

# Learning Method that Facilitates User Understanding of Changes in the Kyoto Townscape: Utilizing a Smartphone Application with the Kyoto City Tram and Bus Photograph Database

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**Abstract:** This study intends to develop a method of learning changes in the Kyoto townscape. We conducted an experiment using the Kyoto Memorygraph with old photographs from the Kyoto City Tram and Bus Photograph Database. The key findings of this paper are the following:

- Users can easily understand the details of changes in the townscape when comparing old photographs with the current townscape using Kyoto Memorygraph.
- By using this application in tours, users who were not previously familiar with the locations and characteristics of old photographs exhibited notable learning outcomes.

In this experiment, participants focused on mountains as a distant marker and buildings, roads, and objects on the roadside as proximate markers. These are the basic components of the city; participants examined the structure and elements from the old photos and became aware of changes in the townscape. In the case that the characteristics of the photo had changed significantly, some participants felt it was difficult to match old photos with the current townscape. By visiting the location where the old picture was taken and capturing the current cityscape, users of Kyoto Memorygraph were able to consider the city's structure and elements. These results indicate that Kyoto Memorygraph can be a regional learning tool for understanding townscape development.

**Keywords:** old photographs, townscape, Kyoto City Tram and Bus Photograph Database, Kyoto Memorygraph

## 1. Introduction

Kyoto was less intensely affected by World War II than other cities in Japan; thus, many historic buildings have remained and comprise a historic townscape.

However, the historical Kyoto townscape is gradually being lost because economic growth has taken top priority following the war, and many historic buildings had been demolished due to substantial uniform land development and construction activities. The historical townscape was formed as considering the policy of townscape to better understand its factors and transitions.

In addition to the problem of townscape destruction, there are various issues such as population decrease, rapidly aging population, and decline of local industry.

As the underlying community is gradually weakened, the local residents' active promotion of regional revitalization while cooperating with various stakeholders is necessary (KCCC 2018).

In order to promote distinctive regional formation, it is important for local people to reaffirm the significance of regional resources, such as historic buildings, regional records, and local memories. Some residents have begun trying to become familiar with the landscape.

Old photographs and maps that help people visually comprehend past townscapes are considered to be effective for facilitating the understanding of townscape changes, and digital archives have attracted the attention of various fields, including folklore, history, and geography (Seto & Yano 2009).

In recent years, the development of information and communication technology (ICT) and the reduced cost of information equipment have generally created an environment in which large amounts of data can be processed efficiently, which provides local residents the ability to discover and archive regional resources.

On the other hand, there are institutional issues such as legal restrictions, copyrights, and portrait rights, which

protect the proper operation of content, that can hinder flexible secondary use. Other issues include a lack of methods and systems that have been established to collect and archive materials. Furthermore, in the case of old photos taken individually, the shooting location, date, and time may be unknown. Therefore, they may be difficult to use as academic materials, and there are situations in which the use of content does not appreciably progress after archiving.

In this context, it is considered important to systematically find a proper archive of old photographs and use their regional data efficiently.

This study focuses on the Kyoto townscape between 1950s and 1970s and examines the method of learning changes in the townscape by comparing the present landscape with old photographs from the Kyoto City Tram and Bus Photograph Database that is digitally archived and published at the Ritsumeikan University Art Research Center (ARC).

When comparing old photographs with the current townscape, it is considered significant to compare them in the same composition in order to fully comprehend the change. In this study, we implement the smartphone application Kyoto Memorygraph, developed by Kitamoto. The characteristics of Kyoto Memorygraph are detailed in 1.2.

### 1.1 Kyoto City Tram and Bus Photograph Database

This study focused on old Kyoto Tram photographs to understanding changes in the Kyoto townscape after the war. The reasons for focusing on these photographs are as follows:

- Photographs of railroads, including Kyoto City Trams, are often available in the form of collections, even though personal photographs are not generally available since cameras were not widely used in the 1960s.
- While the railroad car is the subject of the photograph, the townscape of the time is reflected in the background; being able to visualize the landscape of the time is valuable due to the limited access to photographic materials.
- A relatively large number of photographs from the Meiji period to closed in 1978 are left; this especially facilitates the understanding of change in the Kyoto townscape after the war.

