Museum visitor way-finding information transmission evaluation

using fixed location kiosks at the Museum of Prehistory as an example

ABSTRACT

This study uses the Taiwan National Museum of Prehistory as an example, through the guide platform with 3D perspective diagrams, to evaluate whether such tools can deepen understanding for the movement paths for viewing at the museum. The wayfinding behavior explored in this study conducted through a performance experiment of 3D perspective diagrams wayfinding tasks via the public kiosks, with the goal of wayfinding in the real space of the environment. This study used the observation method on 12 first-time visitors, who use museum kiosks to find their destination in a wayfinding experiment. At the end of the experiment, in-depth interviews were conducted to understand problems that arose when subjects used the kiosks and in the wayfinding process. The results were as follows:

It is suggested to decrease the amount of information on a single screen on the guide platform.

There were two models that most subjects used in wayfinding:

Model 1: Subjects used their memories or indicators to search for the destination. This type of subjects had better sensitivity for direction, and was more correct in identifying orientations.

Model 2: according to the viewing paths and the indicators for path guidance, but they may lose their sense of direction in the long slopes. These viewers would use the referential pictures on the kiosks to recall their impressions to find the destination

The enhanced indicator guides in the decision-making points on the floors

I Introduction

With the changes of the times and demands for knowledge communication, museum management was originally based on collection and research, but it has gradually become an institution for informal learning by the general public; thus, people could gain massive amounts of information from museums. Screven (1999) indicated that museum personnel want the people to know the priority of knowledge through the communication channels, while the application of information guidance and search in the museum also hopes to categorize information through the concept of channels. In 1977, Murray Lappe of University of Illinois-Urbana Champaign designed the first touch-operated interactive kiosk, The Plato Hotline, which motivated the application of touch-operated information service devices. In recent years, as digital media and image control interface technology have matured, in order to help visitors search different types of information, fixed location kiosks have used touchscreens to replace the traditional guidance platforms, becoming a tool that assists visitors to guide themselves in the museum.

The purpose of establishing public service kiosks is that, when viewers enter a strange environment, they can autonomously tour the location with the guidance of kiosks, so they can decrease the sense of unfamiliarity with the site, and in turn have a pleasant experience at viewing the museum. Other than the design for the guidance programs, locations of kiosks are important factors that affect museum viewing. This type of information platforms provides visitors with information about the movement paths, guidance to public facilities, and on museum collections. It also guides the visitor about “where am I now” and “where am I going next,” so kiosks at fixed locations can provide real-time search information based on the direction and nearest service facilities.

Recognition of visual information in museums is the key issue in wayfinding research, and how to provide visitors with correct guidance information in the museum space with massive information. The wayfinding research has originated with Lynch (1960), who coined the term “wayfinding” as one of the central functions of the city image. He used cases of actual cities as examples, how the spatial elements can be depicted and identified to constitute the urban image. In the process of wayfinding, people identify common elements in the environmental image, including five types of path, margin, area, nodes, and landmarks. Generally speaking, in the process of wayfinding, the users use spatial cognition to establish spatial concepts to determine wayfinding strategies, and then proceed based on the directions of the expected reference points (Wang, 2003). The research of spatial images by Lynch (1960) was similar to the concept of cognitive maps, in which the construction of mental images or cognitive maps provides referential structures and information for wayfinding. The on-site study by Arthur & Passini (1992) in Montreal, Canada found that even though more than half of the subjects had inaccurate hand-drawn maps, most of the subjects are able to effectively find suitable paths, without feeling lost. In other words, wayfinding cannot only rely on accurate spatial images, so he defined wayfinding as: operations that allow for the resolution of a series of spatial problems by using environmental information.

