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Design, Implementation and Evaluation of a Mobile Exhibition Guide

A thesis submitted in fulfilment
of the requirements for the degree of

Master of Science

in Computer Science

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by

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Design, Implementation and Evaluation of a Mobile Exhibition Guide

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Abstract

As mobile devices are increasingly merging into our daily lives, exhibition services are also facing innovation based on the newly available technologies. Our project addresses these new circumstances. We developed a mobile exhibition guide for the exhibition called "Mrs Brown's Big Day Out: Hamilton Women in the 1950s". That is organized by the Waikato Museum. The proposed system re-uses the TIP (Tourist Information Provider) system's framework and provides information via mobile devices to visitors on Victoria Street, which is an outdoor part of the exhibition. The information about a sight will be delivered according to visitors' current locations and their interests.

We would also like to examine the possibility of re-using our TIP system within the application area of exhibition guide. Therefore, we built the mobile exhibition guide system under the TIP system's framework and developed corresponding services that tailored the system to the requirements of visitors and the exhibition organizer. During the development, we faced a number of challenges, especially, modeling the unknown and unstructured exhibition data into the TIP database. The development process as well as the implementation and evaluation are detailed in this report.

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Chapter 1

Introduction

The goal of this project is to develop a mobile guide for an outdoor exhibition. The exhibition called "Mrs Brown's Big Day out" is about Hamilton women in 1950s. It is organized by the Waikato Museum. According to the meeting with the exhibition organizer [1], the exhibition will take the visitors back to the 1950s by exploring the social experiences of women at that time in several areas such as fashion, recreation, keeping house, beauty, shopping and social expectations. Various interpretive tools such as text panels, graphics and recorded oral histories will be used to present the information. The main part of the exhibition will be held in the museum. In addition, the exhibition allows visitors to explore the building heritage, with a special focus on Victoria Street in Hamilton. This is the outdoor part of the exhibition in which our project will play a role.

The project described in this thesis will add some additional features and extend the exhibition to Victoria Street. The mobile exhibition guide will provide information via handheld devices to visitors while they are walking along Victoria Street. The users situation is illustrated in Figure 1.1. The information will be delivered to the visitors according to their current locations and their interests. With these features, visitors will have more actual experiences while exploring the changes on Victoria Street, Hamilton, from 1950s to now. We hope this project will bring new aspects to the exhibition, and also increase visitors' interests. It is a great opportunity for ISDB (Information System Databases) group to cooperate with the Waikato Museum.

The aim of the project is to develop the mobile exhibition guide by re-using the framework of the TIP (Tourist Information Provider) system. It is a mobile guide system that provides travel information to travelers. An introduction to the TIP system is given in a later chapter. As a research group, we would like to examine the possibility of re-using the TIP framework within other application areas[10]. Although the TIP system is designed for tourists and

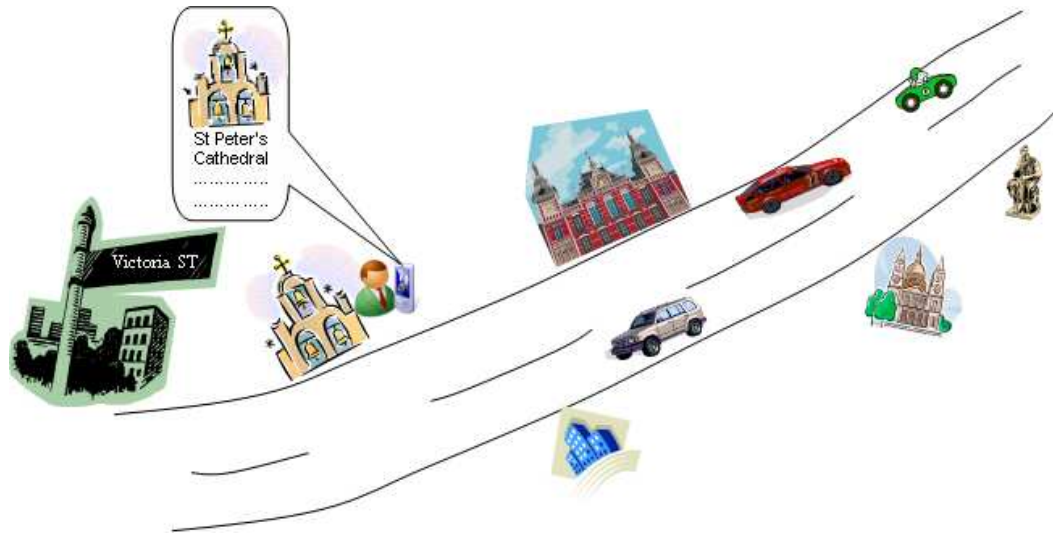


Figure 1.1: Victoria Street Simulation

not explicitly as an exhibition guide, there are common features that can be found in this situation. The advantages of using TIP for our project are list as follows:

1. The TIP system and the mobile exhibition guide are information systems.
2. The TIP system is a mobile system; its mobility feature and its framework suit the exhibition guide system.
3. The proposed exhibition guide system will benefit from the location awareness feature of the TIP system.
4. The personalization feature of the TIP system will allow the proposed system to provide better support for the user.
5. From the TIP system perspective, the success of re-using the system can expand its reusability in other application areas.

Therefore, we propose to build the mobile exhibition guide system under the TIP system's framework and to develop corresponding services that will tailor the system to the requirements of visitors and the exhibition organizer.

In spite of the common features between the TIP system and the proposed mobile exhibition guide, there are still challenges that need to be addressed in order to carry out the proposed solution. For example, the unknown and unstructured data has to be modeled into the existing TIP data structure.

The remainder of the thesis is organized as follows: in Chapter 2, we overview several modalities of exhibition guides and some other mobile guide

systems. Chapter 3 identifies the challenges that need to be solved while developing the system. In addition, the detailed focus of the project is defined. We describe scenarios that could be applied on the mobile exhibition guide in Chapter 4. In addition, the requirements of the system are summarized. Following that, Chapter 5 discusses the design processes of the mobile exhibition guide. The details of the implementation of the system present in Chapter 6. The evaluation plans and results describe in Chapter 7. The conclusion of the thesis and the future work are given in Chapter 8.

Chapter 2

Related Work

Mobility and context-awareness are the features of ubiquitous computing [23]. If we look around us, everyone has probably one or two electronic mobile devices such as mobile phone, PDA, iPod, Laptop, or TabletPC etc. There is no doubt that mobile devices have been merging into our daily life in some extent. Exhibition services are also facing innovation based on the newly available technologies.

In this chapter, we first overview those typical exhibition guides in Section 2.1. As we are not familiar with the exhibition field, through this process, we can learn from typical guides about what features they can provide to the visitors and what criteria they can fulfil. At the same time, we can distinguish the strength from the weakness of each typical exhibition guide. After that, we need to find out whether the mobile exhibition guides can support those features and criteria. Therefore, several mobile exhibition guide systems are reviewed in Section 2.2. In that section, we also look at what kinds of additional features that the mobile exhibition guides can provide. Furthermore, we describe the mobile guide systems that applied in other fields in Section 2.3. Since the TIP system is one of the mobile guide systems, we want to identify the commonalities between the mobile exhibition guides and general mobile guides. Lastly, comparisons among typical exhibition guides, existing mobile exhibition guides and general mobile guide systems are summarized at the end of this chapter. Consequently, we can prove that re-using the TIP system in this exhibition context is possible and feasible in terms of theoretical.

2.1 Typical Exhibition Guides

There are two types of guides that are widely adopted in exhibitions. One approach is to deliver the exhibition information by text, using media such as information sheets, booklets and text descriptions on walls. The advantage of

this way is that visitors can explore the exhibits according to their interests. As a result, visitors can have more freedom in the exhibition. Another advantage is that the text information on a booklet about the exhibits could be worthy to be collected by visitors. However, there are also disadvantages. It is quite tedious for visitors to read a lot of information during the exhibition. In addition, when visitors are reading the description on the wall, they might be disturbed by other people standing in front of them. Consequently, the visitors' enjoyment and learning ability might decrease.

The other typical approach is a guide person that gives information about the exhibits. In this way, visitors can simultaneously obtain some background information or stories about the exhibits while they are wandering along the exhibits. In addition, visitors can have some kinds of communication with other visitors or interaction with the guide person (e.g. asking questions). Therefore, visitors' interests could be increased. However, the information delivery by a guide person has limitations. Often the guide person presents the information only once. That can become a significant limitation because the process of delivering information is easy to be affected by other factors (e.g. people talking, noise). Visitors may not be able to fully hear or understand the information. Another disadvantage is that the visitors have less flexibility to decide what they want to visit. This is because the visitors have to follow the guide person. Furthermore, only a limited number of people can be served each time. Therefore, a guide person is more suitable for a small group of visitors.

In addition to these traditional ways, audio guides have been applied in some of the exhibitions in the recent decades. For example, in the British Museum and the Metropolitan Museum of Art in New York, audio guide services are already available for visitors. In general, in order to receive the information about an exhibit, the visitor needs to enter the corresponding code of each exhibit. In addition to manually control the audio guide, some audio guides can automatically detect a visitor's current position in the exhibition while they are moving (e.g. by location sensors).

One of the benefits from an audio guide service is that visitors can decide where to go and what to listen to. They can also replay the audio file if they want. Another benefit is that multiple languages may be supported in the audio guide. Compared with a guide person service, the audio guide is more suitable for individual visitors. However, a drawback of the audio guide is that the interaction is often invisible or indirect: In most cases, visitors have to enter the code of the exhibit or listen to all the options before they can select their desired option. Furthermore, some audio guides detect visitors' location by sensors, but it might not always as precisely locate visitors as they expect. Hereinafter is the experience of a visitor who visited an exhibition held

in Vienna [19]: "Since some of the indoor rooms were quite small, when the visitor was walking around the audio guide kept changing the topic without giving notice. This is because the audio guide detected that the visitor is currently looking at a new item. After a few times, it gets annoying because visitors do not want to stand still without moving just to listen to all the information."

In short, the audio guide gives visitors the flexibility of moving and receiving information, but the accuracy of the positioning technique and the interaction between visitors and the devices still needs further research. An overview and comparison of typical exhibition guides will be given in Section 2.4.

2.2 Mobile Exhibition Guide Systems

With the emergence of the mobile devices and the development of wireless network technology, mobile exhibition guides are becoming a new trend of exhibition services. It is also an example of applying ubiquitous computing. In the following, we discuss a number of relevant mobile exhibition guide systems in research fields.

Hippie [20, 21] is a prototype of a mobile exhibition guide that is being developed by the GMD in the HIPS project. It is designed for the art collection in the castle of Birlinghoven. This system takes into account the activities that a visitor would do before, during and after the exhibition. Since Hippie is an internet-based system, it allows visitors to access their personal space at home and in the exhibition using different devices (e.g. PCs or PDAs). Before the exhibition, visitors can specify their interests and preferences as their personal profile. While being in the exhibition, information about an exhibit will be presented on the visitor's PDA, according to the visitor's current position and his or her predefined profile, while the visitor is close to an exhibit. The visitor's position is identified by infrared, and the data is transmitted via wireless LAN. The information is presented on the PDA in various manners (e.g. text, graphic, audio). After the exhibition, Hippie also allows visitors to access the information space of the exhibits at home.

An other mobile exhibition guide has been developed within the framework of the PEAH (Personal Experience with Active Cultural Heritage) project [16]. The project aims to enhance cultural heritage appreciation by applying various advanced technologies. The project explicitly takes into consideration the presentation of the information and Human-Computer-Interaction: One of the prototypes combines the interaction between a big screen and the visitors' PDAs so that visitors can receive high resolution graphics, animations and video-clips on the big screen. A feature called lifelike-characters is applied

to improve the usability of the system, which is used to assist the visitor to change the attention between the mobile device and the big screen. With this approach, the PDA is not only used to present the information relevant to the visitor's current location and personal interests, but also as a controller of the big screen.

The mobile exhibition guide *Sotto Voce* has research concerns that differ from the previous systems. *Sotto Voce* is an electronic guidebook, which intends to enhance the communication between visitors and their partners [7, 9]. The system allows a visitor to synchronously share a played audio clip with his or her partner. The researchers call this technique "Eavesdropping". It works in the following way: Visitors can select their individual audio clip of the exhibit they are interested in. The selection is done by clicking the image-maps on the PDA. After that, the visitors will hear their selected audio description respectively. If one visitor turns the "Eavesdropping" option on and this visitor is not playing any clip, then they will hear the audio clip his or her partner is listening to. The other case is that both visitors are listening to their own clips and the "Eavesdropping" is active, then one visitor will hear the rest of the clip that his or her partner is listening, when this visitor's clip finished earlier than the partner's. However, *Sotto Voce* does not support voice communication. In terms of the system design, *Sotto Voce* system stores the information locally in the PDA and does not automatically detect the visitors' position. All interactions are done by explicit the visitors' selections.

As observed in [20, 21], the advantage of mobile exhibition guides is that it not only provides mobility and flexibility for visitors to access information, but also increases visitors' learning interest and learning efficiency. This is because visitors can decide where to go and what they want to see. Another advantage is that the information about exhibits can be delivered in multimedia format (e.g. text, graphic, audio etc). In addition, multiple languages can be easily supported by the system. However, some systems are hard-coded for a specific exhibition. From a system development perspective, this approach is not flexible enough.

2.3 General Mobile Guide Systems

In this subsection, we look at a number of general mobile guide systems that have been developed in research field and for the commercial market. They have been designed for different application areas (e.g. tourism, car navigation). In general, infrared and blue-tooth techniques are used in indoor environment to locate a user's current position. For outdoor environment, Global Positioning System (GPS) is used [15].

The TIP system developed in our ISDB group is a mobile guide system in tourism [10, 12]. From the research point of view, TIP concentrates on studying Location Based Services(LBS) and Event Notification System(ENS). Various travel information is delivered to travelers according to their current position, the preference of their interests, their travel history and their feedback about the sights. In the current version of the TIP system, it provides travel information and recommendation information [14] to travelers while they are traveling. Moreover, travelers can view other travelers' itineraries [24], plan their travel routes [13], write their travel experience [17] and access the Greenstone digital library to get more information about a sight [11]. There are more services that are being developed (e.g. an audio service [8]). More detail about the architecture and implementation of the TIP system is given in Section 6.1

Similar to TIP, the Guide project [4, 6, 5] is also a context-aware mobile guide system, which is designed for supporting the city visitors in Lancaster. The system provides visitors a set of services: accessing information page about the current location, searching on World Wide Web, creating personalized tour of the city, making reservation of accommodation etc. The Guide project has considered the disconnection that might occur in some circumstances so the system is able to cache some part of the information onto the visitor's device. Although some services (e.g. booking service) are not supported by the caching, it still offers the visitor basic information of the city.

GPS technology has been widely used in car navigation system for identifying the location. Many commercial organizations (e.g. Navman¹, TomTom², Garmin³) have produced car navigation systems and put them to the market. Most car navigation products have the following common features:

1. Giving guidance on digital maps.
2. Interacting on a touch screen.
3. Finding the route from the current location to the destinations.
4. Providing guidance in audio and/or on screen.

In addition, some products can plan routes for multiple destinations and optimize the routes. Moreover, the nearest patrol station and parking location can also be located.

¹<http://www.navman.com>

²<http://www.tomtom.com/index.php>

³<http://www.garmin.com>

2.4 Summary

In this chapter, we analyzed several existing exhibition guides, from typical guides to mobile exhibition guides. Additionally, we introduced some other mobile guides in research and commercial world. In this section, we compare typical exhibition guides and mobile exhibition guides on Table 2.1. The comparisons among several mobile exhibition guides and general mobile guides are presented on Table 2.2.

	Typical Exhibition Guides			Mobile
	Text Guide	Guide Person	Audio Guide	Exhibition Guide
Information Accessibility	+	-	+	++
Reading Effort	Large	No	No	Medium
Anti-disturb Ability	+	-	++	++
Information Repeatability	++	-	++	++
Personalize Route	++	-	++	++
Communication with Others	+	++	-	+
Serving Relation (Guide/Visitor)	1/1	1/n	1/1	1/1
Multiple Language	+	-	+	+
Controllability	-	-	+	++

Table 2.1: Comparison of Exhibition Guides

(Symbols: ++ supported, + partly supported, - not supported, ? no information)

As shown in Table 2.1, the first column of the table lists all the features of the exhibition guides. We identified these features by analyzing what the different approaches can provide to visitors. The typical exhibition guide in text format supports most of the features, but this way requires visitors the most reading effort and provides the least control of the information in the exhibition guides. For information delivered by an exhibition guide person, it does not support most of the features and the number of served people is limited. However it provides much more interaction with other people than any other exhibition guides. Furthermore, there is no reading requirement in this format. Exhibition audio guide and mobile guide both provide information repeatable feature, multiple language presentation and allow visitors to decide their visiting route. The reason why a mobile exhibition guide is better than an exhibition audio guide is that a mobile exhibition guide allows visitors to access their interested information more easily. Moreover, the mobile exhibition guide delivers information in multimedia format so it integrates almost all advantages

of the other exhibition guides.

As shown in Table 2.2, we compare the mobile exhibition guides and general mobile guides in terms of the following aspects: system architecture, location-awareness technology and application services. For system architecture, we look at two criteria, which are multi-modular and information storage. For location-awareness technology, the positioning technology and using environment are considered. Lastly, in application services aspect, personalization, recommendations, audio service and map service are the criteria to be compared between mobile exhibition guides and general mobile guides.

	Mobile Exhibition Guides			General Mobile Guides		
	Hippie	PEACH	Sotto Voce	TIP	GUIDE	Car Navigation
Multi-modular	++	+	-	++	-	-
Information Storage	Server Side	Server Side	Local Device	Server Side	Server Side, Local Device	Local Device
Positioning Technology	IrDA	IrDA	?	GPS	GPS	GPS
Using Environment	Indoor	Indoor	Indoor	Outdoor	Outdoor	Outdoor
Personalization	++	?	-	++	+	-
Recommendations	+	?	-	++	++	-
Audio Service	+	+	++	+(developing)	-	++
Map Service	-	-	+	+(developing)	-	++

Table 2.2: Comparison of Mobile Exhibition Guides and Other Mobile Guides (Symbols: ++ supported, + partly supported, - not supported, ? no information)

General speaking, mobile exhibition guides and general mobile guides have similarities in system architecture and application services. The main differences between these two groups are positioning technology and using environment. The mobile exhibition guides mentioned in Section 2.2 are employed in indoor exhibitions, and they almost use IrDA to identify visitors' current positions. On the other hand, the mobile guides introduced in Section 2.3 are

applied in outdoor environment with GPS technology to locate users' current position. We can also see from Table 2.2 that only Hippie and TIP build on multi-modular framework and provide personalize service. Moreover, TIP provides more comprehensive services than the any other mobile guides.

To conclude, we discovered that mobile exhibition guides can provide more mobility and flexibility to visitors than the general exhibition guides. In addition, mobile exhibition guides and mobile guides have many common features. Moreover, the TIP system fulfils most of the features. Since the requested mobile exhibition guide is not for the actual exhibition, but adds additional feature for visitors to explore the real sight. Therefore, it is possible and applicable to re-use the framework of TIP to build the requested mobile exhibition guide.