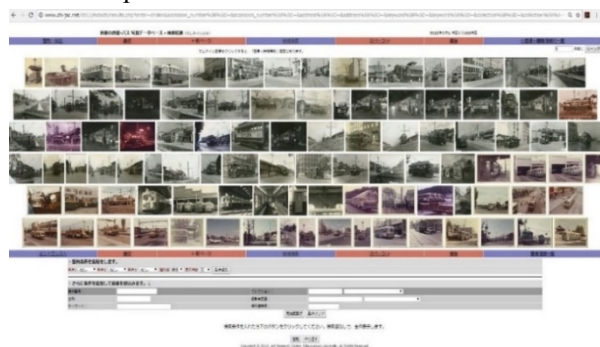


Figure 1. List of photographs (KCTDB)

The authors (Yamamoto et al. 2017) have constructed and released the Kyoto City Tram and Bus Photograph Database (KCTDB), which is a digital archive linked to maps, on February 2017 at ARC on the web (Figure 1).

At the time of collecting photographs to comprise the KCTDB, we obtained permission from the owners; furthermore, we examined the identification method for each photograph's location information (Takahashi et al. 2017).

For each photograph in KCTDB, basic information is registered as metadata: ID, source name, address, photograph year, subject, location reliability, owner, collection name. Users are then able to search the database using various information such as the document number, photograph year, and keywords. The photograph location is specified using Google Maps, and the current place can be easily seen by using the "Street View" function (Figure 2).



Figure 2. Information of a photograph (KCTDB)

As of March 1 2019, KCTDB has released 5,322 items (6 collections), 3,310 of which specify the photograph position, and there are 2,628 items in which the photograph position is specified in Kyoto City and Keifuku Electric Railway, which only have Kyoto City as their business area (Table 1).

location reliability	management companies			amount
	Kyoto City Tram (Kyoto City)	Keifuku Electric Railroad	Other	
a (exact)	2561	67	682	3310
b (near)	44	0	0	44
c (unknown)	414	164	1390	1968
amount	3019	231	2072	5322

Table 1. Location reliability of photographs (KCTDB)

Figure 3 shows the density distribution of 2628 points and the route of Kyoto City Tram between the 1950s and 1970s and Keifuku Electric Railroad.

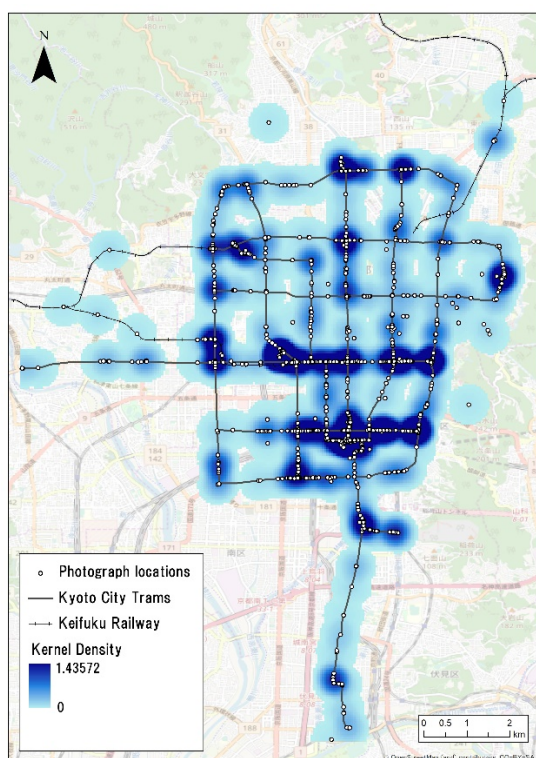


Figure 3. Kernel density distribution of photograph locations (KCTDB)

## 1.2 Kyoto Memorygraph

This study compared old photographs with current landscapes at the same position in order to understand changes in the townscape accurately. We utilized Kyoto Memorygraph (developed by Kitamoto, 2018) to achieve that.

Kyoto Memorygraph is a smartphone application and a new photographic technique to create layers of historical images. Its basic function is accurately capturing photographs at the same place and with the same composition by displaying old photographs as a semitransparent filter on the viewfinder. The map function supports users ability to find the location of old photographs.