Other wayfinding researchers had found that three major issue influence wayfinding behavior, which are individual, environment, and interaction between the two (Annett, 1992; Casey, 1996; Eaton, 1992; Ingwersen,1982; O’Neil, 1991) , Down & Stea (1973) suggested that after people enter the actual environment, and new information has been continuously added, with continued comparison and reassembly of the original cognitive map, or the cognitive-mapping process. This process is more important than the cognitive map that was most recently updated, since it represents the human ability to collect, organize, store, remember, and apply information from the environment. Seigel & White (1975) proposed the three stages of wayfinding knowledge formation:

Step 1, Information on landmarks: understanding and impressions of landmarks themselves are referred to as declarative knowledge.

Step 2, Paths between locations: landmarks serve as intermediary decision-making points or connective points, referred to as procedural knowledge.

Step 3, Establish comprehensive spatial relationships: produce a cognitive map, referred to as configurational knowledge.

However, Colle & Reid (2003) argued that clearly understandable environment can be quickly used to construct a perception map, and path knowledge is not required. This finding allows for the possibility of using maps to assist with the construction of perception maps. Learning of spatial knowledge does not necessarily require declarative and procedural knowledge; map learning can directly yield in configurational knowledge. Thorndyke & Hayes-Roth (1982) found that, map users are better at

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determining overall spatial relationships and linear distances than those who have been guided by on-site guides, while those who received guidance from guides are better at determining path distances. From the above literature relating to wayfinding, it can be summarized that when people are looking for their way, they use environmental information such as landmarks and nodes with vertical and horizontal connections to form spatial concepts in self-cognition, and use such information to determine strategies on wayfinding.

This study used kiosks at the Taiwan National Museum of Prehistory as the case, and the guidance interface of 3D perspective diagrams are used to evaluate whether visitors can have better understanding of the movement paths in the museum, and factors that affect wayfinding behavior, or misunderstandings over space that arise when visitors are unable to comprehend the guidance information. The wayfinding behavior explored in this study conducted through a performance experiment of 3D wayfinding tasks via the public kiosks, with the goal of wayfinding in the real space of the environment.

Primary purposes of this study are as follows:

1. The basic research content is based on visitors who are using the museum's information guide platform for the first time.
2. After the test, the questionnaire surveys obtained are used for basic evaluation and investigation, the analysis is then used to understand what the important factors are.
3. Records of in-depth interviews, matched with the wayfinding experiment, are used to understand whether 3D information kiosks are relatively more beneficial for wayfinding in comparison to 2D diagrams.

II. Methods

This study used behavior observation to understand the wayfinding behavior of subjects in using museum kiosks, the purpose of which is to see whether visitors can learn from the 3D map information of kiosks based on personal memory and signals in the environment to find their target locations. The non-participatory observation method was used in the model of the subject in front and the observer following behind, to make behavioral notes in the recording of subject wayfinding movements and problems. After the test, in-depth interview was used to understand subjects' experiences in using the kiosk, the movement paths in the museum, and the indicator system, as well as other issues.

The subjects were first-time visitors to the exhibition hall of the museum. After the subject's agreement, he was given a wayfinding test, in which the subject first used the kiosk located at the second floor exhibition hall entrance at the Taiwan National Museum of Prehistory, with the 3D virtual environment interface to understand the target location and spatial movement path. The guidance platform is a touchscreen, and on the right of the kiosk interface there are floor menus with 3D perspective diagram interface design, providing subjects with a basis for consulting their present conditions. Among them, in the 3D perspective diagram, when the related space is selected, the actual photographs would be shown on screen (Figure 1), which enhances the memory of subjects for subsequent on-site testing. In addition, in order to understand the usage model of subjects in using the guidance and browsing, their actions are recorded from behind the screen as to allow for the recording of problems encountered in operation and for the calculation of time spent.