Chapter 3

Challenges and Proposed Solution

As we analyzed in the previous chapter, the TIP system can be possibly re-used the infrastructure on this project. However, there are several aspects that we should pay attention to while we are developing the mobile exhibition guide. Therefore, this chapter looks at the challenges that arise in this project. According to that, we also define the detail focus of the project and give out the proposed solution in Section 3.2.

3.1 Challenges

We identify the following challenges:

- Ch1 To identify requirements that visitors and the exhibition organizers have. As we discussed in Chapter 2, the exhibition guides are used as interpretation tools for the exhibition, we should find out the visitors' requirements and also meet exhibition organizer's requirements.
- Ch2 To model the exhibition data into the TIP database. Since the data of the exhibition is still not concrete, it raises the biggest challenge on modeling the unknown data into the existing TIP data structure.
- Ch3 To present the information under this specific exhibition circumstance. Since we intent to apply the TIP system into exhibition area, the information presented to users should not only be about the tourism, but should be related to the exhibition to a certain extent.

- Ch4 To analyze what should be modified in the TIP system in order to tailor to the requirements of the mobile exhibition guide. In terms of system's infrastructure, the TIP system has fulfilled the basic infrastructure that the a mobile exhibition guide should have. Therefore, we should consider how to modify some of the services in TIP to tailor to the new system. As a result, we attempt to reduce the effort of developing the new system and increasing the re-usage of the TIP system.
- Ch5 To decide what kind of mobile device we are going to use. Since the mobile devices are rapidly developed, we should choose a mobile device that is the most suitable for the project. Different mobile devices have their pros and cons, we need to consider carefully on the actual situation of the exhibition.
- Ch6 To consider limitation of the mobile devices that would be used in the exhibition. How to present the information to the user. Small screen, lower resolution and small keypad are the limitations of mobile devices. With those limitations, we should think carefully in design stage how to present the information in a simple and clear way.
- Ch7 To consider visitors' behaviors. Wandering in the exhibition is the most significant behavior of visitors. As the fact that the visitor needs to interact with the mobile exhibition guide to retrieve the information about the exhibit. However, these interactions might affect the exhibition visiting of the user. Therefore, we should design the system to provide information for the visitors and reduce the affect as much as possible.
- Ch8 To consider the network connection. Wireless network might not be available in Hamilton. Therefore, we need to think about the possible alternative ways to build the mobile exhibition guide.

Considering to the challenges identified above, we define focus of the project in more detail and provide a proposed solution in the coming section.

3.2 Proposed Solution

As we mentioned earlier, the TIP (Tourist Information Provider) system has been developed as a multi-services mobile guide system. It delivers context information to users according to users' preferences and current locations. Currently, the services that are provided by the TIP system are recommendation

service, trust-based recommendation service, travel itineraries, community-base service and Greenstone digital library service. In addition, a map service is being developed. The infrastructure of TIP is the combination of an event notification system and a location awareness system [10]. In Chapter 2, we have pointed out the common grounds between the TIP system and the mobile exhibition guide: The TIP system is developed for tourism purposes and the focus of this mobile exhibition guide is the outdoors. Therefore, we propose to re-use the framework of TIP and develop additional services that satisfy both the Waikato Museum as information provider and the visitors. However, as stated in Section 3.1, there are several challenges existing in this approach. For this project, we will focus on the Challenges 1, 2, 3 and 4 (on information service) that we mentioned in Section 3.1. The reasons for why we choose those challenges as our main focus are explained as follows:

Firstly, we need to find out the requirements of the exhibition (Ch1) in order to design corresponding services for users. For re-using the framework of the TIP system into the mobile exhibition guide, we may have to adapt the database, the services and the interfaces so that the new system can be used in the exhibition context. To find out more about the visitors' requirements and the museum's requirements, we will cooperate with the museum staff. In addition, we will analyze some scenarios to find out how the mobile guide could be applied to the outdoor exhibition context. The results are reported in Chapter 4.

Secondly, we need to extract the possible data structure from the requirements. Modeling the un-concrete data into the TIP database (Ch2) is the crucial step. This is because it is difficult to identify the pattern from unknown data. Moreover, the information storage in and retrieval from the TIP database are depended on the pattern. If the TIP database can be re-used, then it would reduce the effort of developing the whole system.

Lastly, for the exhibition purpose, presenting the information related to the exhibition (Ch3) is indispensable. Since visitors are walking on the street while they explore the buildings or statues, we need to reduce users' effort of accessing the information. We should present the exhibition related information to users and simplify the interaction between the system and the users. While we overcome Ch3 and Ch4, the rest of the challenges are also attempted to consider and solve, especially, CH6, and CH7. At the same time, another project about providing audio service [8] in the TIP system is being carried out by one of our ISDB group members. That project will be integrated into this mobile exhibition guide in near future.

3.3 Summary

We have clarified the challenges that we are facing and the proposed solution for the mobile exhibition guide in this chapter. The remainder of this thesis reports the development processes of the project, which includes finding out requirements, re-using the database, implementing the system and evaluating the system.

Chapter 4

Scenario Analysis

In this chapter, we first describe several scenarios that the mobile exhibition guide system could be used by visitors while they are visiting the exhibition on Victoria Street. After that, we model the mock up data from scenario 1 to 4, which could be used as one of the data patterns when we model the exhibition data. This is followed by the requirements of different priorities, which are extracted from the scenarios. By taking these steps, Ch1 identified in Section 3.1 can be overcome.

4.1 Scenarios

As discussing the requirements with the exhibition organizer and observing the visitors' habits, we identify seven possible using scenarios of the mobile exhibition guide. Each scenario is characterized by a particular usage situation.

Scenario 1: Time-line for a place

A group of students from Hamilton Boys' High School has an activity class to explore the changes on Victoria Street in Hamilton. The teacher told them the task of this class is on the historical buildings on the street. Frank and Jimmy use the mobile exhibition guide system to explore the changes while they are walking on Victoria Street. They indicate that they are interested in historical buildings on their profiles. The information about a historical building will display on their screen when they are close to the building. In addition, there are links for accessing the building's history and pictures. They can look at some pictures of this building from 20 years ago, 50 years ago and over 100 years ago. Moreover, those history events happened in the building are displayed on the system. Since they set their preferences accordingly, the system also guides them to the other historical buildings on Victoria Street. Frank

and Jimmy easily finish the task by using the mobile exhibition guide.

Scenario 2: Time-line for a person

Judy is interested in the information about famous people . She specified famous person in her profile on the mobile exhibition guide system. Before she walks on the Victoria Street, the system shows all the names of those famous people who were living or visiting there. One of the famous people is Ms Wendy Brewer. She was a famous singer in 1990s. Wendy once visited in Hamilton and spent a half day on Victoria Street. Judy is curious about where Wendy went to on that day, so she follows the mobile exhibition guide to explore the places where Wendy had been to. Firstly, Judy stops on a shop in which was the cafe that Wendy had been to. The system displays the information about Wendy visiting this place. After that, the system informs Judy that Wendy also went to a gallery on Victoria Street. Then Judy follows the guidance to visit the gallery. By comparing the gallery with those old photos shown on the screen, Judy finds out that the gallery is almost as same as the time when Wendy visited it. When Judy finishes Wendy's half day trip on Victoria Street, she also follows the mobile exhibition guide to visit other famous peoples' trip on Victoria Street.

Scenario 3: Time-line for a concept

Two Indian friends come to visit John. He wants to show them around the Hamilton city, especially the busiest street Victoria Street. He decided to bring his two friends to the street and show them the interested parts of the street. Instead of walking around on the street shop by shop, he would like to follow some kinds of interesting route. He uses the mobile exhibition guide and set the preference to special route about concepts. With this setting, those special routes display on the system (e.g. theater route etc.) John and his friends follow the movement route of Victoria Cinema to explore the street. Firstly, they visit the oldest address of the cinema, which is a bookshop today. They looked at the old photos of the cinema on the system. After that, the system guides them to the second place that is also related to the concept. Lastly, they come to the current modern cinema. Following the moving, they get to know more about the interesting changes on the street from past to present.

Scenario 4: Walking along the street

Tony is from China and it is the first time that he comes to Hamilton. He is excited to visit the busiest street in Hamilton city. He would like to know the general information about the building, the famous people and important events that relate to the Victoria Street so that he can get to know the local culture of Hamilton. He chooses the "general option" in his profile. In addition, he would like to hear the information in Chinese so he sets the language to Chinese. He walks along Victoria Street to visit the shops one by one. The general information about the building, famous people or important events starts playing to him in Chinese while he is close to the place. By using the mobile exhibition guide, Tony not only can explore the current Victoria Street, but also understands more information about the street in the past. This is because the information is delivered in Chinese.

Scenario 5: Track and Travel (Kiosk)

Jack and his friends just arrived at the transport center in Hamilton. They knew that there is an exhibition on Victoria Street. In the transport center, there are some Kiosks, which are computerized self-service information stations. They use the Kiosk to find out where Victoria Street is and what the exhibition is about. On the Kiosk screen, it also shows the other Kiosks' location on Victoria Street (e.g. at the Track and Travel shop). The location of each Kiosk on the street is the must see place in the exhibition. After they found out the exhibition's information, they reach to Victoria Street and start exploring the must see places according to the guide displays on the Kiosk.

Scenario 6: Online virtual exhibition

Mike just visited the exhibition held on Victoria Street. He really enjoyed using the mobile exhibition guide system to explore the exhibition. He also wants to show his friends how the exhibition was; even though his friends cannot come to the exhibition. So he invites his friends to access the virtual exhibition website. Shelly is a friend of Mike, she accesses the virtual exhibition website, and explores the exhibition by setting her interests in her profile. Most of the facilities on the mobile exhibition guide are available on the virtual exhibition, except for the location-awareness facility. Shelly needs to click the links to access the information and audio service. In this way, she almost has the experience as same as Mike had.

Scenario 7: Online viewing other people's exhibition route

Anita has heard her friends that the exhibition hold on the Victoria Street is so great. She also wants to visit it. Before she goes there, she accesses the online exhibition routes planer to plan her preferred route. She firstly reads other visitors' reviews of each popular route, and she collects the most interesting routes in her profile. In addition, she adds her personal interests in her profile. When she is in the exhibition, her preferred route is shown on the system and guides her to each place on the street. After the exhibition, she writes down her experience about the visit route on the online exhibition review page so that she can share her experience to other visitors.

The exhibition organizer gave us the following feedback on those scenarios. General speaking, Scenario 1 and 4 are the most suitable usages for this particular exhibition. In Scenario 1, the idea of having information about the building at different time periods is an important element for the exhibition. The general option describes in Scenario 4 also cater the purpose of most visitors. For Scenario 2 and 3, the exhibition organizer pointed out that they are interesting but they might cater the need of those wider tourists. For Scenario 5, 6 and 7, they could be useful in the future but not for this particular exhibition.

According to the feedback from the exhibition organizer, we made some assumptions. First of all, we will pay more attention on the usages of Scenario 1 and 4. This is because they cater the need of the exhibition and general visitors. Furthermore, we will also pay attention to the usages of Scenario 2 and 3. Since they could be the new aspects of the information service for the TIP system. Although their purposes are more on tourist, it is worthwhile for our research purpose. Lastly, we might consider the usages of Scenario 5, 6 and 7 in the further research.

4.2 Data Model from Scenarios

According to the scenarios mentioned in previous section and the assumptions we made, different kinds of data that related to the location and the time are identified in this section. Figure 4.1 illustrates the mock-up data from Scenario 1 to 4 and the possible types of data are list below.

1. Location (address, GPS data). Address is needed for identifying the location from human perspective. GPS data is used to identify the location from technical perspective.

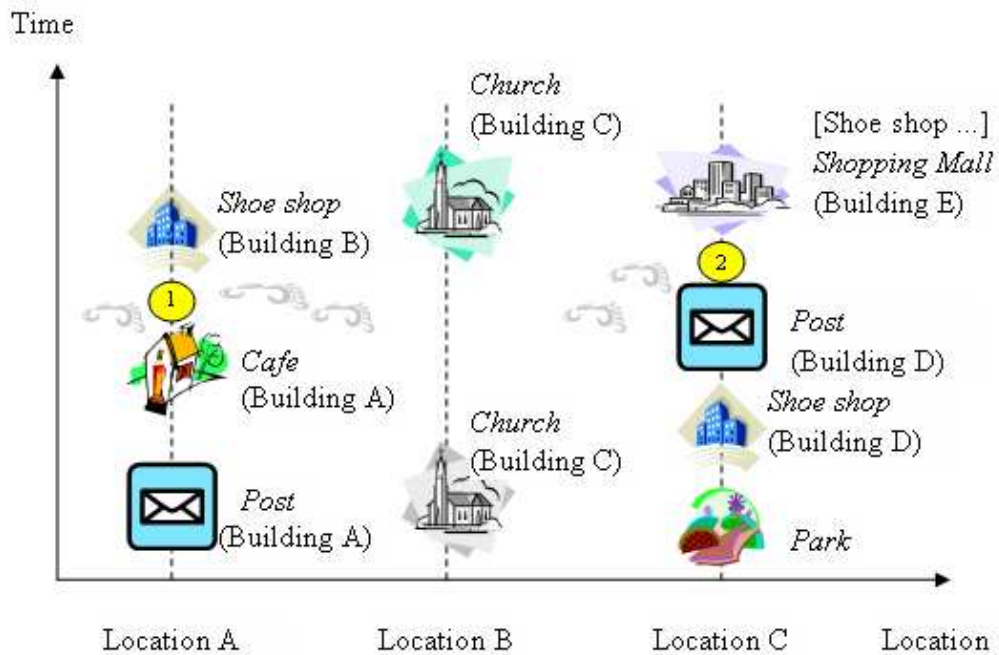


Figure 4.1: Mock-up Data

2. Building (a building description, at time frame, pictures, related concepts). Those are the information elements that a building may have to present to the user on the mobile exhibition guide.
3. Concept (a concept description, at location, at time frame, related concepts). This is a new information aspect that a sight may have.
4. A person's day trip (the person's information, stop at location, at time). It would be the additional information that links to those particular sights.
5. Audio files, sound tracks. Those kinds of data are needed for audio service.
6. Map data. It is needed for the map service.

We identified four basic visiting routes from Scenario 1 to 4. Location and time are the main context that we consider. Hereafter we describe the routes shown in Figure 4.1:

1. **Follow the time line of a place.**

Visitors can see the changes of places through the time line. For example,

the visitor can see the changes of location A from building B to building A from present to past along the time line, when the visitor stands around location A. In this case, the visitor will receive the current sight information about location A, which is a shoe shop in Building B. Along with the time line going backward, in the same location, Building A located at Location A. The information about the building will present as text description and pictures. In addition, the visitor can switch to other modes to explore more information about the building such as the mode shows the related concept (e.g. fashion style, shopping) and the mode shows a related person's information).

2. Follow the time line of a person.

Visitors can follow a person's trip to explore the information. For example: the visitor stands at Location A, and from the historical sight mode of the Location A, the visitor found out that there is a famous person related to this historical sight at Location A. The foot prints shown in Figure 4.1 illustrates the visiting route of that famous person, who visited the cafe in Building A, and then this person visited location C where was a post office at the time. In addition, visitors can compare the differences from past to present from these two locations by exploring the historical sight mode of these two locations.

3. Follow the time line of a concept.

Visitors can follow a certain concept to explore the information. For example, the visitor can follow concept "shopping" to visit. The route relates to location A (Shoe shop) and location C (Shoe shop within a shopping Mall in Building E). At location A, the visitor can read the information about the current shoe shop information. At location C, the visitor not only can receive the information about the current shoe shop in Building E, but also can retrieve the shoe shop information from years ago in Building D. In addition, there is another related concept (post) that were related sights in these two locations in the past. Therefore, visitors can also explore the information about the related sights of "post" concept.

4. Walking along the street.

Visitors can explore the historical sights of each location. For example, there is a shoe shop in building B at location A. However, Building A was at Location A. The original usage of Building A was a post office, but years later the usage of Building A changed to be a cafe. That information about Building A will treat it as the history information of Building A. As the visitor moves along to Location B, Building C has

been used as a Church from past to present. At location C, currently, the new building E is at location C, which is a shopping mall. There are a lot of shops in this building and a shoe shop is one of them. However, back to long long time ago, it was a park, and then there was Building D in which it was used as a shoe shop. After that, a post office replaced it.

4.3 Requirements Analysis

As the scenarios and the mock-up data described above, a list of requirements are extracted from the scenarios. In this section, we outline the requirements in three priority lists as follows:

High-priority requirements:

The requirements of this group are about capturing context information and presenting different kinds of data in text formation to visitors. When the system meets these requirements, the mobile exhibition guide system can provide the basic context-aware facility to visitors.

1. *To identify the location.*

The system needs to identify the different buildings' locations and visitors' current locations in order to display corresponding exhibition data.

2. *To present the information with time context.*

According to Scenario 1, 2 and 3, time is an indispensable context element in context-aware system. Presenting the information with time context allows users obtain information from time axis. However, the mobile systems mentioned in Chapter 2 only focus on location context and do not take the time context into account. In this project, we place this requirement as one of the high-priority requirements.

3. *To provide cross-links between different aspects.*

According to Scenario 1, 2 and 3, different types of exhibition data are needed to attract visitors' interests. For example: history about a building, pictures in different years and a famous person's daily route in the street. As a result, cross-link references between information can be generated, which will facilitate visitors to access the information from different aspects.

4. *To present information in different modes.*

The exhibition data can be presented in different modes and it is required to be able to access the exhibition data among various modes. Visitors can select their preferred information aspect (e.g. building history) to

explore the changes of the building along Victoria Street. In addition, they can also switch to other modes when other aspects information is available.

Medium-priority requirements:

To fulfil the requirements in this group, the mobile exhibition guide will provide additional functions (e.g. electronic map, audio guide) to visitors.

1. It can be identified from Scenario 1 to 5 that an electronic map is needed to show all the exhibition spots and a visitor's preferred route on the screen. With this facility, visitors can visually identify where they are and where they can go to.
2. According to Scenario 4, the exhibition data also would be delivered in audio so the description clips or related sound tracks are needed. In addition, for internationalization purpose, audio clips in multiple languages are beneficial to visitors who come from all over the world.
3. Although, the audio clip will automatically play when visitors close to the place, visitors still need to have some flexible controls on the currently playing audio clip. This might be the case: two places are very close to each other, the visitor is moving forward from the first place to the second place, but the audio clip of the first place has not finished playing and the audio clip of the second place is about to play. Therefore, visitors need to control on whether continually playing the first clip or starting the other clip.

Low-priority requirement:

The requirement in this group is about the extra services of the system. The system should allow visitors to login to their account and write their visited route and share with other visitors. Therefore, visitors can follow someone's route to visit the exhibition. In addition, visitors would be able to give feedback on the route that they followed.

4.4 Summary

Through analyzing the scenarios and mock-up data, we identified the requirements of the mobile exhibition guide. As a result, Challenge 1 stated in Section 3.1 has been addressed. In order to develop the mobile exhibition guide by re-using the TIP infrastructure, we need to bear the requirements in mind and fulfil the high-priority requirements, which is one of the important tasks.

In order to map the exhibition data into the existing TIP data model, the comprehensive design process is given out in the next chapter.