The basic usage procedure is as follows (Figure 4):

- Go to the place where the old photograph was taken using the map function.
- Take a photograph at the same angle with the old photograph as a reference on the viewfinder.
- Share the photograph on the application.

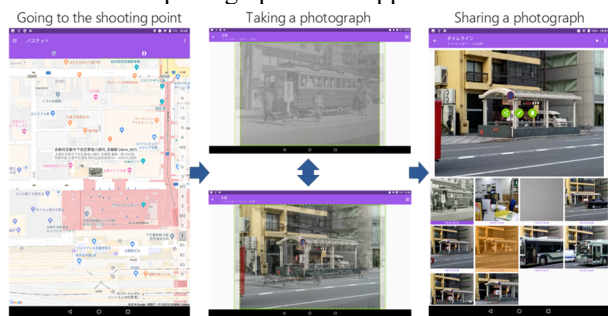


Figure 4. Basic operation of Kyoto Memorygraph

Kyoto Memorygraph has two modes: Project mode, intended for sharing old photographs to be taken with a number of people, and Local mode, intended for using photos taken by an individual. The outline of Project mode, which was the mode employed in this experiment is as follows (Figure 5):

- As preliminary preparation, digital data and metadata (i.e., ID, position information, photographer) of old photographs are prepared in a server, and the data is registered as a project.
- The registered projects can be downloaded from the server of each terminal; many users can use it simultaneously.

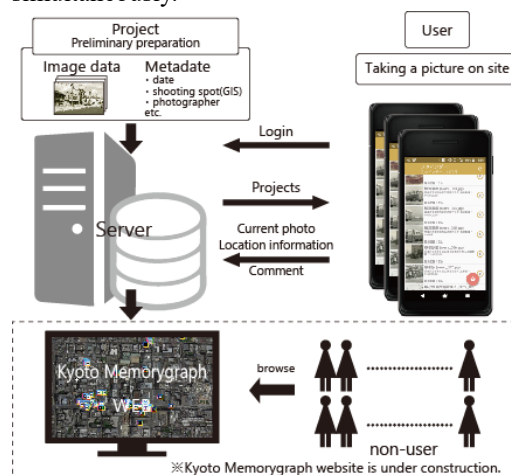


Figure 5. Kyoto Memorygraph, Project mode

## 2. Method

Our experiment consisted of walking around town with Kyoto Memorygraph and conducting questionnaires with participants (Figure 6) and the participants were recruited using a website (Table 2).



Figure 6. Image of participants taking photographs

Applications and inquiries	: KYOTO KEIKAN FORUM(NPO)
Application period	: 9/27/2018-10/13(extended 10/17)
Application method	: Web form and Telephone
Publication	News Paper : The Kyoto Shimbun (Morning newspaper 10/13)
	Web : KYOTO KEIKAN FORUM (NPO)
	<a href="https://kyotokeikan.org/">https://kyotokeikan.org/</a>
	Kyo Manabi Net (Kyoto city Board of Education)
	<a href="http://miyakomanabi.jp/">http://miyakomanabi.jp/</a>
	Civic activity information sharing portal site (Kyoto Civic Activity Center)
	<a href="https://shimisen-kyoto.org/">https://shimisen-kyoto.org/</a>
	Maipure(Future Link Network Co.,Ltd.)
	<a href="https://myplnet/">https://myplnet/</a>
Flyer	: Kyoto Center for Community Collaboration
	Kyoto Civic Activity Center
	etc.
Participants	: without any qualification