Figure 1 the snapshot from the screen shown

1) Location selection: the museum exhibition hall was used as the primary space for investigation, divided into four floors (Figure 2). The entrance leads to the second floor; for most visitors, this was the beginning of spatial confusion, and that is why the test point was located here.
2) Test subjects: no limitation of ages, but must be first-time visitors to the museum. Among the 12 subjects, 6 are men and 6 are women, all were first-time visitors. They engaged in the wayfinding experiment with fixed location kiosks between December 12, 2010 and May 5, 2011.
3) Test destination: in carrying out the wayfinding task, the four destinations in the museum were set for testing, and they were:
   A) the bathroom on the third floor;
   B) the introductory exhibition hall of prehistory on the B1 floor;
   C) the entrance of the archaeology of science hall, and
   D) the bathroom on the first floor.

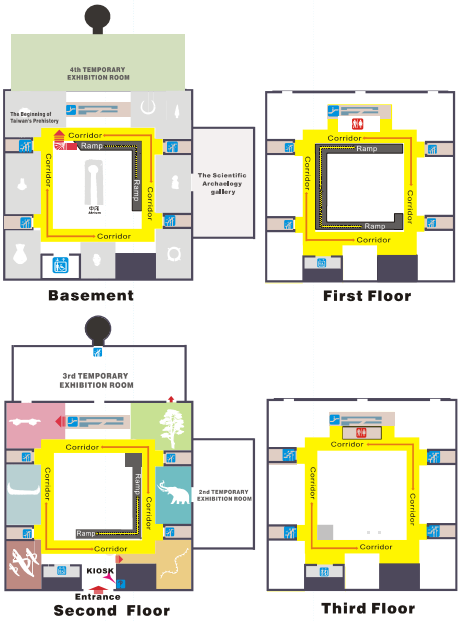

Figure 2. Four layers of museum exhibition gallery

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PLACE	THE ENTRANCE OF SCIENTIFIC ARCHAELOGY（B1F	THE BEGINNING OF TAIWAN PREHISTORY（B1F）	THE 3RD FL. TOILET	THE 1ST. FL. TOILET
Time	69sec.(A3)	48sec (A2)	64sec (A1)	96sec (A4)
	154sec (A5)	135sec (A9)	78sec (A8)	74sec (A6)
	160sec (A7)	35sec（A10）	67secA11）	75sec（A12）
Mean	127sec	72 sec	69 sec	82 sec

Table 1 Time Spent On Operating The Guide Machine

III Results

3.1 Time spent by the subjects when operating the tour guide platform and wayfinding

The guide platform uses 3D to create a virtual space of the Museum, giving museum visitors the ability of finding important decision points of the vertical and horizontal generatrix while wayfinding around. The decision points may include landmarks such as stairs, lifts and escalators and other related virtual models. The central space (based on the design concepts of the New York Solomon R. Guggenheim Museum) emphasized in the Prehistoric Artifact Section also has a spiral ramp from the second floor to the first basement level. It is hoped that by using a 3D interface and providing the said interface to the subjects for on-site testing, whose task was to find the main vertical generatrix in the spaces of the B1 (basement floor) level.

A.Time spent on operating the guide platformOverall, the subjects spent an average of 87.5 seconds for wayfinding when using the guide platform, the shortest time being 48 seconds and 160 seconds for the longest (Table 1). From the average results of four groups of subjects, the longest time was spent looking for the entrance of The Scientific Archaeology gallery(127 seconds), and the shortest (69 seconds) for finding toilets on 3F (third floor).

a. The toilet is marked using a universal symbol in the 3D guide interface. The subjects were able to find the location of the toilets on 1F and 3F in a very short time, and most subjects used the nearest vertical generatrix staircase as the main path to complete the search task of the guide platform.