Chapter 5

Design

This chapter focuses on how to carry out the design process of the proposed mobile exhibition guide. Firstly, by taking a close look at the example data of the exhibition, we find out the characteristics of the exhibition data. Following that, in Section 5.2, the exhibition data framework is defined, which combines the characteristics of the example data and the mock-up data of the scenarios mentioned in Section 4.2. Since re-using the TIP database structure is one of the main challenges in this project, the approach of mapping the exhibition data structure into the existing TIP database structure is comprehensively discussed in Section 5.3. In addition, the new relational schemas and the modified relational schemas in the TIP database are summarized in Section 5.4. Finally, the detail of the design of the proposed system is described in Section 5.5, we analyze the use cases, generate the information interaction model of the system and illustrate the user interface design in paper-based prototypes.

5.1 Example Data Analysis

Since the development process of the exhibition and the mobile exhibition guide are carrying out parallel, the actual exhibition data was still not concreted when we were in design phase. Under this circumstance, we attempt to capture the exhibition data structure by taking the following steps. Firstly, we analyze the scenarios described in Chapter 4 to identify the possible mock-up data, which is discussed in Section 4.2. Secondly, in this section, we analyze the example data of the exhibition to extract the underlying data structure. Finally, we will combine the results from these two steps to define an appropriate and comprehensive data structure so that it can satisfy the exhibition data pattern and map to the existing TIP data structure.

5.1.1 Example Data

The following example information pattern is given by the exhibition organizer (Crystal Arden from the Waikato Museum). Example of the Embassy Theater (a historical sight). The example data information about the other sight is given out in Appendix C.

1. History (brief history of building, then with other options to click into):
 - Architecture style and info
 - Architect info (plus photo)
 - 1920/30s Heyday of the building
 - 1950s changing of name and facade (photo)
 - Demolition (photo)
 - Short brief on other theaters that were in Hamilton
 - Short brief on NZ theater going habits during the 1920s-1990s (with graph)
 - Riff Raff (photo) (it is the current sight)
 - Info on building of the statue and the event that took place
 - Info on Hamilton winning a creative art award for the statue
 - Info on Richard O'Brien (photo)
 - Info on Rocky Horror Picture Show

2. Exhibition Link Info (e.g. women's experience of the theater in the 50s)

Personal short story/quote of going to the theater In the 1950s

 - Popular shows/movies of the 1950s
 - What you would wear in the 1950s to the theater (with photo)
 - Where did you buy the fashions? (link to other screen on another building, which would have sold clothes)

3. Famous Connections
 - Richard O'Brien
 - Info on Rocky Horror
 - List of famous people that once played at the Theater

5.1.2 Analysis

In this subsection, the characteristics of the example data are addressed. We discovered that a sight may have information from three main aspects, which are history, related exhibition information and related famous people. The explanations of these aspects list as follows:

1. History aspect:

Actually, the sight "Riff Raff" is at the current location so this example sight "The Embassy Theater" is the historical sight of the current location. Therefore, we can define that a location can have a current sight and a list of historical sights at different time periods. In addition, a sight no matter exists at current time or at history time periods is associated with information in different topics (e.g. history, architecture, etc.). Furthermore, pictures of the sights at different time periods are needed.

2. Related exhibition aspect (Concept aspect):

We can know from the example that a sight may relate to some exhibition information or some abstract concepts such as "NZ theater going habits", "women's experience of the theater in the 50s" and "fashion". From now on, we refer that information to concept information. A concept should have a piece of descriptive information. It might also have a number of associated concepts. For example, "theater" is a concept, and "women's experience of the theater in the 50s" is one of the associated concepts of "theater".

3. Famous person aspect:

The information of the famous person aspect is also important to a sight. The person's information and the events of this person that related to the sight are required. For example, Richard O'Brien is the writer of "The Rocky Horror Show", and who is one of the performers of "The Rocky Horror Picture Show". In addition, he contributes to the statue of "Riff Raff". "Riff Raff" is a sight, and Richard O'Brien is one of the famous persons related to this sight. Furthermore, he is also related to the historical sight "The Embassy Theater" because "The Rocky Horror Picture Show" was played there.

Beyond those three aspects, we realized that each aspect can possibly have its corresponding information in those three aspects. For example, a concept can have its history information, its related concepts' information and its related famous persons' information. Therefore, we can summarize that a

concept and a famous people have similarities in terms of the information from those three aspects.

5.2 Exhibition Data Framework

In this section, we describe the process of generating the exhibition data framework in detail. Firstly, by comparing the data models extracted from the scenarios and the example exhibition data, we identify the common characteristics between those two data models. Those common characteristics are the essential elements of the definition of the exhibition data framework, which have to be modeled in the exhibition data framework. Secondly, we analyze the unique features of each data model. In order to model the exhibition data framework more flexible and more comprehensive, those unique features should also be considered. Throughout those two steps, the exhibition data framework is generated and presented at the end of this section.

Refer back to Section 4.2, the mock up data consists of the information about location, building, concept, a person's day trip, audio files and map data. Since the audio files and map data relate to the other services, we do not take them into comparison here. On the other hand, as the analysis in Section 5.1.2, we extracted from the example exhibition data that a sight probably contains the information from history aspect, related exhibition concept aspect and famous person aspect. According to the composition of the information from those two data models, we discovered the following common characteristics:

1. A sight that referred in the example exhibition data is a building in the mock up data from the scenarios. Therefore, they share the commonalities of each other, which are the information of the sight, the historical sights in the current location, and pictures at different time periods.
2. A related exhibition concept that identified in Section 5.1.2 is a subset of Concept pointed out in Section 4.2. As a result, concept should be another element in the exhibition data framework.
3. Famous person's information is also the common feature of both data models. Therefore, it should be modeled in the exhibition data framework.
4. The correlations between a sight and a concept exist in those two data model. From the analysis of those two sections, we can find out that a sight may relate to certain concepts. On the other hand, a concept may relate to certain sights as well. Therefore, the relationship between sight and concept should be model.

For flexibility and comprehensiveness of the exhibition data framework, we should take the unique features of each model into account. Those unique features are list as follows:

1. Location information is an important element in the mock up data of the scenarios. However, it is not explicitly stated in the example exhibition data. Since the proposed mobile exhibition guide is a location-aware system, the location information plays an essential role in the system. It has to be contained in a sight.
2. A person's day trip information is also a unique feature of the scenario mock up data model. Although it does not include in the example exhibition data, it would be an additional feature of the exhibition data model. Person's day trip information can be contained in the famous person aspect.
3. The correlation between a sight and a famous person or between a concept and a famous person imply in the example exhibition data. In order to generate a comprehensive exhibition data framework, we decided to include the correlations to the framework.

The following descriptions of the exhibition data framework summarize the findings from the discussions above. The ER diagram of the exhibition data framework is shown in Figure 5.1.

Exhibition Data Framework:

Sight

- Location information
- Brief information and photo about the building
- Architecture information and photo about the building
- History about the sight (information and photos at different time period)
- Historical sights in the same location
- Related concepts that the sight has
- Related people
- Related sights

Concept

- Information about the concepts
- Related concepts of the specific concept
- Related sights
- Related people

People

- Information of a famous person (name, career, trivia, or external link from the Internet)
- Visiting rout of this famous person (if the data is available)
- Related sight
- Related concept
- Related people

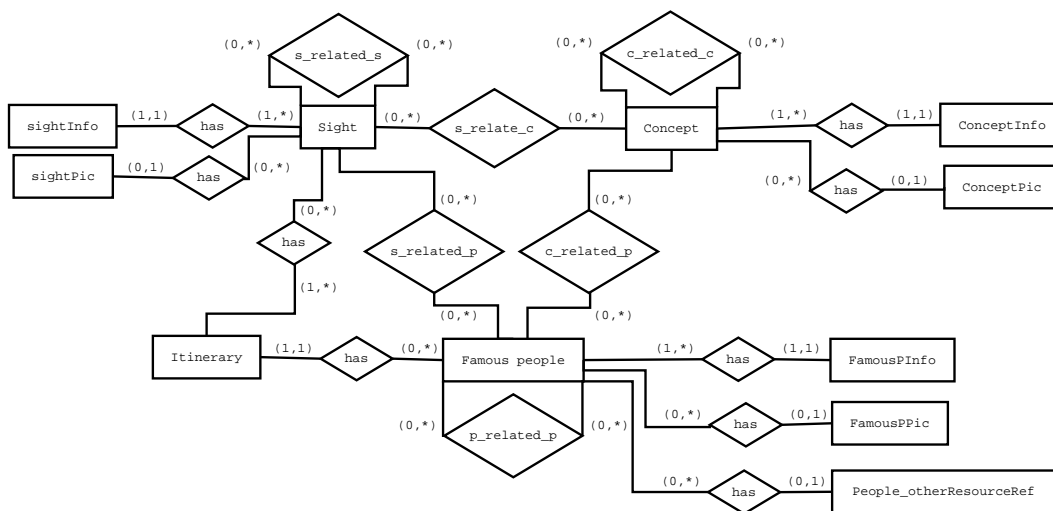


Figure 5.1: Exhibition ER Diagram

The subsequent section describes how the exhibition data framework maps into the existing TIP database structure.

5.3 Exhibition Data Structure Mapping to the TIP Data Structure

Instead of creating the new database structure as Figure 5.1 shown for the mobile exhibition guide, we decided to model the exhibition data framework into the TIP database structure as much as possible. This is because re-using the TIP database structure is one of our focuses and the main challenges of the project. This section presents our approach of mapping the exhibition data framework into the existing TIP database structure (for more detail about the TIP database can be found in [18, 3]). To minimize the modification on the TIP database structure is crucial, but necessary modifications should be made. In order to keep the balance between re-using and modifying the TIP database structure, we distinguish the commonalities between the exhibition data framework and the TIP database structure.

Mapping Common Entities and Relationships:

By comparing Figure 5.1 with Appendix A.1, we can identify the most significant common feature of the sight entity in the Exhibition data framework and the sight entity in the TIP database are almost same. Therefore, the sight entity can directly map to the TIP database. Furthermore, the `sight_has_sighInfo` and `sight_has_sightpic` relationships also exist in the TIP database, which are referred to `sight_has_information` and `sight_has_picture` respectively. In addition, the itinerary entity in the exhibition data framework is same as the itinerary entity in the TIP database. As a result, the relationship "sight_related_itinerary" and the entity itinerary can easily map to corresponding relationship and entity in the TIP database.

Apart from those commonalities, there are commonalities among the three entities in the exhibition data framework if we analyze the exhibition data framework more deeply. Firstly, the concept entity and the famous people entity have the similar structure as the sight entity. This is because they all have relationships with their information entity and their picture entity. As a result, it is possible to map concept and famous people entities into the sight entity in the TIP database. In addition, their relationships with their information entity and their picture entity can be mapped the relationships of `sight_has_information` and `sight_has_pictures` in the TIP database. In this approach, the concept entity and the famous people entity are treated as the sight entity in the TIP database.

By doing this, we now need to distinguish among this three entities in the sight entity of the TIP database structure. This can be solved by indicating these two entities to different sightgroups. Therefore, we can create two new

sightgroups, one is called "concept", and the other is called "people". After that a new concept (e.g. fashion) can be assigned a new relationship with sightgroup "concept" in `sight_belongTo_sightgroup`. This process is also employed to create a new famous person in "sight" entity. As a result, we can easily identify "sight", "concept" and "famous people" in "Sight" entity by looking at their corresponding "sightgroup" names.

Mapping Additional Entities and Relationships:

Next, we consider the relationships between sights, concepts and famous people. There are two approaches to solve the problems. The first approach is to map those relationships into the "sight_to_sub sight" relationship. The advantage is that the "sight_to_sub sight" relationship can be re-used. However, the significant drawback of this approach is that "sight_to_related sight" relationship conflict with the "sight_to_sub sight" relationship. "sight_to_related sight" is used to describe a sight related to other sight in terms of their conceptual similarity. On the other hand, "sight_to_sub sight" is used to represent the relationship between sights in terms of physical location. Therefore this proved that the "sight_to_sub sight" relationship can not be re-used in this situation.

The second approach is to create a new relationship "conceptual_relation" for storing the relationships between sights, concepts, and famous people. In this approach, we can store all the relationships without any confliction. This is because we can identify their relationship by retrieving the sightgroups they belong to. For example, if a relationship both elements belong to sightgroup "concepts", then this relationship represents "concept_to_related concept" relationship. Under this approach, it can also store the relationships between sight and concept, between sight and famous people, between concept and famous people. This is because if a relationship one element belongs to "concept" sightgroup, and the other one belongs to the other sightgroup except "concept" and "famous people" (e.g. building), then the relationship represents a "sight_to_related Concept" relationship. Although this approach does modify the TIP database structure, it is proved that is worthwhile to apply it.

The entity "other_resourceRef" entity and the relationship with entity "famous people" need to be stored in the TIP database as well. As we seen from A.1, there is no similar entity as "other_resourceRef" in the TIP database. Therefore, we need to extent the TIP ER diagram by creating a new entity "miscellaneous_source". The relationship between the elements in entity "sight" and the resource reference not only can be used to store the external source of a famous person by an URL reference, but also can be used to store the external source of a sight or a concept. This approach satisfies the purpose of flexibility and comprehensive.

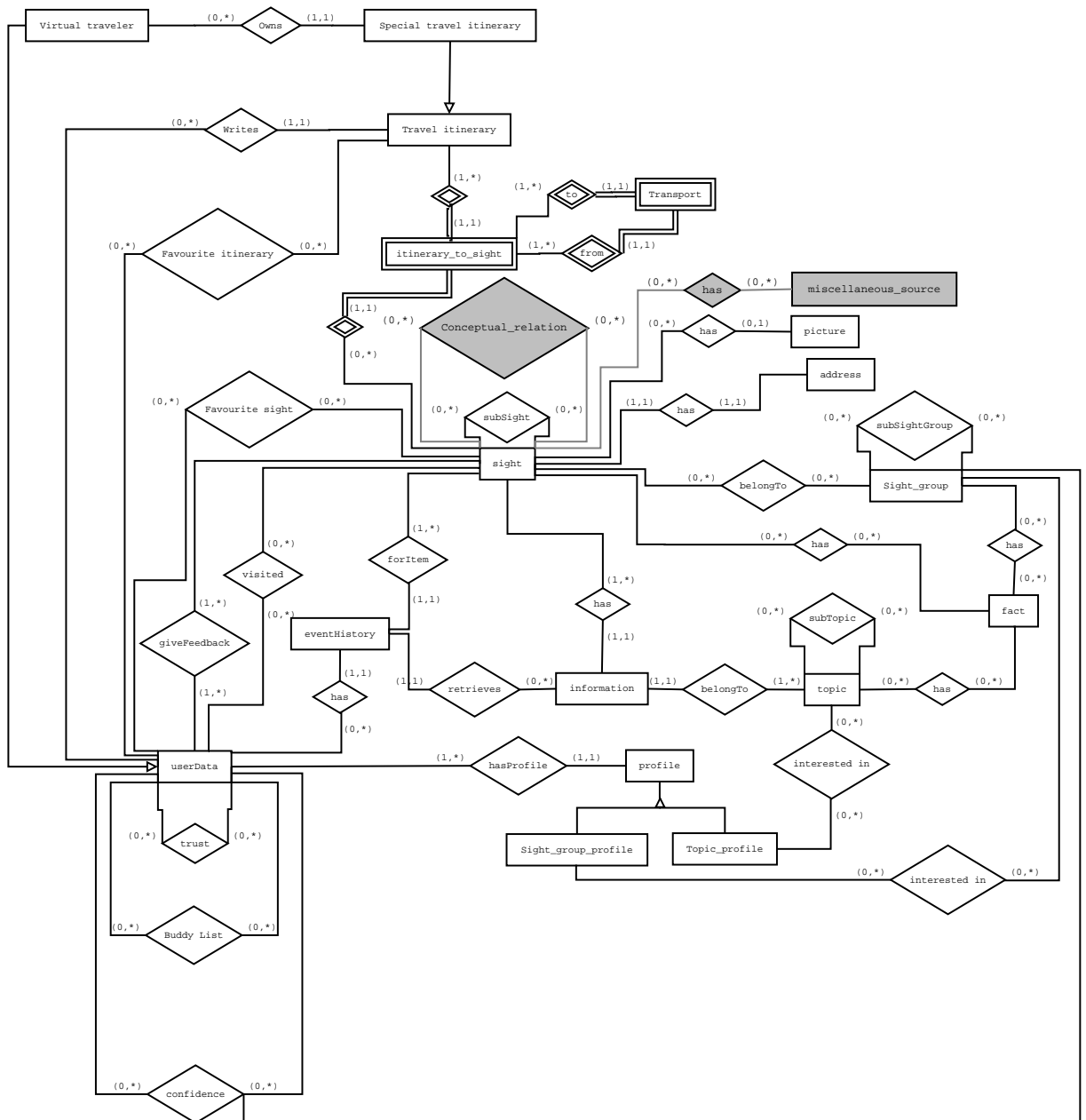


Figure 5.2: Entity Relationship Diagram of the Modified TIP Database

Lastly, for mapping the "famous people_has_itinerary" to the TIP database, we can embed the relationship on the entity "userdata". As "famous people" is treated as a sight, and a "famous people" and a "virtual traveler" is one to one relationship, we can add an additional attribute to specify their relationship. Therefore, the relationship "virtual traveler_owns_special travel itinerary" can be re-used for mapping the relation "famous people_has_itinerary" in the exhibition data framework.