Table 2. Recruitment method of participants for Kyoto Memorygraph experiment



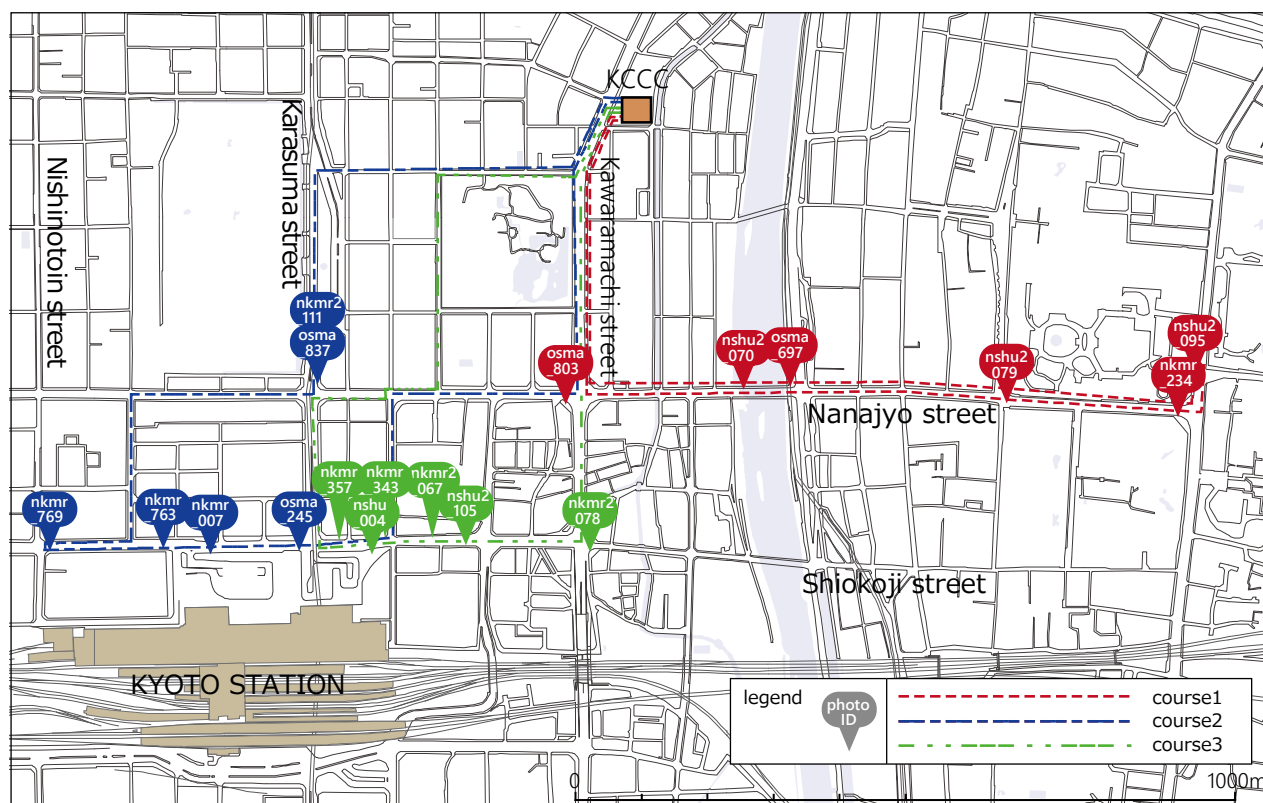


Figure 7. Course and photo spots of the experiment

Table3 shows the overview of the experiment and questionnaire. The experiment was conducted on October 21 2018.

Experiment	
Date	: 21.Oct.2018
Day Schedule	: 9:00 Opening and Reception 9:30 Kyoto Memorygraph and tour outline 10:30 Experiment tour departure (courses 1-3, 6 groups) 12:30 End 14:00 Talk session (joint event)
Place	: Kyoto Center for Community Collaboration(KCCC) 83-1 Umeminato-cho, Nishi Kiyamachi-dori, Kaminokuchi agaru, Shimogyo-ku, Kyoto 600-8127, Japan
Participants	: 23
Questionnaire	
Title	: Kyoto Memorygraph experiment questionnaire
Survey item	: 1.Participant informaiton 2.About tour 3.About usage of apprication 4.About Memorygraph(Overlay of photos)
Answer	: 23(100%)

Table 3. Content of Kyoto Memorygraph experiment

The number of participants was 23, and the questionnaire collection rate was 100%. The details of the experiment are as follows:

- The participants were organized into six groups of 3-5 participants and 2 staff members.
- Before the experiment, participants were taught how to use Kyoto Memorygraph.