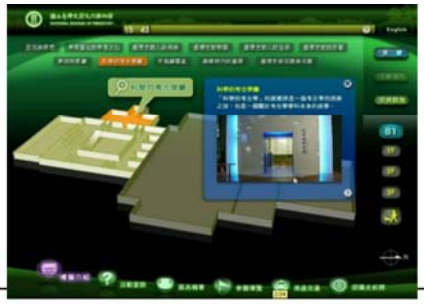
b.When the target is the gallery, most subjects spent more time trying to find the main location of the gallery to plan the most suitable path. However, subjects often had to reaffirm their current location, filter through the descriptions of the levels and gallery from the right and top side of the screen, shifting back and forth between the graphics of the 2F and B1 while thinking about the differences of the relative location. Using the beginning of Taiwan Prehistory gallery and the Scientific Archaeology gallery as examples, the difference between searching for either two would be that subjects subconsciously choose stairs or lifts vertical generatrix as their first search point. Since the B1 Prehistoric Dawn gallery is at the intersection of an escalator and a staircase, hence the time used to look for it is shorter when compared to searching for the gallery of Scientific Archaeology on the same level.

c. When using the guide platform, the viewer's eye movement usually shifts from the center of the screen to the upper left, upper right, lower right and then lower left. The illustrated location of the Scientific Archaeology gallery in the 3D is at the upper right area, making it a target that is relatively harder to detect by the subjects.

Step 1>0:08 seconds - beginning to use the guide machine

Step 2 >0:51 seconds - return to the overall plan view to search for user's current location and relative to the target

Step 3>1:06 minutes - begin search after a pause of 15 seconds



Step 4>2:07 minutes - after selecting B1, the screen will show all the display halls. After selecting the name of the display hall, the location will be designated an orange color on the 3D map for subjects to find the location of the Scientific Archaeology display hall.

Figure 3. Search model of subject A7 when looking for the location of Scientific Archaeology gallery using the guide platform.

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2.Time spent when looking for a path by the visitors and observations of visitor behavior

According to the investigation results shown in Table 2, after the subjects had completed the operations on the guide platform, the actual time spent on looking for the target location was 153 seconds. The subjects started from their current location to 4 targets and return. The longest time was spent on going to the 1F toilet, with an average of 238 seconds. Subjects A4 and A2 spent 330 and 290 seconds respectively, which was almost 2-4 times of the time spent going to other locations. The shortest time for a round trip was the L3 toilet, the average time being 88 and 69 seconds respectively. According to the results of wayfinding behaviors of the 4 groups of subjects, it was more difficult looking for the 1F toilet compared to other locations. Subjects also spent more time returning to their location on 2F from the Scientific Archaeology gallery then going there. The results from the investigation of wayfinding behaviors were as follows:

A. When the subjects had to find the 1F toilet physically, two situations were observed. After completing the search on the guide platform, one of the subjects followed the directional pointer provided and found the staircase closest to the starting location within a short time, after which the subject kept following directional pointers and completed the test within 95 seconds. The other two subjects, however, did not find the directional pointer provided near the staircase and continued down their paths along the central sloping path. Since the sloping path connects 2F with the visiting generatrix of B1, few directional pointers pointed them towards the 1F toilet. The visitors usually lost their sense of direction relative to their starting location and target location after walking through the 360o spiral ramp. Hence, the two subjects must go to B1 floor and found the target by using the directional pointers and spent time to re-familiarize themselves with the surroundings. The two subjects finally found the toilet after following the directions provided at the escalators or staircase. On the return trip, the two subjects had already familiarized themselves with the shortest vertical generatrix situated at the lift close by and were successful in returning to their starting location as a result.

B.

When observing the return trips made by the subjects from the target location to the starting location, the trip from B1 Scientific Archaeology gallery entrance to the 2F starting point was found to be more confusing. Two subjects used the shortest vertical generatrix staircase to find their way, which made returning to the starting location difficult. These two subjects attempted to find the shortest path but instead lost their sense of direction, thus failing to use the staircase closest to the gallery. They used the directional pointers system to locate an escalator to return instead. One of the subjects spent 5 minutes at B1 before returning to 2F.

Another subject focused on the actual photo of the entrance to the gallery of Scientific Archaeology shown on the display screen of the guide platform. Despite going straight down along the central spiral ramp, the subject found the gallery by comparing the surroundings with the photo shown on the guide platform while gazing through the windows. The subject changed directions after locking down on the target destination and reached the destination quickly. The subject

was also relatively successful in returning to the starting location.