Throughout the discussion of mapping the exhibition data framework into the TIP database structure, the modification on the ER diagram of the TIP

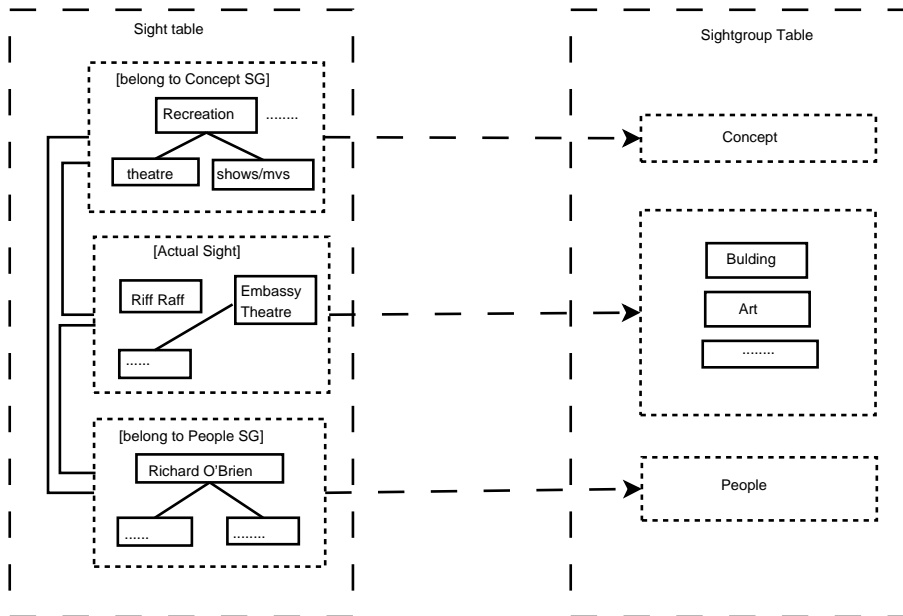


Figure 5.3: Abstract Layer in Sight Entity

database is shown in Figure 5.2 in gray. "conceptual_relation", "sight_has_miscellaneous_source" and "miscellaneous_source" are new relationships and a new entity respectively. More detail information about the modification on TIP database is given out in Section 5.4. By re-using the TIP database structure, there is an abstract layer in the entity "sight", which illustrates in Figure 5.3. As the figure shown, the sight entity in the TIP database not only contains actual sights, but also contains instances of sightgroup "concept" and instances of sightgroup "people". In addition, the links among items in the entity "Sight" represent their relationships, which describe in the relationship "conceptual_relation". There are six types of relationships in "conceptual_relation". Those are listed as follows:

- Concept_to_concept (e.g. theater is related to recreation)
- Sight_to_sight
- Sight_to_concept (e.g. Embassy Theater is related to concept 'theater')
- Sight_to_people (e.g. Riff Raff is related to people 'Richard O'Brien')
- People_to_people
- People_to_Concept (e.g. Richard O'Brien is related to concept 'shows/mvs')

5.4 Relational Schemas

According to the modifications discussed in previous section, the new relational schemas and the modifications on the existing relational schemas are described as follows:

Modified Relational Schemas

- Sight (s_id, name, location, address, *starttime*, *endtime*) : it is the relational of the entity "Sight". Starttime and endtime are the new attributes of this relational, which is used for tracking the sights at different time periods at the same location. In addition, if an instance of the sightgroup "concept" or "people" stores in this relational schema, the location attribute should be null.
- Information (iid, id, tid, lvl, information, *starttime*, *endtime*): it is the relational of the entity "Information". Starttime and endtime are the new attributes in this relational, which is used for tracking the information at different time periods.
- Userdata (ud_id, name, lastname, login, password, creation_date, level, reputation, email, description, virtual, authority, status, *famouspeopleid*): it is the relational of the entity "Userdata". Famouspeopleid is a new attribute in this relational, which is used for indicating the famous person in the entity "Sight" as a traveler in the entity "Userdata". As a result, this famous person's travel itinerary can be retrieved from the relationship "virtual_traveler_owns_special_travel_itinerary" or "userdata_writes_travel_itinerary".

New Relational Schemas

- *Conceptual_Relation* (sid, related_sid, *relation*): it is the relational of the relationship "conceptual_relation" shown in Figure 5.2, which is used for specifying the following relationships : sight_to_sight, concept_to_concept, people_to_people, sight_to_concept, sight_to_people, concept_to_people. The attribute "relation" is used to describe their relation in words (e.g. sight_to_people, sight= "Riff Raff" , related people = "Richard O'Brien" , relation = "Creator").
- *Miscellaneous_source* (srcid, *hyperlink*, *description*, *source*): it is the relational of the entity "miscellaneous_source" shown in Figure 5.2, which is used for storing the URL of the external source.

- *Sight_to_mis_src(sid, srcid)*: it is the relational of the relationship "sight_has_misellaneous_source" shown in Figure 5.2, which is used for specifying the relationship between a sight and a external source.

5.5 Design of the Software

As the discussion in previous sections, the exhibition data model is mapped to the existing TIP database structure. In this section, we describe the design of the software in three steps. The first step is to analyze use cases, which is used for capturing the functional requirements of the system. The second step is to generate the information interaction model, which is described in Subsection 5.5.2. The last step is to generate the paper-based prototype of the user interface. We illustrate the prototype in Subsection 5.5.3.

5.5.1 Use Cases Analysis

According to Scenario 1-4 described in Section 4, we summarize the following five types of use cases in the proposed system (see Figure 5.4).

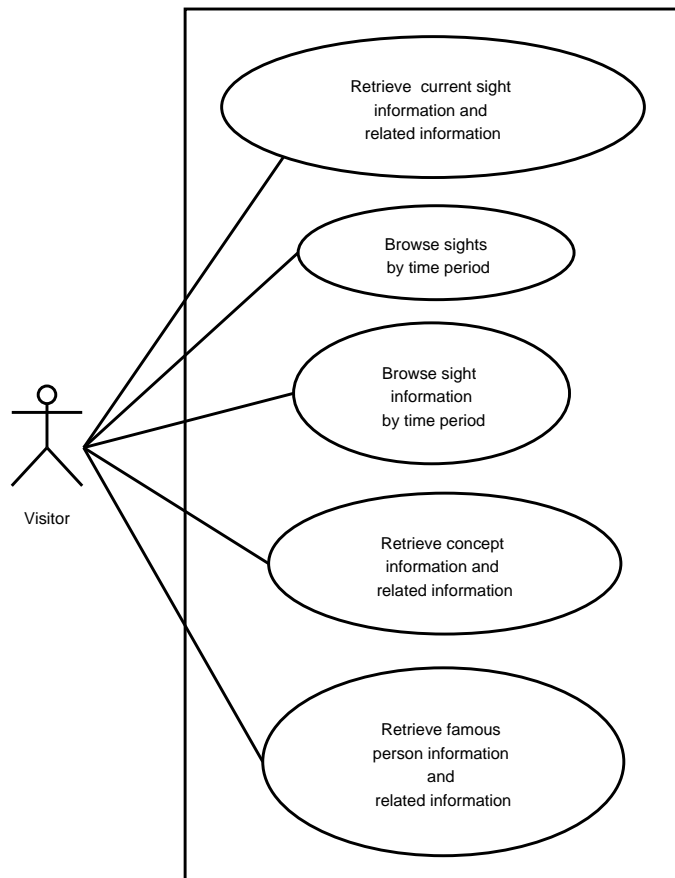


Figure 5.4: Use Cases of the Proposed Mobile Exhibition Guide

Use Case 1: Retrieve current sight information and related information

Actor: Visitor

Pre-condition: Visitor closes to a certain sight on Victoria Street.

Basic Course:

1. System automatically detects the visitor's current location.
2. System looks up whether there is a sight that is closed to the visitor and matched the visitor's profile in the database.
3. System retrieves the sight information and its related information (e.g. historical sights in the same location, related concepts, related sights and related famous people)

Alternative Course:

If after step 2, there is no match sight for the visitor, then there is no information to be shown on screen.

Use Case 2: Browse sights by time period

Actor: Visitor

Basic Course:

1. The visitor inputs a time period for searching the sights at that period.
2. According to the given time period, system looks up the match sighs from the database
3. System returns back a list of the sights at that period.
4. Visitor selects one of the sights from the returned list.
5. System retrieves back the information of the sight.

Alternative Course:

If after step 2, there is no match sight in the given time period, then system goes back to step 1.

Use Case 3: Browse sight information by time period

Actor: Visitor

Basic Course:

1. The visitor specifies a time period for searching the information of sights at that period.

2. According to the given time period, system looks up the match information of sights from the database
3. System returns back a list of the information of sights at that period.

Alternative Course:

If after step 2, there is no match information of sights in the given time period, then system goes back to step 1.

Use Case 4: Retrieve concept information and related information

Actor: Visitor

Basic Course:

1. The visitor specifies a concept name.
2. System retrieves back the information of the concept and its related information (e.g. related sights, related concepts, and related famous people)
3. System presents the information on the screen to the visitor.

Use Case 5: Retrieve famous person information and related information

Actor: Visitor

Basic Course:

1. The visitor specifies a famous person's name.
2. System retrieves back the information of the person and its related information (e.g. related sights, related concepts, related famous people, and)
3. System presents the information on the screen to the visitor.

5.5.2 Information Interaction Model

This section presents the information interaction model in the system. Figure 5.5 illustrates the information flow when the system retrieving the information from different modes. There are four different modes in the system, those of which are *Sight Mode*, *Concept Mode*, *Famous Person Mode*, and *Time Period Mode*. The first three modes are the main interaction modes of the system. Comparing with *Sight Mode*, specifying the time period for searching sights is the only additional part of *Time Period Mode*. Therefore, *Time Period Mode*

is just an other entry point of *Sight Mode*. The detail information displays in each mode are listed as follows:

Sight Mode according to the sight name, the system displays:

- The information about the sight in different topics
- Historical sights in the same location
- Related Concepts
- Related Sights
- Related people

Concept Mode according to the concept name, the system displays:

- Concept information
- Related concepts
- Related people
- related sights

People Mode according to the person's name, the system displays:

- Person information
- Related concepts
- Related sights
- Related people
- The itineraries owned by the person

Time Period Mode according to the time period, the system displays:

- the sights that existing at the time period

Figure 5.5 shows the information flows of three modes, which are Sight Mode, Concept Mode and People Mode respectively. Each mode are surrounded by a dash-dot frame. It can also be seen from Figure 5.5 that there are cross information interaction among different modes, which are illustrated by dotted arrow lines. In other words, the information flows are in multi-directions. For example, if the entry point is in "Sight", we can access to "Concept" and "Person" by the relationships "Sight_to_concpet" and "Sight_to_people" respectively, and vice versa. As a result, the visitor can access to a certain mode from the entry points of any other modes.

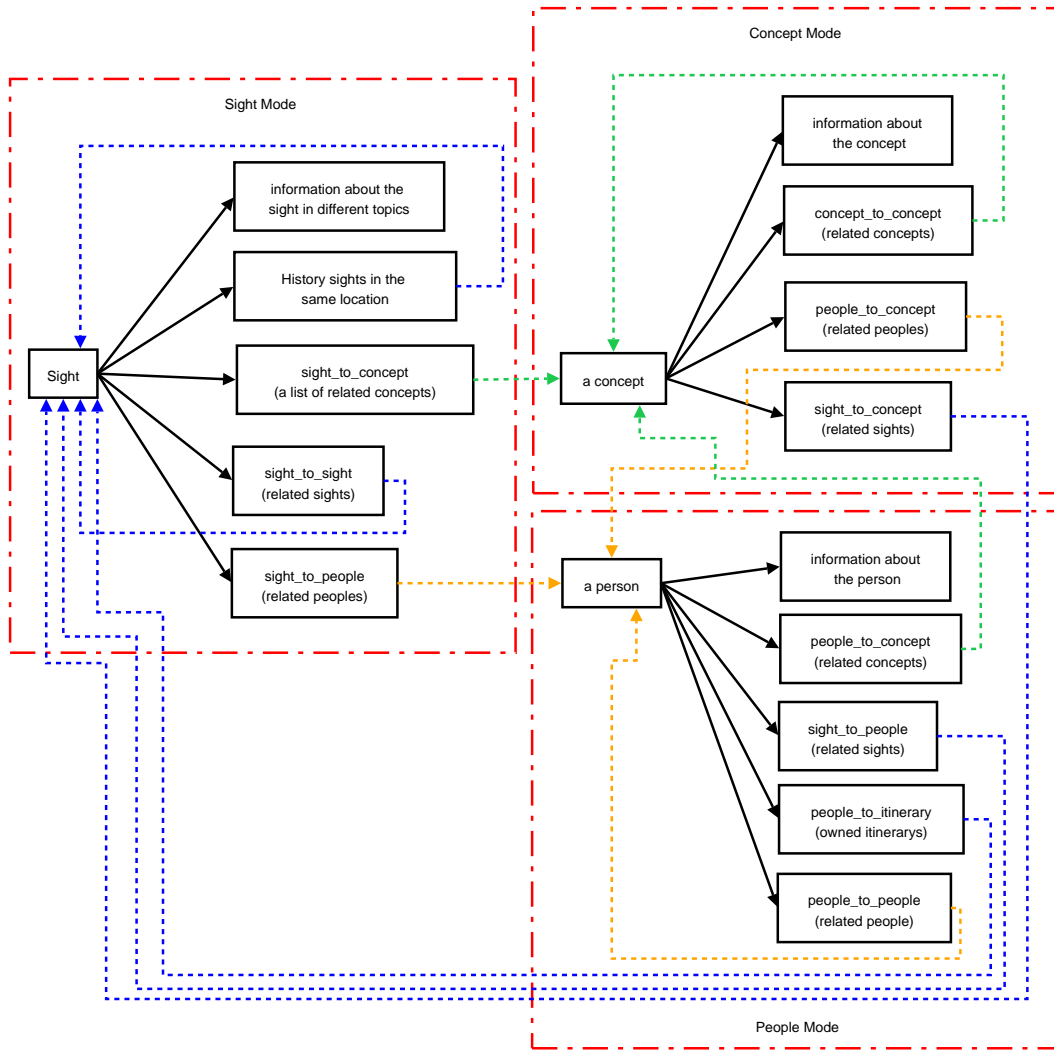


Figure 5.5: Retrieve Information from Different Modes

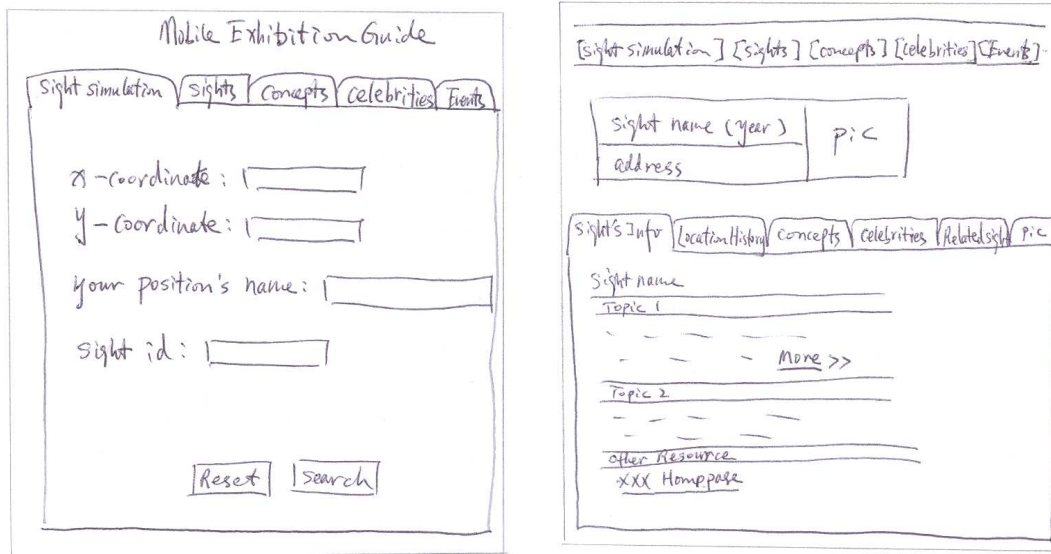
5.5.3 User Interface Design

In this section, we describe the paper-based prototypes of the mobile exhibition guide in detail. The prototypes are shown in Figure 5.6 to Figure 5.15. The main page of the mobile exhibition guide is shown in Figure 5.6. As we can see from the figure that the main page is divided into five parts, which are the "sight simulation" tab, the "sights" tab, the "concepts" tab, the "celebrities" tab and the "events" tab. According to these five parts, the explanations of each part's prototypes are given as follows:

Prototypes for Sight Simulation

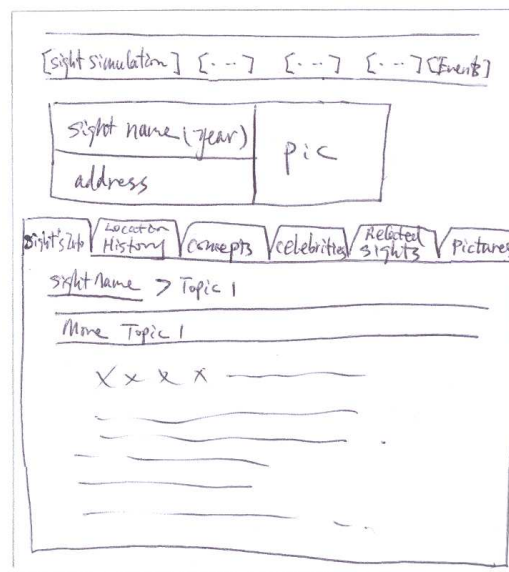
Figure 5.6 to Figure 5.11 show those prototypes for the sight simulation. In Figure 5.6(a), it shows the interface for simulating the entry of the current sight, the user can type in the current GPS coordinates, position name or the sight id. To clarify, this interface is only for test purpose. If the mobile device

has a GPS receiver then the system will enter to the current sight page as shown in Figure 5.6(b).



(a) Sight Simulation Mode Interface

(b) Sight Simulation Interface



(c) More Sight Information Interface

Figure 5.6: Prototype for Current Sight Mode Interfaces

The interface shown in Figure 5.6(b) represents the layout pattern for a sight, which means this layout is not only applied to a current sight, but also applied to a historical sight, a related sight and the sight in browse view. We can see from Figure 5.6(b) that the layout of the page is divided into three parts. The first part is the system menu that allows the user to switch to other parts of

the system. The second part is an brief view of the current sight, in which shows the current sight name with time, address and a picture of the current sight. The third part shows the main content of the current sight, in which the content presents in six tabs. Those are "Sight's Info" tab, "Location History" tab, "Concepts" tab, "Celebrities" tab, "Related Sight" tab and "Pictures" tab, respectively. The sight information is shown in "Sight's Info" tab, in which the information is shown as a brief view for each topic. For more information about a certain topic, the user can click on the "More" link. Then the system shows more detail information about that topic (see Figure 5.6(c)). If the user wants to get back to the interface shown in Figure 5.6(b), then he/she can click the sight name on the navigation bar with in the "Sight's Info" tab.