- After that, the participants had the opportunity to use Kyoto Memorygraph by taking photographs around KCCC.
- Three different courses were set up. KCCC was the start and goal for each course, and the walking distance was about 2.5km. The course was intended to be finished in 2 hours (Figure 7).
- In each course, participants targeted 6 old photos selected from KCTDB to match locations in the course.
- After arriving at the photograph location, participants searched for the photograph angle for about 5 minutes. After 5 minutes, the staff showed the photograph angle to participants who were unable to find it.
- Participants were asked to complete the questionnaire after the tour.  
The questionnaire included items that collect participant information and information about the tour, app, and what participants focused on when taking photos.

### 3. Results and discussions

#### 3.1 Participants information

Figure 8 outlines the participants' demographic information: 39% of participants were teenagers, 22% were in their 60s, and 13% were in their 70s and over. There were few participants in their 20s and 30s. Of all the participants, 39% were students, 22% were self-employed,



and 17% were traditionally employed.

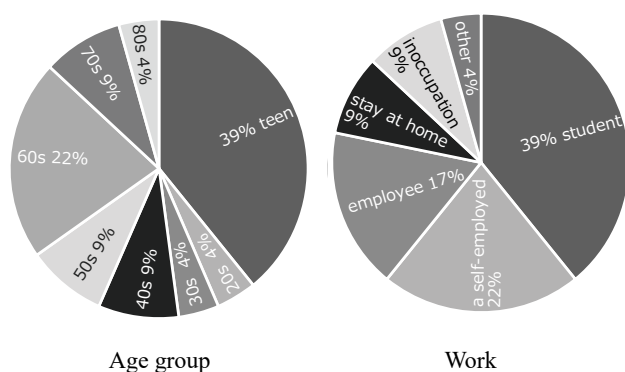


Figure 8. Information of the participants (N=23)

### 3.2 About the Tour

Table 3 shows the results of participants' satisfaction by age, derived from the questionnaire item "How was the tour?" The results indicate that satisfaction was high regardless of age, and 82.6% of participants answered that they were satisfied. No participants reported dissatisfaction.

	extremely satisfied	satisfied	neither satisfied nor dissatisfied	no answer	total
10s	1	8			9
20s		1			1
30s		1			1
40s	1	1			2
50s	1		1		2
60s	1	2	2		5
70s		1		1	2
80s		1			1
total	4 17.4%	15 65.2%	3 13.0%	1 4.3%	23 100.0%

Table 3. Satisfaction of the tour: "How was the tour?"

Table 4 shows the results of the tour duration by age, derived from the questionnaire item "How did you feel about the tour time?" The results indicate that 69.6% of the participants felt that the tour was "neither short nor long." Although this study examined a small sample, older people felt that time of the tour was shorter, and younger people tended to feel longer.

Some participants hoped that the tour was going to be conducted in a familiar place. One participant commented: "I hope it is held where I always go around buildings I know well." (10s), and one elderly participant commented: "I hope it is held in areas with many memories." (70s). Moreover, some participants liked that there was an explanation about the townscape in old photographs from the staffs. One participant commented: "I enjoyed going around with the guide and listening to something I didn't know. It's nice to go around with the guide." (40s) and another commented: "I would like to go around in various places in Kyoto while watching the change with the guide and this app." (70s).

	very short	quite short	neither short nor long	quite long	very long	total
10s			6	2	1	9
20s			1			1
30s				1		1
40s			2			2
50s			2			2
60s		2	3			5
70s	1		1			2
80s			1			1
total (%)	4.3%	8.7%	69.6%	13.0%	4.3%	100.0%

Table 4. Time of the tour: "How did you feel about the tour time?"

### 3.3 About the Application

Table 5 shows the results of the usability of the application by age, derived from the questionnaire item "Was it difficult to use the application?" The results indicate that 34.8% of the participants believed that using the app was "neither easy nor difficult." Younger users are less likely to find it difficult because they are "used to it" (10s), but there some barriers for older users. No participants answered that it the app was easy to use. One participant commented "I have never used a smartphone" (70s), and the other commented: "The display sometimes changes when I touch the screen" (60s).

	very easy	quite easy	neither easy nor difficult	quite difficult	very difficult	total
10s	1	4	4			9
20s		1				1
30s				1		1
40s			2			2
50s				1	1	2
60s			1	2	2	5
70s			1		1	2
80s				1		1
total	1 4.3%	5 21.7%	8 34.8%	5 21.7%	4 17.4%	23 100.0%

Table 5. Usability of the application: "Was it difficult to use the application?"