Sample	Gender	Destination	Inbound Spend Time (Sec.)	Outbound Spend Time(Sec.)
A3	M	THE ENTRANCE OF SCIENTIFIC ARCHAELOGY (B1F)	170	130
A5	M		118	330
A7	M		119	150
A2	M	THE BEGINNING OF TAIWAN PREHISTORY (B1F)	190	140
A9	M		146	120
A10	F		125	95
A8	F	THE 3RD FL. TOILET	108	80
A1	F		76	69
A11	F		80	60
A6	F	THE 1ST. FL. TOILET	95	60
A4	M		330	120
A12	F		290	90
MEAN				
A	THE ENTRANCE OF SCIENTIFIC ARCHAELOGY (B1F)		135	203
B	THE BEGINNING OF TAIWAN PREHISTORY (B1F)		153	118
C	THE 3RD FL. TOILET		88	69
D	THE 1ST. FL. TOILET		238	90

Table 2. The Investigation Results LIST- THE ROUND-TRIP TIME When Looking For A Path By The Visitors

3.Visitor behavior observations and interview result

After completing the wayfinding tasks, the subjects were interviewed in depth to understand the issues of the tour-guiding system of the museum. The investigation results were as follows:

A. Amongst the 12 subjects, those below 40 years of age had a better understanding of the touchscreen-style interface of the guide platform as well as the relation between virtual and actual space. Those subjects above 40 years old, excluding two who work in design-related fields, needed longer time to understand how to operate the tour-guiding interface. They also spent more time understanding the options list and browsing the 3D maps

of each floor ▪

B. Observation of wayfinding behaviors amongst the subjects found out that the primary concern of most subjects was to find the target location as quickly as possible. A portion of the subjects followed the directional pointers provided but did not observe the surrounding environment carefully. Additionally, subjects also lost their sense of direction after walking through the central spiral ramp pathway. Hence, when the subjects embarked on their return trip, only those with the task of finding the 3F toilet were able to retrace their steps and return to the starting location. Most subjects tasked to find a B1 location would have to use the directional pointers system to return to the starting location.

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Most subjects felt that the actual photos of locations displayed on the guide platform were helpful when trying to find the physical location within the museum. The directional pointers were important for guiding the directions and finding the target location in most wayfinding processes. However, subjects from the research could also form an image from the actual photos and 3D virtual view provided by the guide platform. The image was used to find familiarities in the surroundings and also reduced the anxiety experienced during wayfinding processes.

From the results of on-site testing, it was found that the position and layout of the 3D tour guiding machine and the directional pointers play possible roles in affecting the users' decision. The means of providing adequate information at a suitable situation, time and position are all important in wayfinding behavior. In public service areas like the museum, locating of public-use facilities such as toilets, exits and vertical generatrix such as lifts and staircases should be the most important areas for testing.
With respect to the beginning of Taiwan Prehistory gallery, ordinary tourists are easily disoriented when using the central spiraling ramp as a route. This is an important area that requires future improvements from the Museum.

IV Conclusions and Suggestions

It is increasingly common to place guide platforms at fixed locations within museums which allow visitors to search for relevant information. Museums are able to compile great volumes of information for service facilities, exhibitions, items and others into a touch-screen guide platform. With the current situation, touchscreen facilities are getting cheaper and active units are increasing sharply. Information change and update processes are becoming easier. Thus, the following suggestions are proposed for future improvements ideas for public-service search-function platforms:

1.Simplifying the user interface of the guide platforms
By observing visitor behaviors, it is found that excessive amounts of data provided by the platform cannot be properly digested or remembered by the users within a short time. Miller (1956) suggested that people are only able to think about 5-9 topics at once. This also means that short term memory is limited to 7±2 units of information. Although information provided by the guide platforms of the museum was divided into 4 blocks, there were about 20 touch-sensitive areas in the menus. Hence, users of the platform will use a significant amount of time when choosing their destination or trying to understand how the interface work. To solve this issue, interface designers should consider providing multiple layers to the functional menus on the screen and reduce the total amount of information displayed at once on the screen.