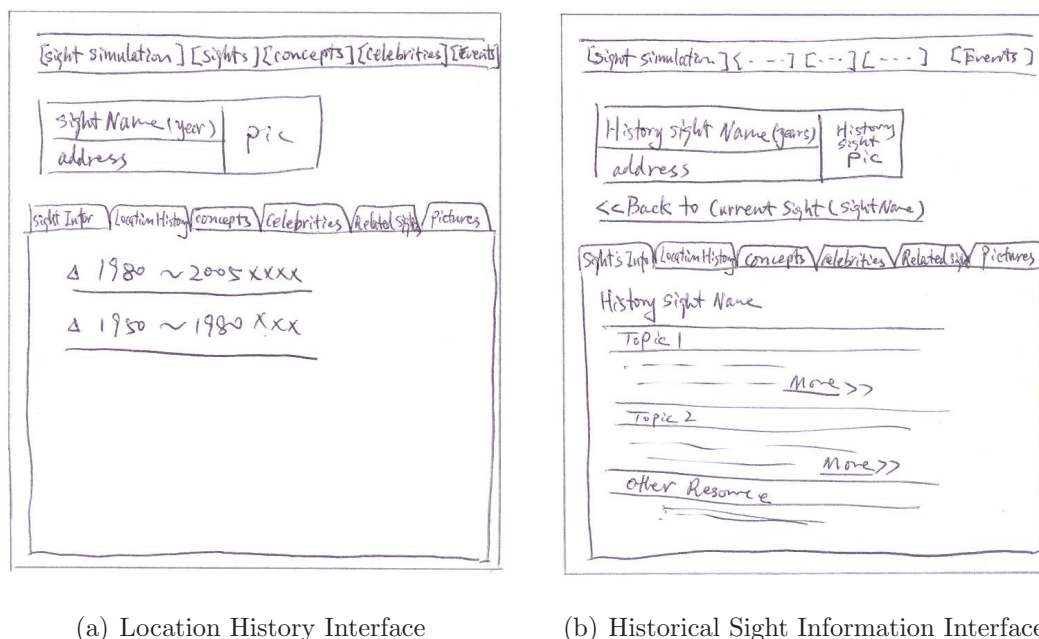
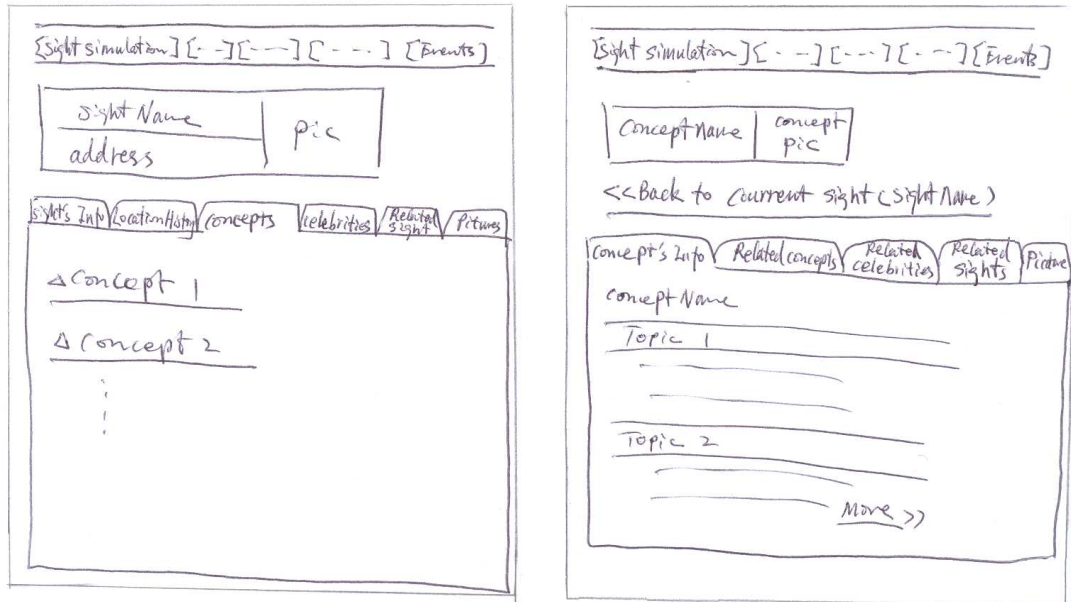


Figure 5.7: Prototype for Historical Sight Interfaces

Figure 5.7 shows the layout for historical sights in the current location. If there is a sight that located at the same place as the current sight, then the sight is called a historical sight of the current sight. When the user clicks the "Location History" tab from the interface shown in Figure 5.6(b), the historical sight with its time period will be displayed in the "Location History" tab as shown in Figure 5.7(a). When the user clicks the historical sight, the detail information about the historical sight is presented in the interface as Figure 5.7(b) shows. As mentioned before, the layout of the historical sight is same as its current sight's layout. There are related information to the historical sight, those content are spread into the "Location History" tab, the "Concepts" tab, the "Celebrities" tab, the "Related sight" tab and the "Pictures". However, for differentiation purpose, we add the link "Back to

Current sight” underneath the brief view of the historical sight. As a result, the user can get back to the current sight’s page by clicking the link and the user is also able to realize that the current page is about the historical sight.



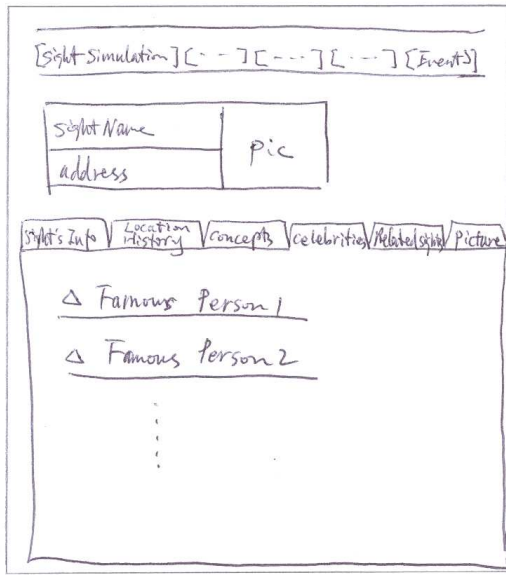
(a) Sight concept Interface

(b) Concept Information Interface

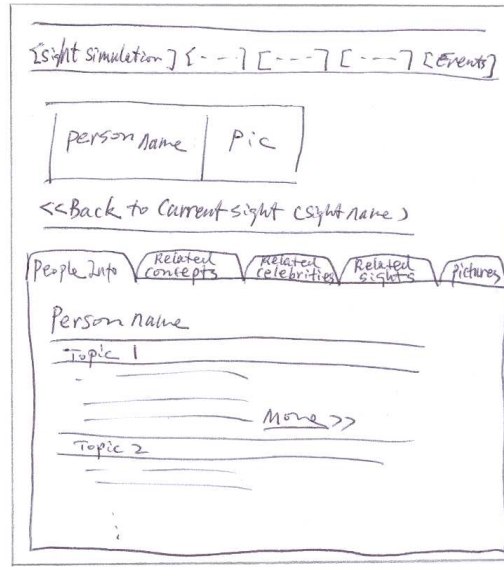
Figure 5.8: Prototype for Sight Related Concept Interfaces

When the user clicks the "Concepts" tab in the interface shown in Figure 5.6(b), the concepts that are related to the current sight are displayed within the "Concepts" tab (see Figure 5.8(a)). When the user clicks one of the concept names, the detail information about the concept is shown in the interface as Figure 5.8(b). As we can see from the figure that the brief view of the concept is shown underneath the system menu. Following that, there is a link "Back to Current Sight", which allows the user get back to the current sight’s interface shown in Figure 5.6(b). It can also be seen from Figure 5.8(b) that the content of the concept is spread into five tabs, which are the "Concept’s info" tab, the "Related concepts" tab, the "Related celebrities" tab, the "related sights" tab and the "Pictures" tab. This is the layout pattern of the concept page.

When the user clicks the "Celebrities" tab in the interface shown in Figure 5.6(b), the famous people that are related to the current sight are displayed within the "Celebrities" tab as shown in Figure 5.9(a). When the user clicks one of the famous people, then the system shows the detail information about the famous person (see Figure 5.9(b)). This is the layout pattern of the famous person page. The content of the famous person is spread into five tabs, which are the "People Info" tab, the "Related Concepts" tab, the "Related



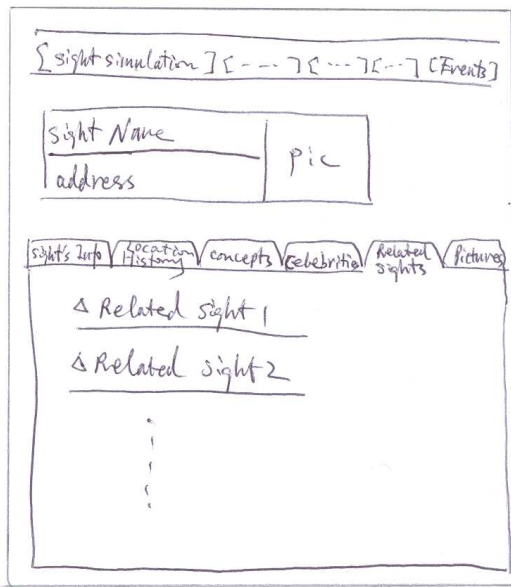
(a) Celebrities Interface



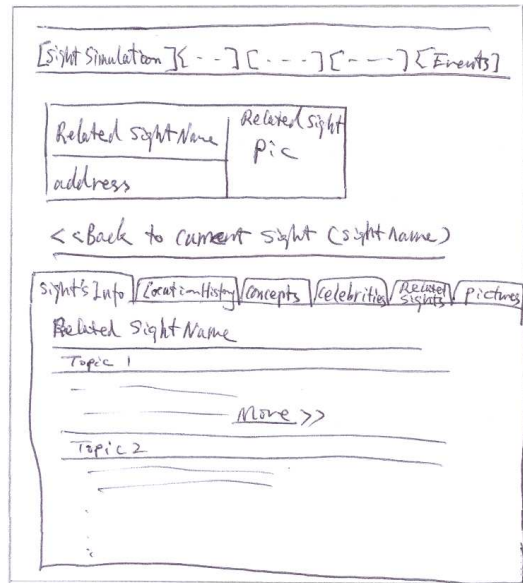
(b) Person Information Interface

Figure 5.9: Prototype for Sight Related People Interfaces

Celebrities” tab, the ”Related Sights” tab and the ”Pictures” tab. When the user accesses from the current sight page, the ”Back to Current Sight” link will be displayed. As a result, the user can get back to the current sight page.



(a) Related Sight Interface



(b) Related Sight Information Interface

Figure 5.10: Prototype for Sight Related Sight Interfaces

when the user clicks the ”Related Sights” tab in the interface shown in

Figure 5.10(a), the related sights that belong to the current sight are list within the "Related sights" tab as shown in Figure 5.10(a). When the user clicks one of the related sights, then the detail information about the related sight is shown in the interface (see Figure 5.10(b)). We can see from the figure that the content of the related sight is also spread into five tabs as same as the current sight page. In addition, the link "Back to Current Sight" allows the user get back to the current sight page.

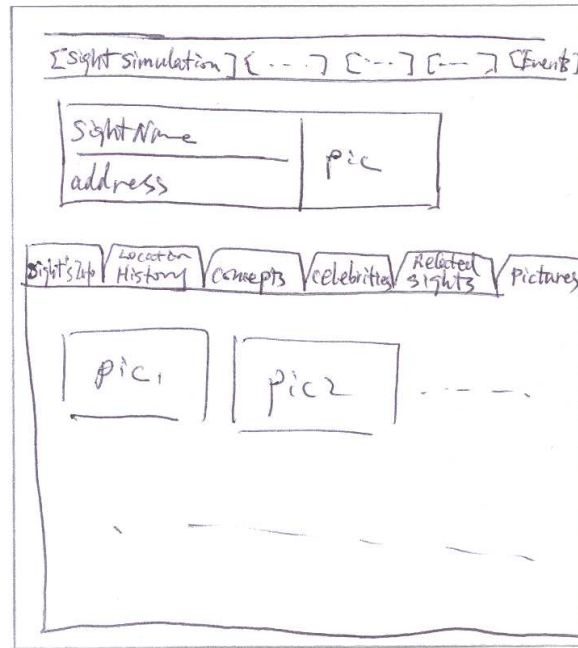
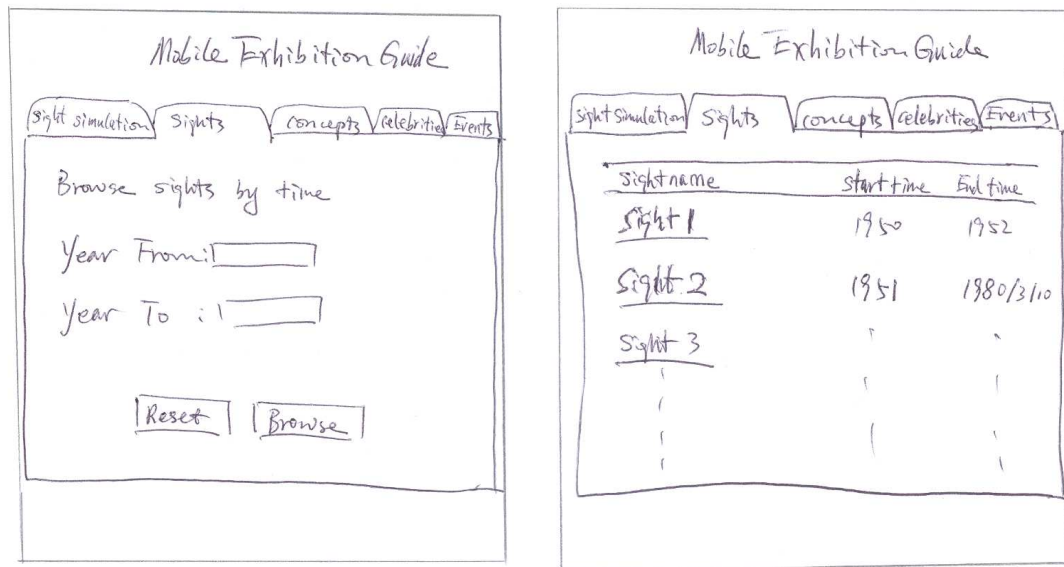


Figure 5.11: Prototype for Sight Pictures Interface

The last tab in the current sight page is the "Pictures" tab. The user can clicks on the tab in the interface shown in Figure 5.6(b), then the thumbnail pictures of the current sight are displayed as Figure 5.11 shows.

Prototypes for Browse Sight When the user wants to browse the sights by time period, then the user can click the "Sights" tab on the main page of the system (See Figure 5.12(a)). By giving the values of "Year From" and "Year To" and clicking the "Browse" button, the user can receive a list of sights that exists in the given time period, which is shown in Figure 5.12(b). If the user want to have more information about a certain sight, the sight page is displayed by clicking the sight name. The interface of the sight page is same as the current sight page as Figure 5.6(b) shows. The only difference is that there is no "Back to Current Sight" link for browsing sight page.



(a) sight mode Interface

(b) Prototype for Sight in Time Frame Interface

Figure 5.12: Prototype for Browse Sight Mode Interface

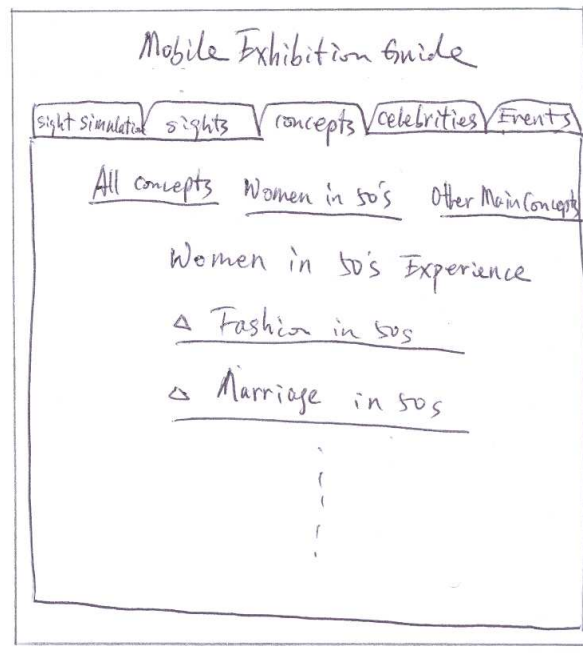


Figure 5.13: Prototype for Concept Mode Interface

Prototype for Concepts When the user clicks the "Concepts" tab in the main page of the system (see Figure 5.13). For the exhibition purpose, the concepts are divided into three categories, which are "All concepts", "Women in 50's" and "Other main concepts". If the user clicks "Women in 50's", then a list of related concepts is displayed. By clicking one of the concepts, the system will present the concept page as Figure 5.8(b) shows, except the "Back to Current Sight" link.

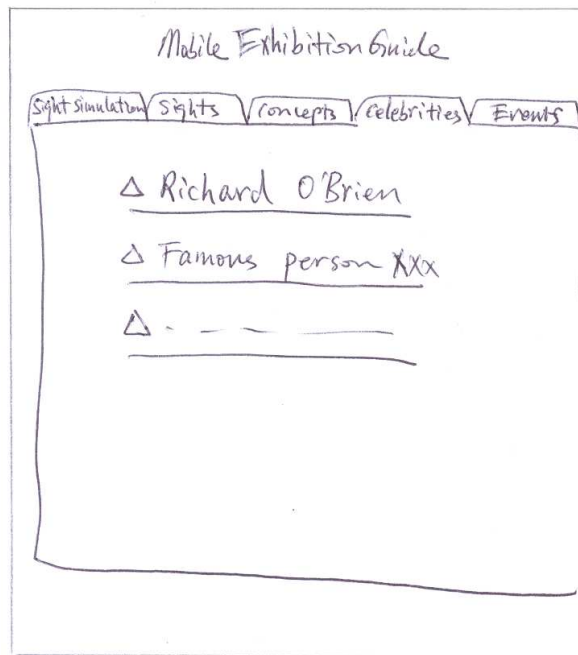


Figure 5.14: Prototype for Celebrities Mode Interface

Prototype for Celebrities When the user clicks the "Celebrities" tab in the main page of the system as Figure 5.14 shows, a list of famous people is displayed. By clicking one of the famous people name, the famous person page will be displayed as Figure 5.9(b) shows. The only difference is that there is no "Back to Current Sight" link on the page.

Prototype for Events Apart from browsing sights by time period, the system also allows the user to browse the sight information by decades. As shown in Figure 5.15, the sight information is divided into decades, which starts from 1950s to 2000s. In addition, the sight information is presented with "topic", "information", "start time" and "end time". For example, by clicking the link "1950s", the corresponding sight information is displayed.

Mobile Exhibition Guide

Sight simulation | Sights | Concepts | Celebrities | Events

1950s 1960s - - - - - 2000s

Events in 1950s

Sight	Topic	Information	Start time	End time
xxxx	- - - -	-----	1950	1956
xxx	xxxx	=====	1951/3/6	1957
.	-	-----	.	.

Figure 5.15: Prototype for Events Interface

5.6 Summary

To conclude, in this chapter, a number of strategies are taken to achieve the challenge of mapping the exhibition data framework into the TIP database structure (Ch2). According to the analysis in design phase, it is proven that re-using the TIP database structure into the exhibition is possible. In addition, we fulfilled the challenge of presenting the information under the specific exhibition circumstance (Ch3) through the paper-based prototype design process. The following chapter is going to demonstrate how to re-use the TIP database structure and implement the design in practice.

Chapter 6

Implementation

In this chapter, we address the implementation details of the proposed mobile exhibition guide. Firstly, the background of the TIP architecture and implementation is given in Section 6.1. Furthermore, the implementation of the database is described in Section 6.2. Following that, the proposed mobile exhibition guide's architecture and the software implementation are presented in Section 6.3 and Section 6.4, respectively. Lastly, some comments on user interface implementation are given in Section 6.5.

6.1 Background of the TIP Architecture and Implementation

As introduced at the beginning of the report, the TIP system is a mobile guide system. It provides various types of information to users according to the users' current locations and the profiles of their interests. The TIP core system [12] an infrastructure that is a combination between an Event Notification System (ENS) and a Location-Based System (LBS) . Since TIP 2.0, there are more services available in the TIP system such as recommendation service [14] and trust-based recommendation service [22], travel itineraries service [24], community-base service [17], and Greenstone digital library service [11]. In addition, a number of services are currently being developed (e.g. photo gallery service [25] etc.). In this section, we take a close look at the TIP system from the technical viewpoint. The TIP system is implemented as a client-server architecture. Desktop clients and mobile clients are supported. The architecture of the TIP system is shown in Figure 6.1.