Table 6 shows the results of participants' satisfaction of the application, derived from the questionnaire item "Was it fun to use the application?" The results indicate that 65.2% of the participants were "satisfied" with the application. One elderly participant felt that it was difficult to operate the app, but he was "satisfied" and commented: "When I saw the picture of the old train, I remembered that I went to school in my school days" (80s). In addition, others commented: "changes in the city can be compared" (70s), "I felt the connection between the past and the present." (50s), and "Not only passing by, but also taking a photo and I could see the town from another perspective by comparing with photos." (50s). On the other hand, some participants made negative comments: "I had a hard time working on the operation method, so I couldn't get to the

point where I could really understand the fun.” (60s), “I still do not understand the meaning of comparison with photos” (70s) and “It was difficult to do the operation with transparency.” (60s).

	extremely satisfied	satisfied	neither satisfied nor dissatisfied	dissatisfied	extremely dissatisfied	total
10s	1	6	2			9
20s		1				1
30s		1				1
40s	1	1				2
50s	1				1	2
60s		1	1	2	1	5
70s		1		1		2
80s		1				1
total	3 13.0%	12 52.2%	3 13.0%	3 13.0%	2 8.7%	23 100.0%

Table 6. Satisfaction of the application: “Was it fun to use the application?”

The usability of the application was not a problem for younger participants, whereas older participants believed either that the app could be usable if they became familiar with it or that the app had poor usability. Some participant’s opinions suggested that using the app is fun because it is possible to visualize changes in landscape.

	past lifestyle	transition of townscape	change of city structure	change of vehicle	Inter- generational exchange	regional learning	(Multiple answers) total
10s	1	6	5	4	2	4	22
20s		1	1		1		3
30s			1				1
40s	1	2	1	2	1	2	9
50s	1	2	1	1		1	6
60s	2	5	3	2	2	3	17
70s		1				1	2
80s	1		1				2
total/N=23 (%)	6 26.1%	17 73.9%	13 56.5%	9 39.1%	6 26.1%	11 47.8%	62 -

Table 7. Purpose of using the application: “What do you think this app will be helpful for? (Multiple answers allowed)”

Table 7 shows the participants’ perspective of the purpose of the application, derived from the questionnaire item “What do you think this app will be helpful for? The results indicate that 73.9% of participants believe that the app will be helpful in demonstrating the “transition of the townscape” and 56.5% believe it will be helpful in showing “changes in city structure.”

### 3.4 About Kyoto Memorygraph (Overlay of photos)

Figure 9 shows example answers regarding Kyoto Memorygraph (overlay of photos) for the participants. The participants evaluated “the difficulty of finding the photograph location” and “the difficulty of finding the photograph angle” on a five-point scale, and they reported “the points that they focused on while taking a photo.”

Table 8 shows the answers of the participants about Kyoto Memorygraph (Overlay of photos). Illustrations and comments were grouped according to similarity. The

results indicate that the subjects were primarily mountains, buildings (landmarks, temples, shrines, and town houses), roads (streets, paths, and bridges), and objects on the roadside (power poles and signals).

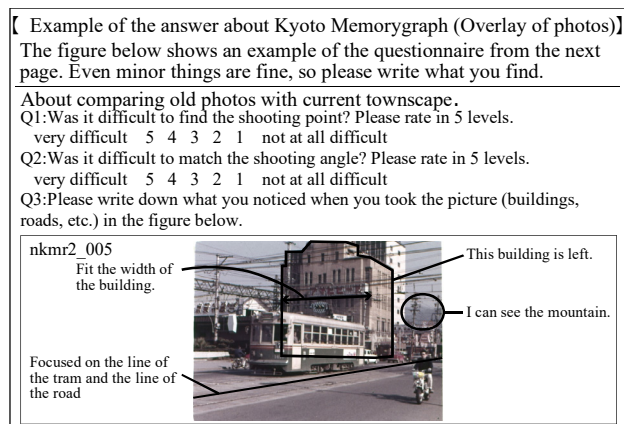


Figure 9. Example answer regarding the use of Kyoto Memorygraph (Overlay of photos)

Some participants highlighted mountains out as big hint for taking photos in the case of NO2 and NO3, and they commented: “I compared my photo with the mountain.” “Evaluation of the difficulty of the photograph location” (EL) and “Evaluation of the difficulty of the shooting angle” (EA) were relatively low.

