings in the protected area and to constructing new modern buildings outside the protected area.

5.2. Purpose and Method of the Project

The purpose of this project reflects the feedback from the previous project in a new application and expands the project to the whole city of Graz.

Many old photos of townscapes and maps are kept and archived at museums and libraries in Graz. We are developing a smartphone application using these old photos and maps.

We manage old photos, maps, and data of places where the old photos were taken on the database server. The interface makes it easy to grasp the whole city because the application shows the places where photos were taken as pins on the map. Users can understand more easily the change of townscapes because old maps are displayed in addition to the photos.

5.3. Application

Many old photos of townscapes and maps are kept and archived at museums and libraries in Graz. We are developing a smartphone application using these old photos and maps.

We manage old photos, maps, and data of places where the old photos were taken on the database server. The interface makes it easy to grasp the whole city because the application shows the places where photos were taken as pins on the map. Users can understand more easily the change of townscapes because old maps are displayed in addition to the photos.

Figure12 shows the system image. When users tap the pin on the map within a certain area around the place where the photo was taken, the application will display the old photo. Users can compare the old photo and the present townscape, confirm, and experience the change. In addition, users contribute to the photo archive by taking present pictures at the exact place where the old photos were taken and by uploading them to the database server of our application. This application has a function to upload to Social Networking Services on the internet, tagging them automatically and opening them to the public.

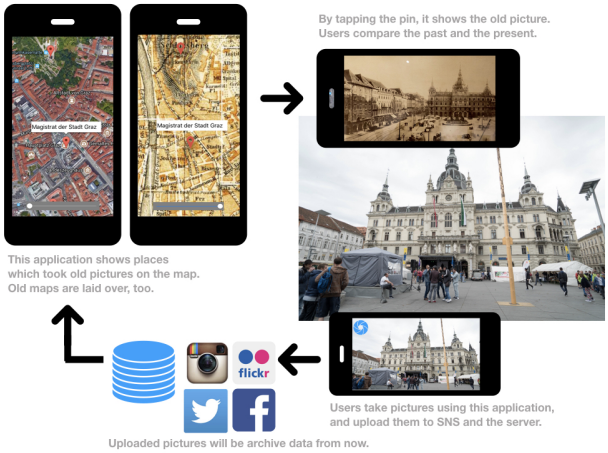

Figure 12: *System image of the project in Graz*

5.4. Expected Effects of the Project in Graz

Users can learn about the history of townscapes by using this application. The experience of walking around in a town, finding a

building, and taking pictures makes users attached to the town. The attachment will lead to more awareness of efforts to protect the townscapes.

It is possible to acquire logs of user behaviour, like the route they used, the place where they took pictures, and to make them open to the public and utilise them. For example, we can teach routes from a new perspective of changes of townscapes to first time visitors of the city of Graz by analysing the log data from previous visitors.

6. Future Works

Although the function of comparing old photos and present townscapes is currently done manually by users, we are considering adding the function to automatically compare old and present photos. ShootAR [SHR11] uses feature point detection as the method of comparing pictures. We have been trying feature point detection not only pictures but also real time video by SIFT algorithm [Low99] (Figure13), SURF algorithm [BTG06] (Figure14), and AKAZE algorithm [ABD12] (Figure15). We need to try and improve more for the practical use. There are other methods of automatically compare, too, like Rephotography tool by 3D reconstruction [BAD10] and edge detection by deep learning [LPRD16]. We will consider and examine these methods.

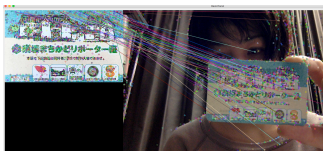

Figure 13: *Trial of feature point detection by SIFT algorithm*

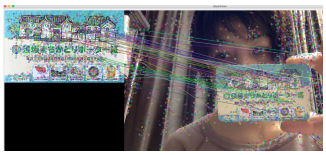

Figure 14: *Trial of feature point detection by SURF algorithm*

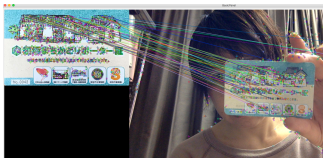

Figure 15: *Trial of feature point detection by AKAZE algorithm*

We will develop a prototype and examine other necessary functions and the user interface. We will release the application for iOS and Android by the end of this year.

After releasing the application, we will measure the effectiveness with a questionnaire for users and with the analysis of log data.

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