The TIP database is created using pure relational database approach to simulate the hierarchy structures between objects such as sight, sight-group and topic. The technology used is PostgreSQL7.3.4 with PostGIS. PostgreSQL

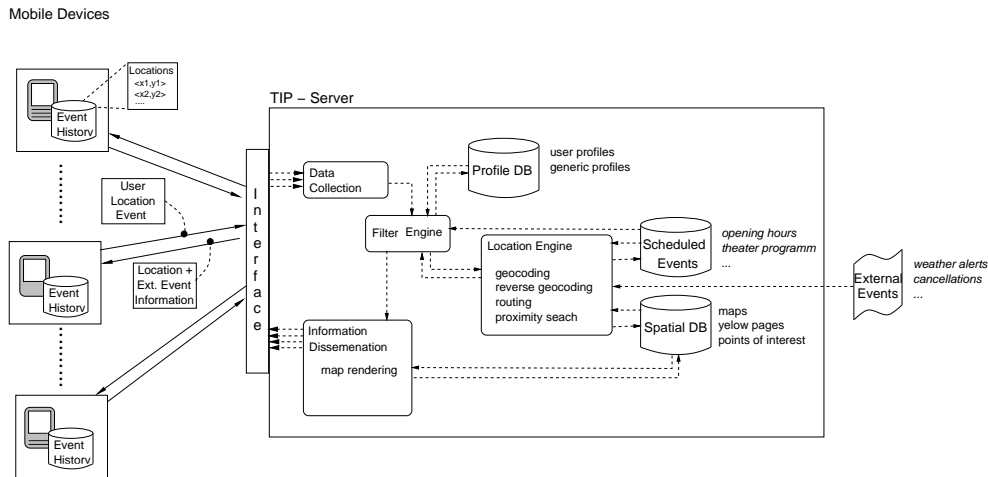


Figure 6.1: Architecture of TIP [12]

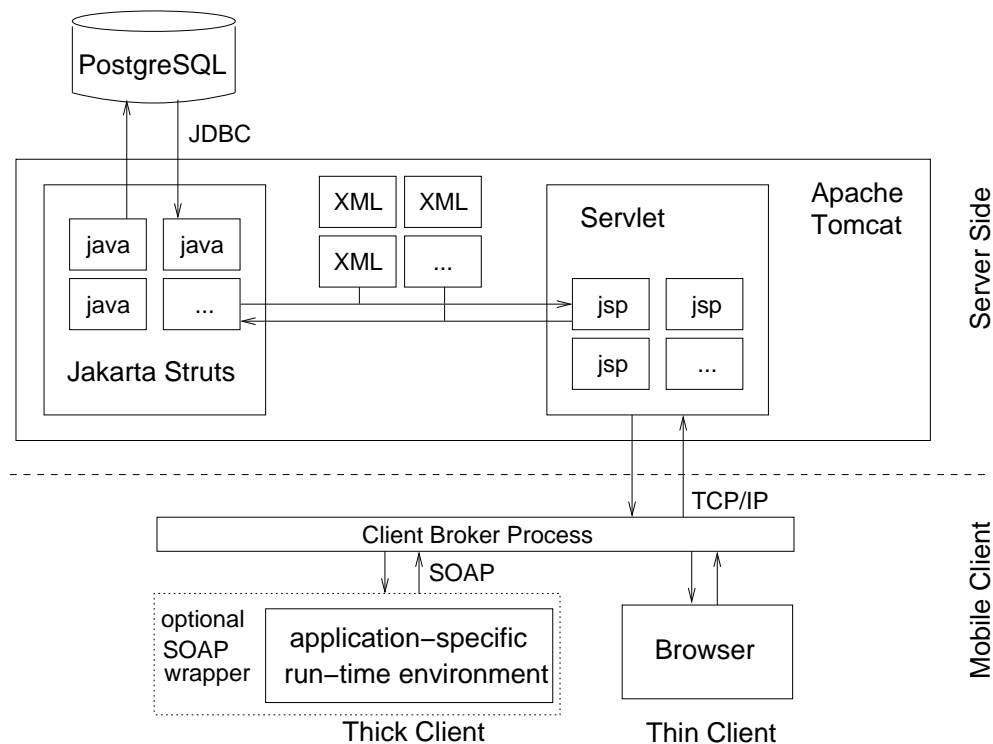


Figure 6.2: TIP Implementation Details [10]

is an object-relational database management system. PostGIS extensions is for manipulating the geographic data. On the software side, the TIP system is implemented under Jakarta Struts framework. Struts is an open source MVC pattern implementation, which divided the application into three components: model, view and control. Each of which components performs a particular set of tasks. The advantage of the MVC pattern is that it makes the software well organized. Because the business logic(java files) separates from user input

and the data presentation(JSP files), which are handled independently. The controller(XML files) manages the requests and responds, which builds a bridge between the model component and the view component. In addition, Struts framework supports multiple language interface. See [2] for more details about Struts. In the TIP system, the model component is written in Java 1.4.2.08 and the view component is developed in JSP. The server of the TIP system is running on Jakarta Tomcat 5.0.28. The architectural details are shown in Figure 6.2. The TIP database ER diagram can be found in Appendix A.

6.2 Implemented Database

According to the discussions in Section 5.3 and Section 5.4, the necessary modifications and the new definitions in the TIP database have been implemented. We modified three existing tables, created three new tables and nine views. The details are list as follows:

Modifications in the TIP Database

1. On table "Sight"

There are two new attributes added to table "Sight", which are "starttime" and "endtime". These two attributes are used to indicate the time periods of a physical sight. The data type of the two new attributes are integer. This is because we realized that the information might not have a precise time. The Date type cannot model well in this kind of situation. For example, "sightA" was created in Jan,1950. In this case, we can set the start time of "sightA " as the integer value(19500100). In other word, we use an eight digit integer value to represent the start time or the end time. In addition, "00" can use to represent the unknown date part.

Column	Type	Modifiers
s_id	integer	not null default nextval('sid_seq'::text)
name	text	not null
location	geometry	
address	integer	
<i>starttime</i>	<i>integer</i>	
<i>endtime</i>	<i>integer</i>	

Table 6.1: "Sight" Table

New Check Constraints:

"ck_st_ed" CHECK (endtime >= starttime)

"ck_endtime" CHECK (endtime > 0)

"ck_starttime" CHECK (starttime > 0)

2. On table "Information"

There are also two new attributes added to this table, which are "starttime" and "endtime" with integer data type. They are used to indicate the time period of a piece of sight information.

Column	Type	Modifiers
iid	integer	not null default nextval('public.information_iid_seq'::text)
id	integer	not null
tid	integer	not null
lvl	smallint	not null
information	text	not null
<i>starttime</i>	<i>integer</i>	
<i>endtime</i>	<i>integer</i>	

Table 6.2: "Information" Table

New Check Constraints:

"ck_info_st_ed" CHECK (endtime >= starttime)

"ck_info_ed" CHECK (endtime > 0)

"ck_info_st" CHECK (starttime > 0)

3. On table "User_data"

There is a new attribute in this table, which is "famouspeopleid". It is used to indicate the relationship between "famous person" in "sight" table and "user" in "user_data" table. As a result, we can retrieve the itineraries owned by the "famous person" through the corresponding relationships with itinerary entity.

New Foreign-key constraint:

"famouspersonid" FOREIGN KEY (famouspeopleid) REFERENCES sight(s_id)

New Trigger:

tri_famouspeople BEFORE INSERT OR UPDATE ON user_data FOR EACH ROW EXECUTE PROCEDURE check_a_personid()

Column	Type	Modifiers
ud_id	integer	not null default nextval('public.userdata_udid_seq'::text)
name	text	
last_name	text	
login	character varying(50)	
password	character varying(50)	
creation_date	timestamp without time zone	default ('now'::text)::timestamp(6) with time zone
level	integer	default 1
reputation	integer	default 0
email	text	
description	text	
virtual	boolean	default false
authority	character(20)	
status	character(20)	default 'active'::bpchar
<i>famouspeopleid</i>	<i>integer</i>	

Table 6.3: "User_data" Table

This trigger is used to ensure the "famouspeopleid" belongs "people" sight group.

New Table Definitions

1. Table "Conceptual_Relation"

This table is created for storing the relationships between sights, concepts and famous people that are implicated in "Sight" table.

Column	Type	Modifiers
sid	integer	not null
related_sid	integer	not null
relation	text	

Table 6.4: "Conceptual_Relation" Table

Indexes:

"conceptual_pk" primary key, btree (sid, related_sid)

Foreign-key constraints:

"con_related_sid_fk" FOREIGN KEY (related_sid) REFERENCES sight(s_id)

"con_sid_fk" FOREIGN KEY (sid) REFERENCES sight(s_id)

2. Table "Miscellaneous_soure"

This table is created for storing the external source references from the Internet.

Column	Type	Modifiers
srcid	integer	not null default nextval('mis_src_id_seq'::text)
hyperlink	text	not null
description	text	
source	text	

Table 6.5: "Miscellaneous_soure" Table

Indexes: "msrc_pk" primary key, btree (srcid)

3. Table "Sight_to_mis_src"

This table is created for storing the relationships between the items in "Sight" table and the items in "Miscellaneous_soure" table

Column	Type	Modifiers
sid	integer	not null
srcid	integer	not null

Table 6.6: "Sight_to_mis_src" Table

Indexes:

"s_src_pk" primary key, btree (sid, srcid)

Foreign-key constraints:

"src_fk" FOREIGN KEY (srcid) REFERENCES miscellaneous_source(srcid)

"s_src_fk" FOREIGN KEY (sid) REFERENCES sight(s_id)

View Definitions

Since we applied generic approaches for mapping the exhibition data structure into the TIP database, creating a virtual layer on the TIP database is essential

to satisfy the exhibition purpose . The virtual layer includes the following views.

1. View "Actual_sights"

This view is created for only retrieving the physical sights with time periods from "Sight" table.

Column	Type	Modifiers
s_id	integer	
name	text	
location	geometry	
address	integer	
starttime	integer	
endtime	integer	

Table 6.7: "actual_sights" View

View Definition:

```
SELECT sight.s_id, sight.name, sight."location", sight.address, sight.starttime,
sight.endtime
FROM sight
WHERE NOT (sight.s_id IN ( SELECT concepts.s_id FROM concepts))
AND NOT (sight.s_id IN ( SELECT famous_people.personid FROM famous_people));
```

2. View "Concepts"

This view is created for only retrieving the concepts from "Sight" table.

Column	Type	Modifiers
s_id	integer	
name	text	

Table 6.8: "concepts" View

View Definition:

```
SELECT s.s_id, s.name
FROM sight s, sight_to_sightgroup s_sg, sightgroup sg
WHERE s.s_id = s_sg.sid
AND s_sg.sg_id = sg.sg_id
```

```
AND sg.name = 'concept'::text;
```

3. View "Famous_people"

This view is created for only retrieving famous people from "Sight" table.

Column	Type	Modifiers
personid	integer	
personname	text	

Table 6.9: "famous_people" View

View Definition:

```
SELECT s.s_id AS personid, s.name AS personname
FROM sight s, sight_to_sightgroup s_sg, sightgroup sg
WHERE s.s_id = s_sg.sid
AND s_sg.sg_id = sg.sg_id
AND sg.name = 'people'::text;
```

4. View "Sight_to_sight"

This view is created for expressing the relationships between a sight and its related sights in terms of semantics.

Column	Type	Modifiers
s_id	integer	
name	text	
relate_sid	integer	
relate_sname	text	

Table 6.10: "sight_to_sight" View

View Definition:

```
SELECT s.s_id, s.name, rs.s_id AS relate_sid, rs.name AS relate_sname
FROM actual_sights s, conceptual_relation rel, actual_sights rs
WHERE s.s_id = rel.sid
AND rs.s_id = rel.related_sid
AND (rel.sid IN ( SELECT actual_sights.s_id FROM actual_sights))
AND (rel.related_sid IN ( SELECT actual_sights.s_id FROM actual_sights));
```

5. View "Sight_to_concept"

This view is created for expressing the relationships between a sight and its related concepts in terms of semantics.

Column	Type	Modifiers
s_id	integer	
sightname	text	
c_id	integer	
cname	text	

Table 6.11: "sight_to_concept" View

View Definition:

```
SELECT sight.s_id, sight.name AS sightname, concepts.s_id AS c_id,
concepts.name AS cname
FROM sight, concepts, conceptual_relation rel
WHERE rel.sid = sight.s_id
AND rel.related_sid = concepts.s_id
AND NOT (rel.sid IN ( SELECT concepts.s_id FROM concepts))
AND NOT (rel.sid IN ( SELECT famous_people.personid FROM famous_people));
```

6. View "Sight_to_people"

This view is created for expressing the relationships between a sight and its related famous people in terms of semantics.

Column	Type	Modifiers
s_id	integer	
sightname	text	
personid	integer	
personname	text	
relation	text	

Table 6.12: "sight_to_people" View

View Definition:

```
SELECT sight.s_id, sight.name AS sightname, p.personid, p.personname,
rel.relation
FROM sight, famous_people p, conceptual_relation rel
```

```

WHERE rel.sid = sight.s_id
AND rel.related_sid = p.personid
AND NOT (rel.sid IN ( SELECT concepts.s_id FROM concepts))
AND NOT (rel.sid IN ( SELECT famous_people.personid FROM famous_people));

```

7. View "Concept_to_concept"

This view is created for expressing the relationships between a concept and its related concepts in terms of semantics.

Column	Type	Modifiers
c_id	integer	
cname	text	
rel_c_id	integer	
rel_cname	text	

Table 6.13: "concept_to_concept" View

View Definition:

```

SELECT c.s_id AS c_id, c.name AS cname, rc.s_id AS rel_c_id, rc.name
AS rel_cname
FROM sight c, conceptual_relation rel, sight rc
WHERE rel.sid = c.s_id
AND rel.related_sid = rc.s_id
AND (c.s_id IN ( SELECT s.s_id FROM sight s, sight_to_sightgroup s_sg,
sightgroup sg
WHERE s.s_id = s_sg.sid AND s_sg.sg_id = sg.sg_id AND sg.name =
'concept'::text))
AND (rc.s_id IN ( SELECT s.s_id FROM sight s, sight_to_sightgroup
s_sg, sightgroup sg
WHERE s.s_id = s_sg.sid AND s_sg.sg_id = sg.sg_id AND sg.name = 'con-
cept'::text));

```

8. View "People_to_people"

This view is created for expressing the relationships between a famous person and the related famous people in terms of semantics.

View Definition:

```

SELECT p.personid, p.personname, rel.relation, rp.personid AS
related_pid, rp.personname AS related_pname

```

Column	Type	Modifiers
personid	integer	
personname	text	
relation	text	
related_pid	integer	
related_pname	text	

Table 6.14: "people_to_people" View

```

FROM famous_people p, conceptual_relation rel, famous_people rp
WHERE p.personid = rel.sid
AND rp.personid = rel.related_sid
AND (rel.sid IN ( SELECT famous_people.personid
FROM famous_people))
AND (rel.related_sid IN ( SELECT famous_people.personid
FROM famous_people));

```

9. View "People_to_concept"

This view is created for expressing the relationships between a famous person and the related concepts in terms of semantics.

Column	Type	Modifiers
personid	integer	
personname	text	
relation	text	
concept_id	integer	
concept_name	text	

Table 6.15: "people_to_concept" View

View Definition:

```

SELECT p.personid, p.personname, rel.relation, c.s_id AS concept_id,
c.name AS concept_name
FROM famous_people p, concepts c, conceptual_relation rel
WHERE p.personid = rel.sid AND rel.related_sid = c.s_id;

```


6.3 Mobile Exhibition Guide's Architecture

In this section, we focus on the implemented architecture of the mobile exhibition guide. Firstly, we present an overview architecture of the extended TIP 2.5 system in Figure 6.3. Then, the detail of information service component in the mobile exhibition guide is illustrated in Figure 6.4.

The action flow from the user sending out request to receive a response from the TIP Server is shown in Figure 6.3. Firstly, the user's request is passed to the "Data Collection" component through the interface. Then, according to the data from Data Collection, the "Controller" component sends the instructions to the corresponding service component. After that, the service component accesses the TIP database to retrieve the required information. Then, the information is passed back to "Controller" so that the "Controller" can forward the information to the "Information Dissemination" component. Next, the required information is sent out to the corresponding interface through "Information Dissemination". Lastly, the required information is presented on the interface. All the TIP services components are surrounded by a dashed-frame at the top of the figure.

As our project aim is reusing the TIP infrastructure, we embedded the mobile exhibition guide services into the TIP server. The architecture of the implemented mobile exhibition guide is shown in the gray dashed-frame that is at the bottom of Figure 6.3. The mobile exhibition guide consists of an "Information Service" component that is the main service in the mobile exhibition guide. The component reuses the "Controller" component for receiving control instructions and sends required information. It can also be seen from Figure 6.3 that the "Information Service" component connects to two dashed-boxes, those of which are "Basic Recommendation" component and "Basic Itinerary" component. These two components are used for communicating with the "Recommendation" component and "Travel Itinerary" component. As a result, the basic services of these two components in TIP can be reused in our project. Recalling Ch4 in Section 3.1, part of the challenge has been achieved. However, there are still difficulties for reusing all of the service components in TIP, further details will be given in Section 8.2.