2. Improve the directional pointers so that it coincides with the decision point in each level
There are several decision points on each level at the intersection of traffic routes. Only a portion of these decision points at the gallery areas have directional signage, while some decision points have no signage. The Museum should reconsider the correct positioning of the directional signage and whether too much directional information is provided in its improvements.

3. With the decrease in the cost for touch-screen displays in recent years, the Museum initially planned for 20 inch touch-screen displays for use as its guide platform. However, the dimension of the screen is too small and limiting considering the amount of information to be displayed by the system. At the same time, the touch-screen devices are situated at the right side of the entrance, a location which is not conspicuous enough. Ordinary visitors would have a hard time finding and using the device. Future improvement plans should include relocating the touchscreen guide platforms as well.

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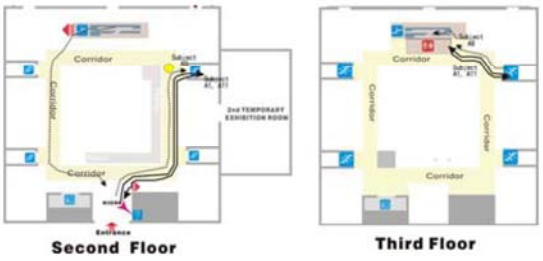
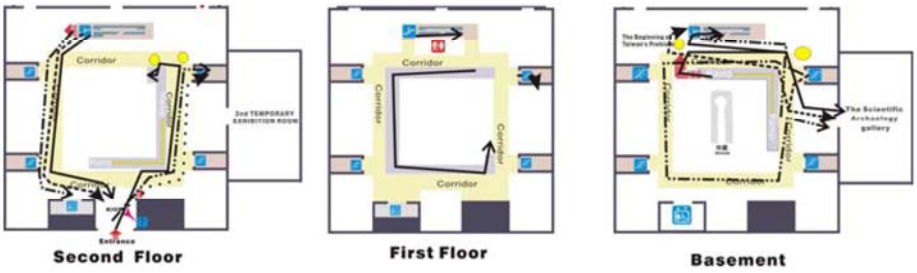
Subject A group：Wayfinding to the 3rd. Fl.toilet

Subject	Lint type	Inbound	outbound	Observation for path tracking
A1	→	76	69	
A8	⇢	108	80	
A11	→	80	60	

Subject B group：Wayfinding to the 1st. Fl.toilet

Subject	Lint type	Inbound	outbound	Observation for path tracking
A4		330	120	
A6	- - →	95	60	
A12	→	290	90	

Subject C Group：Wayfinding to The entrance of Scientific Archaelogy

Subject	Lint type	Inbound	outbound	Observation for path tracking
A3	→	170	130	
A5	- - →	118	330	
A7	⇢	119	150	

Subject D group: Wayfinding to The Beginning of Taiwan Prehistory

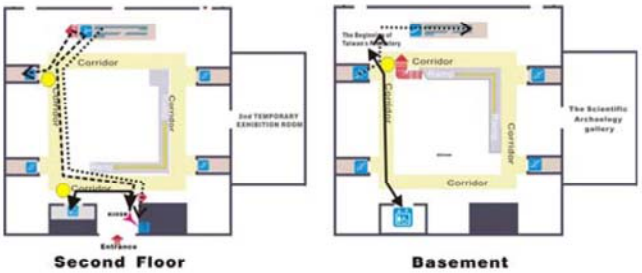
Subject	Lint type	Inbound	outbound	Observation for path tracking
A9	→	146	120	
A10	▪▪▪▪→	125	95	
A2	→	190	140	

Figure 4: The yellow circles indicate traffic decision points suggested for the Museum for reconsideration

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