Some participants focused on buildings it to match their camera angle with the old photographs and commented: “This building was left” and “I tried to fit the edge of this building.” Temples, townhouses, and modern architecture that remained were recognized as important clues that helped participants compare old photos with the current townscape. On the other hand, some participants felt it was difficult to take a picture when characteristic buildings disappear, such as in NO4. One participant commented: “This building was gone, so I felt there was no way to match the scenery.”

In NO3, the river became a closed conduit, and some participants commented: “The river was culvert and I could not find it at all.” In addition, in NO12, the road had been widened, and most of the participants felt it was difficult to match the photograph angle, leading to an EA value of 4.25. One participant commented: “I couldn’t match this photo at all.” In cases in which the characteristics of the photo has changed significantly, some participants felt it was difficult to match the current townscape and old photographs.

Participants focused on the structure and elements of the landscape such as mountains, buildings, and roads from the old photos and became aware of changes in the townscape.

## 4. Conclusion

This study intends to develop a method by which people can understand changes in the Kyoto townscape. We conducted experiments on using Kyoto Memorygraph with old photographs from the Kyoto City Tram and Bus



		Comment	Old photograph	Current photograph			Comment	Old photograph	Current photograph	Comment	Current photograph
NO	1	• (c8) Scaling is a little difficult • (d1) Unexpectedly, roads and buildings were changed			NO	10	• (d5) Bus continued to stop in front of the target, so it was hard to match the angle • (j5) Because this building had changed, it was difficult to find the points to match this building (n6)(p3) width of building			• (i1) Currently there is a subway entrance • (j5) Could not stand at the photograph location because the building had changed • (k1) The color of the building was different • (l1) It was left. (In fact not left)	
ID	osma_803				ID	nkmr_007					
EL	3.20(N=5)				EL	3.13(N=8)					
EA	3.00(N=5)				EA	4.13(N=8)					
NO	2	• (d1)(f6) Focused on here • (e1) compared with a part of the bridge			NO	11	• (i1) There is a big building now • (i1) Bonnet bus is cool • (j5) Could not stand at the photograph location because the building had changed • (k1) Tried to match this building edge (n6)(p3) Kanden Service Center			• (h1)(i1)(m7) Black wall was the same • (i1) City Tram of Kitan Line • (j5) The building was easy to fit because there were window frames • (k1) The altered entrance had been altered • (l1) Was Kanden left?	
ID	nshu2_070				ID	nkmr_763					
EL	2.80(N=5)				EL	2.88(N=8)					
EA	3.00(N=5)				EA	3.75(N=8)					
NO	3	• (c8) Scaling is a little difficult • (d1) Because the building was left under the asphalt • (e1) The river was culvert and I could not find it at all this mountain because of the new building			NO	12	• (i1) It had been changed to a new building • (j5) This building was not left and Road was expanded • (n6) This housing was left (In fact not left) • (k1) adjusted the angle of building was left			• (i1) Couldn't match this building • (h1) Similar house was left • (j5) It was difficult to match this building • (k1) adjusted the angle of building was left • (l1) tried to match this windows	
ID	osma_697				ID	nkmr_769					
EL	3.20(N=5)				EL	3.63(N=8)					
EA	3.20(N=5)				EA	4.25(N=8)					
NO	4	• (d1) It was difficult to take a photo because the building of mountain • (e1)(g6) focused on this mountain • (a1)(d1)(e1)(g6) This building was left			NO	13	• (g1)(v4) couldn't see the central post once anymore (In fact can see)			• (g1)(i1)(v4)(w5) This building was easy to match because of the building's edge • (j5) Difficult to match this building • (k1) According to the wall of Kanden building	
ID	nshu2_079				ID	nkmr_357					