As we mentioned above, "Information Service" component is the main part of the mobile exhibition guide. The detail implemented architecture of this component is shown in Figure 6.4. This component consists of three elements ("Sight Mode", "Concept Mode" and "People Mode") and one "Information Engine". These three elements are responsible for dealing with the corresponding requests that passed from the "Controller" in TIP Server. In addition, these three elements can communicate with each other. Therefore, the functions of each element can be reused. Furthermore, the "Information Engine" is a com-

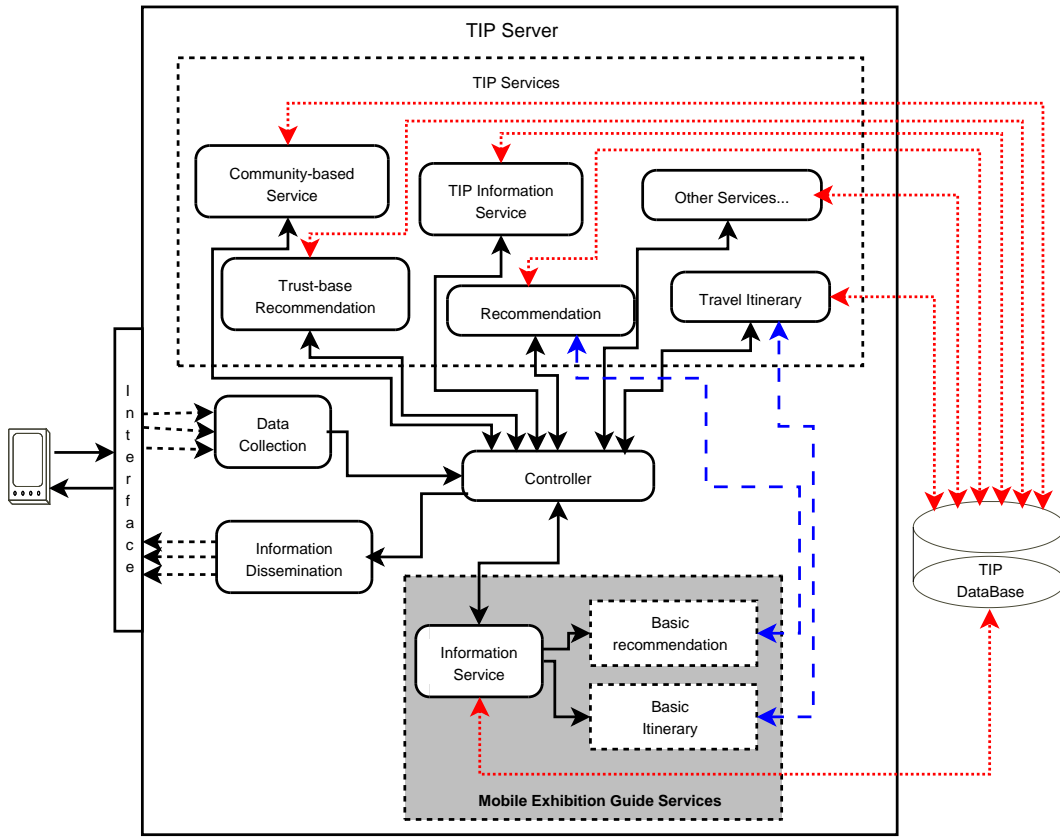


Figure 6.3: Services Model Architecture of TIP and Mobile Exhibition Guide

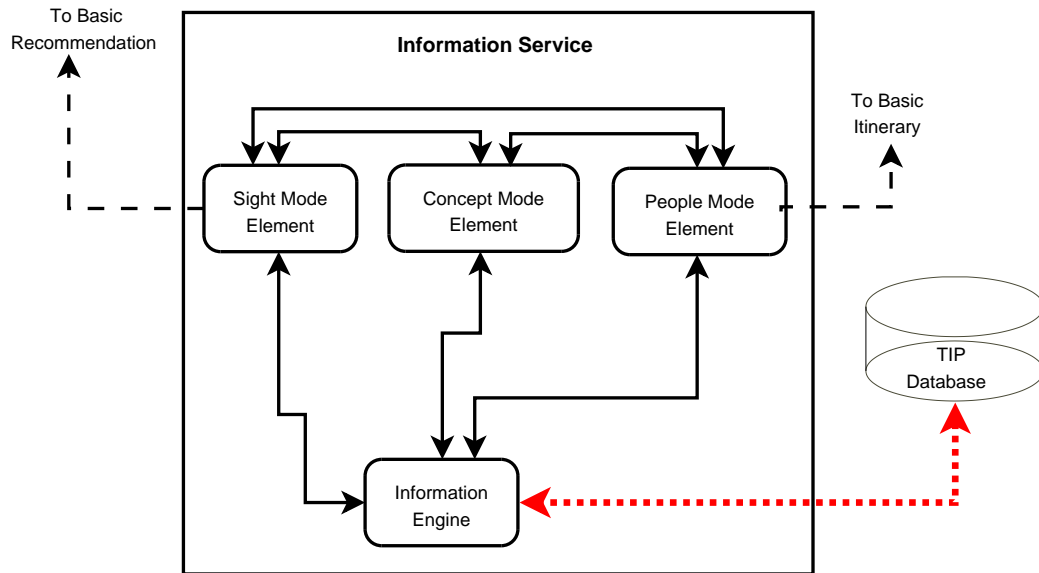


Figure 6.4: Information Service Component in Mobile Exhibition Guide

mon access point to the TIP database. It retrieves the required information from the TIP database and then disseminates to the corresponding element.

For "Sight Mode" element and "People Mode" element, they can communicate with the "Basic Recommendation" component and "Basic Itinerary" component respectively. Therefore, the mobile exhibition guide users can benefit from those TIP services.

6.4 Software Implementation of Information Service Component

As the architecture presented above, let's look closely on the detail software implementation of information service component in the Mobile Exhibition Guide. Firstly, the overview implementation of the action classes in the proposed system is introduced in Figure 6.5. Subsequently, an example action is used to describe the detail of the implementation and the completed action process.

We can see from Figure 6.5 that all action classes extend the Action class in "org.apache.struts.action" package. Those action classes are used to handle the requests from the client. All logic classes are responsible for accessing to the TIP database and retrieving the required data back. In our system, there are four groups of action class, those of which are *sight actions*, *concept actions*, *people actions* and *information actions*. In addition, *SightLogic*, *ConceptLogic*, *PeopleLogic* and *InformationView* are used to manipulate the TIP database from "sight", "concept", "people" and "information" aspects respectively.

Apart from those four groups of Action classes, there is another action class in information service component. The "SimulateLocationAction" class has two responsibilities. One is detecting for the user's current location whether is close to a sight. This task is done by the "LocationTest" logic. The other is invoking the "SightLogic" and the "informationView" logic classes to retrieve the sight information, when the user is close to a sight.

In order to have a closer look on the implementation of the information service component, we use a sequence diagram (see Figure 6.6) and a class diagram (see Figure 6.7) to depict an example action process.

Figure 6.6 shows an action process from the request made by a client to the respond generated by the system. This action happens when a user's current location is close to a physical sight, the user wants to know the sight. The whole process has the following steps:

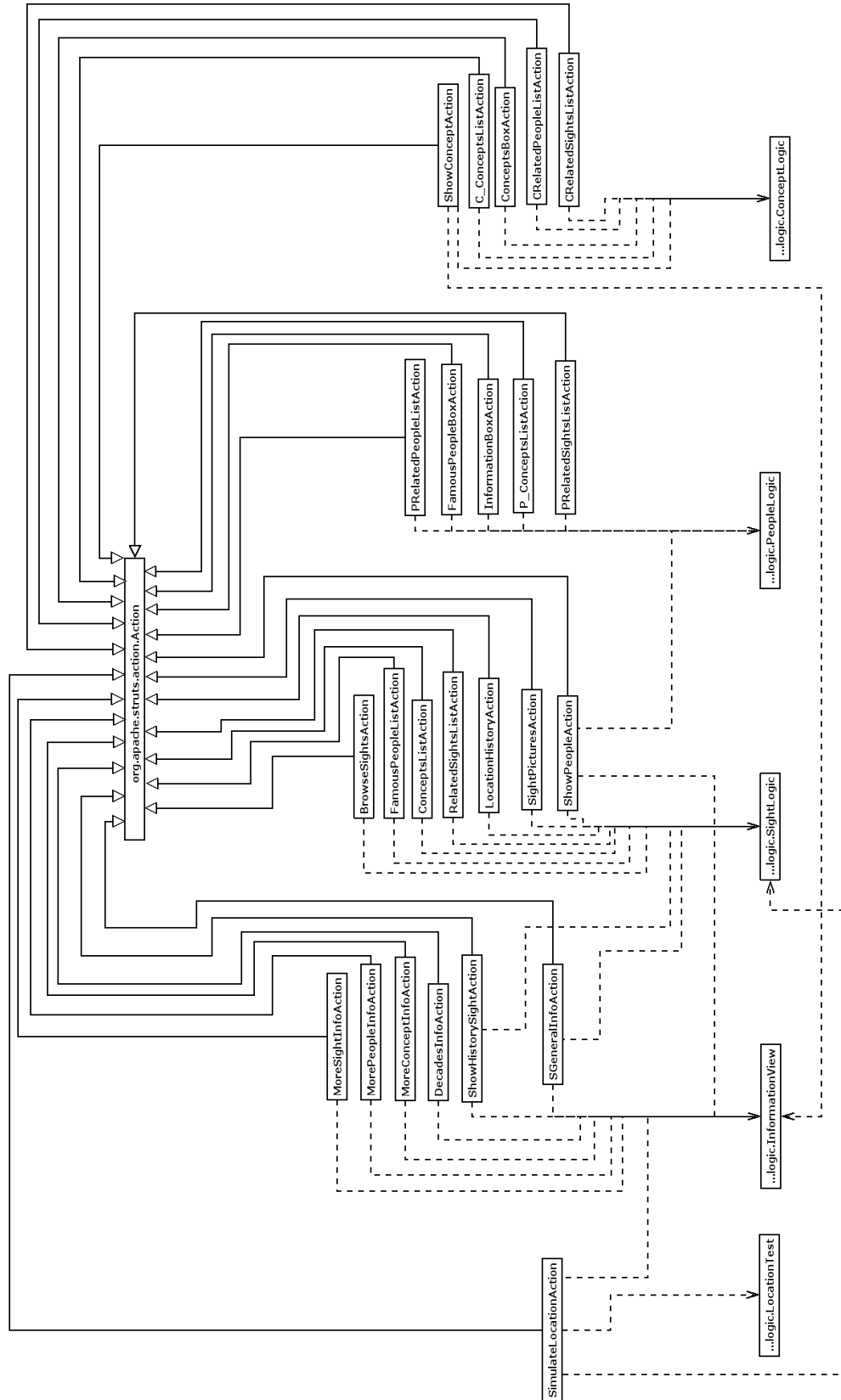


Figure 6.5: Overview of Implemented Action Classes Diagram

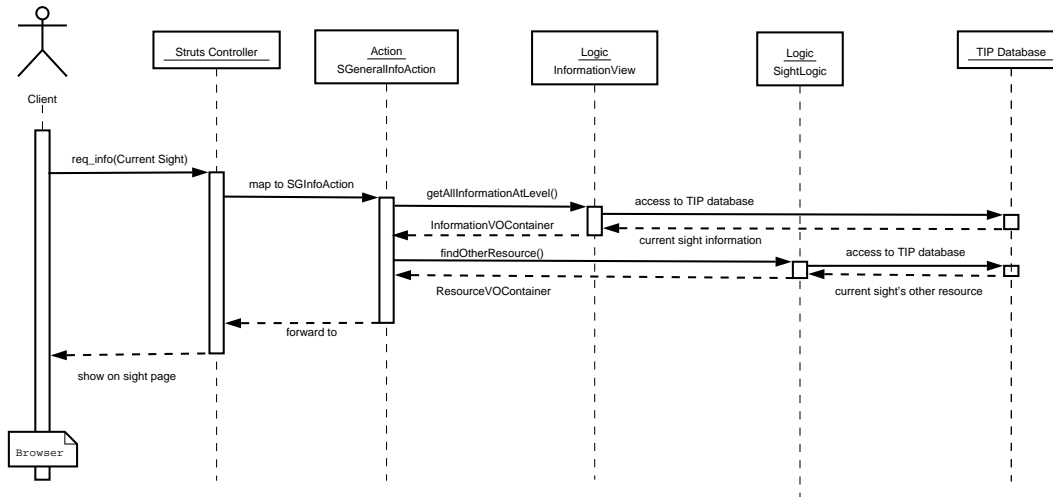


Figure 6.6: Sequence of Sight General Information Action

1. The user sends out a request of current sight's information through a browser to the *struts controller* in the TIP server.
2. The struts controller identifies that this request should map to the action class named "SGeneralInfoAction".
3. "SGeneralInfoAction" class invokes "getAllInformationAtLevel" method in "InformationView" logic in order to get all information of the current sight.
4. "InformationView" logic class accesses the TIP database to obtain the corresponding information about current sight's .
5. The TIP database returns a set of current sight's information to the "InformationView" logic class.
6. "InformationView" logic class packs the returned information into an "InformationVOContainer" object and sends to "SGeneralInfoAction" class
7. "SGeneralInfoAction" also invokes "SightLogic" class to find out other resource of the current sight.
8. "SightLogic" class accesses the TIP database to obtain those external resource.
9. The TIP database returns a set of current sight's external resource references to the "SightLogic" class.

10. "SightLogic" class packs the returned data into a "ResourceVOContainer" object and sends to "SGeneralInfoAction" class.
11. "SGeneralInfoAction" class sends out the required information to the corresponding forward. That is defined in the struts controller.
12. Struts Controller identifies the JSP page for the forward and sends out information about the current sight to the JSP page. As a result, the information about the current sight is responded to the user on the browser.

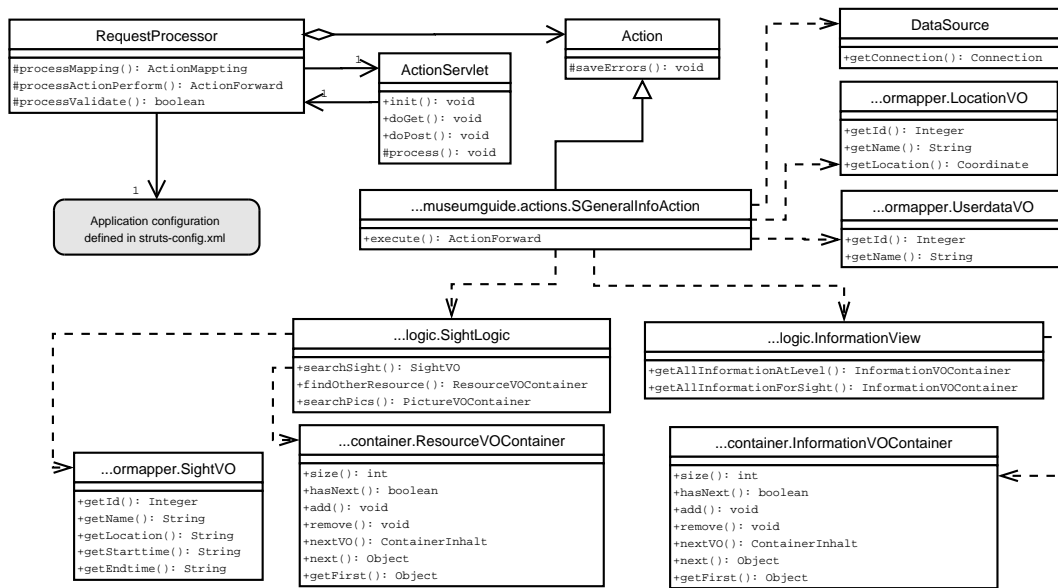


Figure 6.7: Class Diagram of Sight General Information Action

Figure 6.7 illustrates the class diagram of "SGeneralInfoAction" action class. *Application configuration(struts-config.xml)*, *RequestProcessor*, *ActionServlet* and *Action* are the elements of struts controller. The responsibility of struts controller is to receive request from the browser, map to an action, process the request and forward data to the destination page according to the configuration file. "SGeneralInfoAction" is a subclass of "Action", the *execute()* method is called by the struts controller when the request of sight general information is received from a client. This action class can receive the user's current location data that is stored in a "LocationVO" view object. From the request, the action class can also receive user information that is stored in "UserDataVO" view object. In addition, the database connect can be obtained from the request. In order to retrieve the required information from the TIP database, the database connection will be passed to the logic classes "SightLogic" and "InformationView" by "SGeneralInfoAction". The appropriated methods of these two logic classes will be invoked and the

returning data will be stored in the container "ResourceVOContainer" and "InformationContainer".

6.5 Comments on User Interface Implementation

As mentioned in Section 3.1, the wireless network is still not available in Hamilton (Ch8) by the time of this thesis. We made an implementation decision to overcome that challenge and Ch5 as follows: We decided not to use PDAs but TabletPCs as the devices of the mobile exhibition guide. The reasons for our decision are

1. Using a PDA would not work well at the moment, because it would arise a number of problems (e.g. access the database).
2. Comparing TabletPC with PDA, we found that TabletPC has more advantages than PDA: TabletPC has a bigger screen and enough space for storing the database.
3. The Waikato Museum would like to use TabletPC because they can provide better view for a group of people.

As a result, TabletPC can work for our purpose, even there is no wireless network in Hamilton. Therefore, the implemented user interfaces are designed for TabletPCs (screen shots are presented in Section 7.1.2).

6.6 Summary

In summary, this chapter provided an overview of the TIP architecture and the mobile exhibition Guide architecture. The modifications in the TIP database have been implemented to tailor to the needs of the mobile exhibition guide. Moreover, we explored in detail the implementation of the information service component in the mobile exhibition guide from several viewpoints. The implementation of the proposed system has achieved the challenge Ch3 and part of Ch4 mentioned in Section 3.1. The subsequent chapter describes our evaluation of the implemented proposed system.

Chapter 7

Evaluation

In order to assess the quality of the mobile exhibition guide, functionality and efficiency are the two main characteristics to be observed in our evaluation process. Firstly, in Section 7.1, we present the qualitative evaluation, which is used to assess whether the system can fulfill the high-priority requirements listed in Section 4.3. The second half of this chapter describes the quantitative evaluation process in Section 7.2, in which the response time of the system is measured.

7.1 Qualitative Evaluation

In this section, we assess the functionality of the mobile exhibition guide. Recalling the high-priority requirements identified in Section 4.3, which are list as follows:

1. *To identify the location.*
2. *To present the information with time context.*
3. *To provide cross-links between different aspects (e.g. sight, concept and people).*
4. *To present information in different modes.*

We use these requirements as the criteria of our functional test. The evaluation process is to carry out the exemplary study using the mobile exhibition guide. First, the setup of the test is described. Second, in Subsection 7.1.2, the test results are presented as screen shots along with our analysis.

7.1.1 Test Setting

There are five locations that are used in our test, which are illustrated as (blue) dots with label L1 to L5 in Figure 7.1. The test is to explore the information

about these five locations through three dimensions (sight, concept and people) by using the mobile exhibition guide. We use the following data in our tests, part of which is provided by the Waikato Museum and part of which are mock-up data for test purpose only.



Figure 7.1: Map of Victoria Street, Hamilton, NZ

Sights:

- Location L1: St Peter's Cathedral (since 1920).
- Location L2: The Bank Bar and Brasserie (since 1994), Bank of New Zealand (1878 to 1980)
- Location L3: Alexandra Building (since 1903)
- Location L4: Granite Restaurant (since 2004), Milne and Choyce (1950 to 2003)
- Location L5: Riff Raff (since 1991), The Embassy Theatre (1950 to 1991), The Theatre Royal (1915/3/11 to 1950)

Concepts:

- Women fashion in 50s
- Shopping
- Fashion
- Women in 50s experience

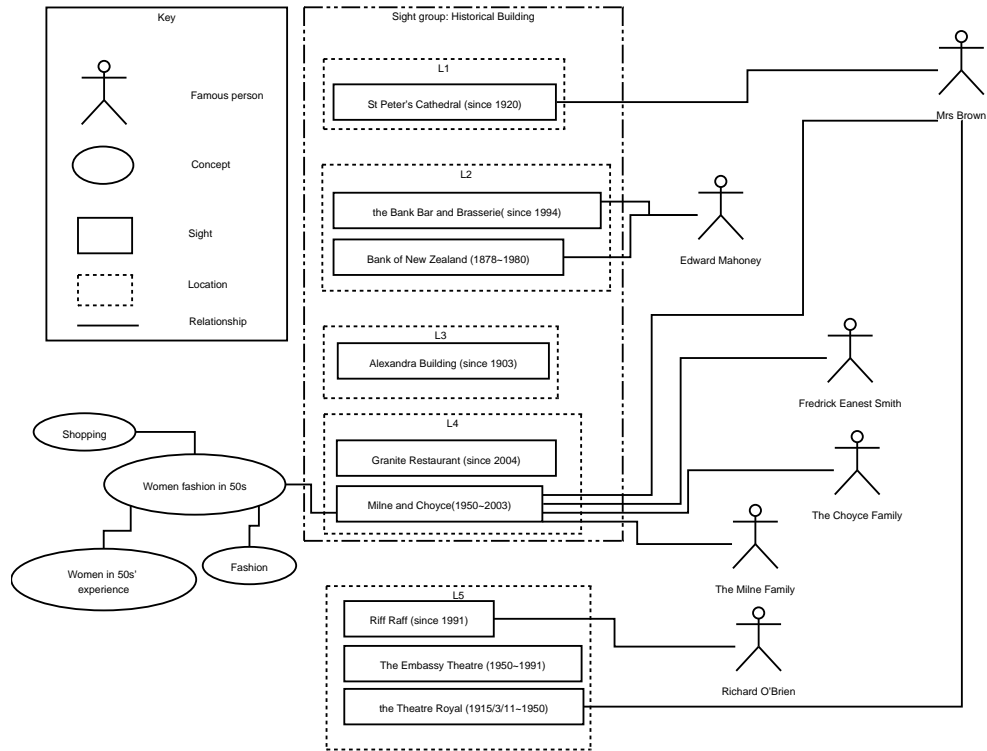


Figure 7.2: Relationships among Functional Test Data

People:

- Edward Mahoney
- Richard O'Brien
- Mrs Brown
- Fredrick Eanest Smith
- the Milne family
- the choyce familiy

In addition, there are relationships among these test data. The relationships are illustrated in Figure 7.2. The lines in Figure 7.2 represent the relationships between objects. For example, we can see from the figure that the sight "Milne and Choyce" relates to the concept "Women fashion in 50s". Moreover "Milne" and Choyce" also relates to the famous people "The Choyce Family", "The Milne Family", "Fredrick Eanest Smith" and "Mrs Brown".