EL	4.00(N=5)				EL	3.57(N=7)					
EA	3.80(N=5)				EA	3.71(N=7)					
NO	5	• (c8) adjusted this line • (a1) It was gone			NO	14	• (f6) Did not know that it was a monument of the tram (f6) tried to match this monument • (v4) felt that I saw it a long time ago			• (f6) Was this signal pole changed? • (g1) Office building • (q1) The track was gone	
ID	nkmr_234				ID	nkmr_343					
EL	2.50(N=2)				EL	3.71(N=7)					
EA	2.00(N=2)				EA	4.00(N=7)					
NO	6	• (c8)(f6) It was difficult to see the screen of the smartphone because it was against the sun • (d1) The road was hard to see because of this tram • (e1) The wall was left (a1)(g1) • (g6) focused on • (a1) It was not left			NO	15	• (t7) This photo was the most difficult • (v4) could not feel the curve of the track			• (f6) Was this triangle roof left? • (g1) It was difficult to match this monument • (w5) This monument was left • (v4) It was very difficult because there was no target	
ID	nshu2_095				ID	nshu2_004					
EL	3.00(N=5)				EL	3.43(N=7)					
EA	2.80(N=5)				EA	4.00					
NO	7	• (i1) This nameboard was not left • (f6) The wall of Temple • (h1) This old car was cool			NO	16	• (t7)(u1) could not see Kyoto Tower • (g1)(v4)(w5) This building was left • (t7) tried to match the wall of Kyoto Tower Hotel			• (f6) focused on this roof the distance • (g1) It was difficult to take a photo	
ID	nkmr2_111				ID	nkmr2_067					
EL	3.13(N=8)				EL	3.57(N=7)					
EA	4.00(N=8)				EA	3.57(N=7)					
NO	8	• (k1) tried to match the edges of this building • (j5) matched the line of sidewalk			NO	17	• (g1)(f6)(t7)(v4) This wooden building was left, I tried to match this building • (u1) This was not left			• (v4) It was sorry to hear that the three-storey wooden house would be destroyed in the near future	
ID	osma_837				ID	nshu2_105					
EL	2.75(N=8)				EL	3.00(N=7)					
EA	3.50(N=8)				EA	3.00(N=7)					
NO	9	• (i1) Signal • (k1)(n6) tried to fit the edge of this building • (j5)(i1)(m7)(n6) tried to match this building			NO	18	• (g1)(t7)(v4)(w5) This building was left • (v5) The power pole was left • (n6) This fence was left (t7) paid attention to the sidewalks			• (v4) felt the landscape has not changed much	
ID	osma_245				ID	nkmr2_078					
EL	2.88(N=8)				EL	3.14(N=7)					
EA	3.13(N=8)				EA	3.14(N=7)					
Legend NO : Photograph NO ID : Photograph ID of KCTDB EL : Evaluation of the difficulty of the photograph location EA : Evaluation of the difficulty of the photograph angle (a-w 1-8) (participant ID, age group) age group: 1=10s ... 8=80s											----- What was not left ----- What was left ----- New things

Table 8. Participants' responses regarding the use of Kyoto Memorygraph (Overlay of photos)



Photograph Database and evaluated it. This study yielded several key findings:

- It is suggested that it is easy to understand the details of changes in the townscape by comparing old photographs with the current townscape using Kyoto Memorygraph.
- By using this application during a tour, users who did not have prior knowledge of the locations of old photographs exhibited notable learning effects.

In this experiment, participants focused on mountains as distant markers and buildings (landmarks, temples and shrines, and town houses), roads (street, path, and bridges) and objects on the roadside (power poles and signals) as proximate markers. These are the basic components of the city; participants examined structures and elements from old photos and became aware of changes in the townscape. In the case that the characteristic features of the photo had changed significantly, some participants felt it was difficult to match the old photo and current townscape. By visiting the place where the old picture was actually taken and taking a picture of the current townscape, users of Kyoto Memorygraph were able to deeply examine the city's structure and elements.

Our results indicate that Kyoto Memorygraph can be an effective regional learning tool.

## 5. Acknowledgements

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