7.1.2 Test Results and Analysis

As the test data stated in previous subsection, there are six experiments that have been carried out. Those experiments are the instances of the combination

among Scenario 1 to 4 in Section 4.1 and use cases in Section 5.5.1. The experiments are:

- Experiment 1: Travel by time-line for a place
- Experiment 2: Travel by time-line for a person
- Experiment 3: Travel by time-line for a concept
- Experiment 4: Travel by sights
- Experiment 5: Browse sights by time period
- Experiment 6: Browse sight information by time period

We show the results of each experiment in screen shots. The log in screen is omitted in our screen shots, since we assume the user has logged into the mobile exhibition guide.

Experiment 1: Travel by time-line for a place

Figure 7.3 to Figure 7.9 show the screen shots for traveling by time-line for a place. In this experiment the user stays at a single location. We assume the user profile has been set to "Historical Building" option in the TIP system. When the user is close to location L2 then the system shows the information of the current sight on the screen (see Figure 7.3). We can see from Figure 7.3 that *The Bank Bar and Brasserie* has been at L2 (117 Victoria Street) since 1991. In addition, the system also presents the information about this sight in several topics (e.g. general, architecture, history etc.). If the user wants to know more about the history information about this sight, the "More" link (highlighted Box 1 in Figure 7.3) can be clicked then the history information is shown as Figure 7.4. The user can go back to previous "sight info" page by click the navigation bar "The Bank Bar and Brasserie". In addition to the history information, the user can also explore more information about the current sight by clicking the link (highlighted Box 2) under the "Other Related Resource" category on the page in Figure 7.3. The home page of "The Bank Bar and Brasserie" is shown in Figure 7.5. If the user is interested in the pictures of the current sight, then a list of thumbnail pictures is shown when the "Picture" tab (highlighted Box 3 in Figure 7.3) is clicked. By clicking on one of the thumbnails, a full view of the picture will be displayed on the screen (see Figure 7.6).

As the experiment is about the time-line for a place, the user can click on "Location History" tab (highlighted Box 4 in Figure 7.3), in which a list of historical sights is shown as Figure 7.7. For L2, the historical sight is "Bank

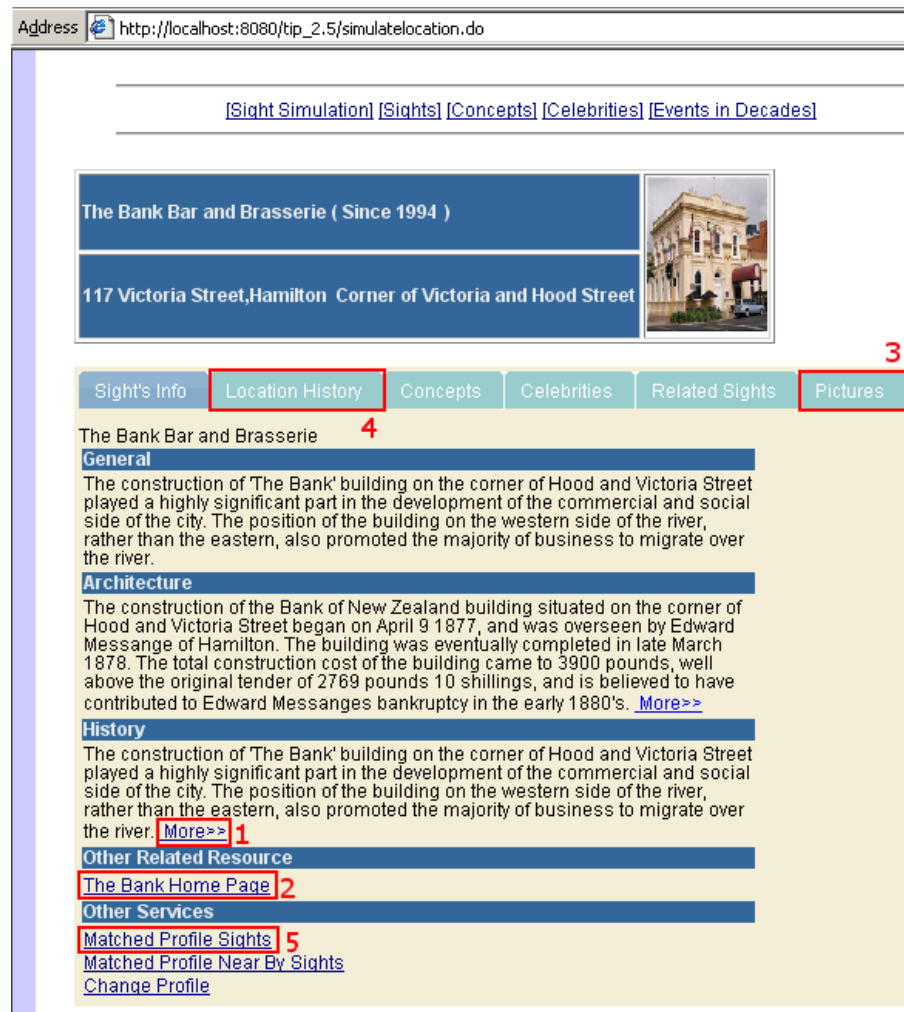




Figure 7.3: Location L2 with *The Bank Bar and Brasserie*

of New Zealand”, which was there from 1878 to 1980. For more information about the historical sight ”Bank of New Zealand”, the user can click on the name (in the screen shown Figure 7.9) then the information page about ”Bank of New Zealand” is presented to the user as Figure 7.8 shows. In addition, the user can explore other historical buildings on Victoria Street by clicking the link ”Matched Profile Sights” (highlighted Box 5) under the ”Other services” category in Figure 7.3. A list of historical sights is recommended by the system (see Figure 7.9), those of which are ”Alexandra Building”, ”Granite Restaurant”, and ”St Peter’s Cathedral”. As a result, the user can click on those links to explore more about those buildings.

Address  http://localhost:8080/tip_2.5/moreinformation.do?sid=257894&tid=4

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)

The Bank Bar and Brasserie (Since 1994)



117 Victoria Street, Hamilton Corner of Victoria and Hood Street

Sight's Info
Location History
Concepts
Celebrities
Related Sights
Pictures

[The Bank Bar and Brasserie](#) > History

More History information

The construction of 'The Bank' building on the corner of Hood and Victoria Street played a highly significant part in the development of the commercial and social side of the city. The position of the building on the western side of the river, rather than the eastern, also promoted the majority of business to migrate over the river.

Historically, the building was one of the first substantial buildings to be erected within Hamilton, and is now one of the oldest commercial structures left in Hamilton. It is also one of the regions earliest surviving banks. The building itself contains valuable evidence of colonial construction technology and materials in the Waikato, particularly the local production of bricks. The building also reflects the origins of Victoria Street as a commercial centre, and still plays a significant role in the town's restaurant and nightlife.

1877-1878 Original Construction

1908-1909 Addition: Hood Street Extension, with internal reorganization

1932-1933 Addition: Victoria Street Extension, and interior modifications

Pre 1953 Internal modification with Balustrading on parapet filled in

1980s - Vacated by Bank of New Zealand

April 1987 - Protection notice issued to prevent destruction or removal of the building so as to avoid the loss of the character building

1988 Plans submitted to redevelop bank into restaurant and marketplace nothing resulted.

1994 Substantial interior modifications. Became 'The Bank Bar and Brasserie'

Figure 7.4: History Information of the Current Sight: *The Bank Bar and Brasserie*



Figure 7.5: External Resource of the Current Sight: *The Bank Bar and Brasserie*

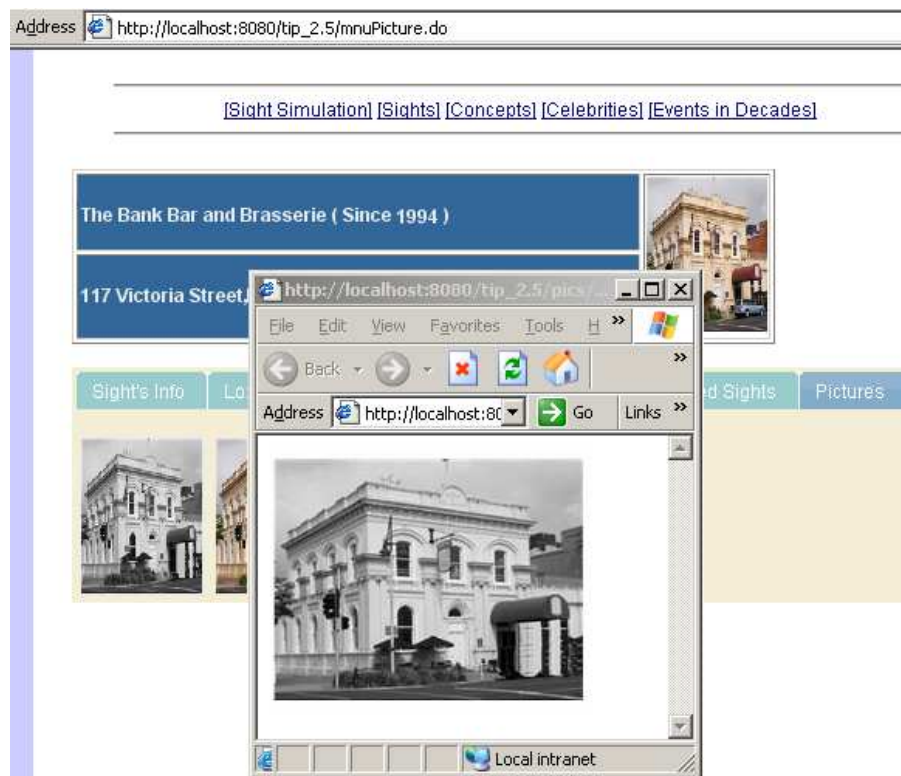



Figure 7.6: Picture of the Current Sight: *The Bank Bar and Brasserie*




Figure 7.7: Historical Sights in Current Location: *L2*






Figure 7.8: Information of the Historical Sight: *Bank of New Zealand* at *L2*

Address  http://localhost:8080/tip_2.5/getmatchedProfile.do

TIP 2.5 - Recommendations 

Hello Annikal Your current position is The Bank Bar and Brasserie.
The following sights are recommended based on your preferences defined in you user profile.

Picture	Name	Sight Group	(sight_id)
	Alexandra Building	historical building	257890
	Granite Restaurant	historical building	257937
	St Peter's Cathedral	historical building	257893

[return to previous page](#)


Figure 7.9: Recommendation of Historical Buildings

Experiment 2: Travel by time-line for a person


Figure 7.10 to Figure 7.16 show the screen shots of traveling by time-line for a person. As Figure 7.10 shows, a list of famous people is displayed in "Celebrities" mode when the user clicks on the "Celebrities" tab on the interface shown in the figure. For testing purpose, we created a person named "Mrs Brown" and assigned an itinerary to this person. The itinerary is shown in Figure 7.11. The sights that Mrs Brown visited on a day in 1950 are "St Peter's Cathedral" (L1), "Alexandra Building" (L3) and "Milne and Choyce" (L4) in order. Therefore, the user can follow Mrs Browns' itinerary to travel. The information page of each sight is shown by clicking the sight name. Figure 7.12 is the information page for "St Peter's Cathedral" at L1. Figure 7.13 shows the information page of "Alexandra Building" at L3. "Milne and Choyce" at L4 was the last sight in Mrs Brown's itinerary, its information page is shown in Figure 7.14. Since "Milne and Choyce" is not the current sight at L4, the user can click the "Location History" tab to look for the current sight at L4, which is "Granite Restaurant" (see Figure 7.15). By clicking the sight name "Granite Restaurant", the information page is shown as Figure 7.16.



Figure 7.10: A List of Famous People

Address  http://localhost:8080/tp_2.5/peopleSight.do?plid=257944

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)

People: Mrs Brown 

People Info | **Related Concepts** | **Related Celebrities** | **Related Sights** | **Pictures**

Mrs Brown
Travel Itinerary Information
 Mrs Brown big day out (on a day in 1950)
 (1) [St Peter's Cathedral](#)
 (2) [Alexandra Building](#)
 (3) [Milne and Choyce](#)

Figure 7.11: Mrs Brown's Itinerary

Address  http://localhost:8080/tp_2.5/historySight.do?hsightid=257893

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)


St Peter's Cathedral (Since 1920) 

55 Victoria Street, Hamilton

Sight's Info | **Location History** | **Concepts** | **Celebrities** | **Related Sights** | **Pictures**

St Peter's Cathedral
General
 St Peters Cathedral is located on the south end of Victoria Street on the hill originally named Pukerangiora, which translates into 'the hill of the life-giving heaven'. [More>>](#)
People
 The architects, John Warren and John Blechynden chose a 14th century castellation style for the church, and the foundation stone was laid by the Governor-General on October 5, 1915.
History
 In the 1860's , when war broke out in the Waikato, the hill was seized and used by the British as a military post by the 4th Waikato Regiment. A number of trenches were dug on the site, some of which can still be accessed through a trap door within the cathedral. [More>>](#)
Other Services
[Matched Profile Sights](#)
[Matched Profile Near By Sights](#)
[Change Profile](#)


Figure 7.12: The First Sight of Mrs Brown's Itinerary at L1

Address  http://localhost:8080/tip_2.5/simulatelocation.do

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)

Alexandra Building (Since 1903)

221 Victoria Street,Hamilton



Sight's Info
Location History
Concepts
Celebrities
Related Sights
Pictures

Alexandra Building

People

Fredrick E. Smith began practice in Hamilton towards the end of the 1800s. It is believed that My Smith was the first full-time architect to work within Hamilton. His style is easily identified and characterized through the use of heavily decorative facades an ornate parapets in the Neo-Classical Mode. [More>>](#)


History

The latter part of the 1800s saw a time of immense growth within the Hamilton commercial centre. The business community moved up from the area around the wharf at the foot of Grantham Street up to the current Hood St and Victoria St intersection. [More>>](#)

Other Services

[Matched Profile Sights](#)
[Matched Profile Near By Sights](#)
[Change Profile](#)


Figure 7.13: The Second Sight of Mrs Brown's Itinerary at L3

Address  http://localhost:8080/tip_2.5/historySight.do?hsightid=257931

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)

Milne and Choyce (From 1950 to 2003)

231 Victoria Street,Hamilton



Sight's Info
Location History
Concepts
Celebrities
Related Sights
Pictures

Milne and Choyce

General

Milne and Choyce was a chain department with one store in Victoria Street, Hamilton, selling men's and women's fashions It was founded in Auckland in 1866 and was in operation into the 1970s.

Architecture

Milne & Choyce Hamilton was designed by Fredrick Earnest Smith. Fredrick E. Smith began practice in Hamilton towards the end of the 1800s. It is believed that My Smith was the first full-time architect to work within Hamilton. His style is easily identified and characterized through the use of heavily decorative facades an ornate parapets in the Neo-Classical Mode.

History

Milne and Choyce was a popular department store on Victoria street in the 1950s. [More>>](#)

Other Services

[Matched Profile Sights](#)
[Matched Profile Near By Sights](#)
[Change Profile](#)

Figure 7.14: The Third Sight of Mrs Brown's Itinerary at L4



Figure 7.15: The Current Sight at L4



Figure 7.16: The Information of the Current Sight at L4

Experiment 3: Travel by time-line for a concept

Figure 7.17 to Figure 7.24 show the screen shots of traveling by a concept. A list of concepts related to "Women in 50s experience" is shown in Figure 7.17. For this experiment, we assume that the user is interested in the concept "Women fashion in 50s". So the user clicks on that link, the information page for "Women fashion in 50s" is shown in Figure 7.18. In addition, the user can also explore the other concepts that are related to "Women fashion in 50s" by clicking the "Related Concepts" tab (See Figure 7.19). Those related concepts are "Shopping", "Fashion" and "Women in 50s experience". If the user wants to look at the pictures about 50s' fashion, then by clicking the picture tab, a list of thumbnail pictures of 50s' fashion is shown in Figure 7.20. "Milne and Choyce" is the related sight of this concept "Women fashion in 50s", which is shown within "Related Sight" tab (see Figure 7.21). Therefore, the user can explore the information about the sight, as Figure 7.22 shows. Since "Milne and Choyce" is not the current sight at L4, the user can find out the current sight at L4 by clicking the tab "Location History" (see Figure 7.23). The current sight at L4 is "Granite Restaurant" since 2004 and its information page is shown as Figure 7.24.

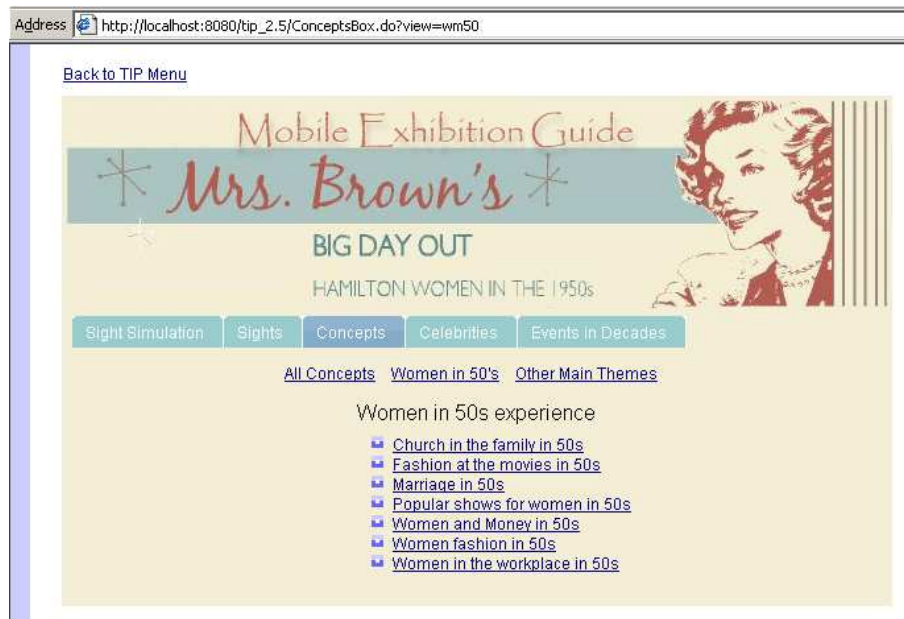


Figure 7.17: A List of Concepts

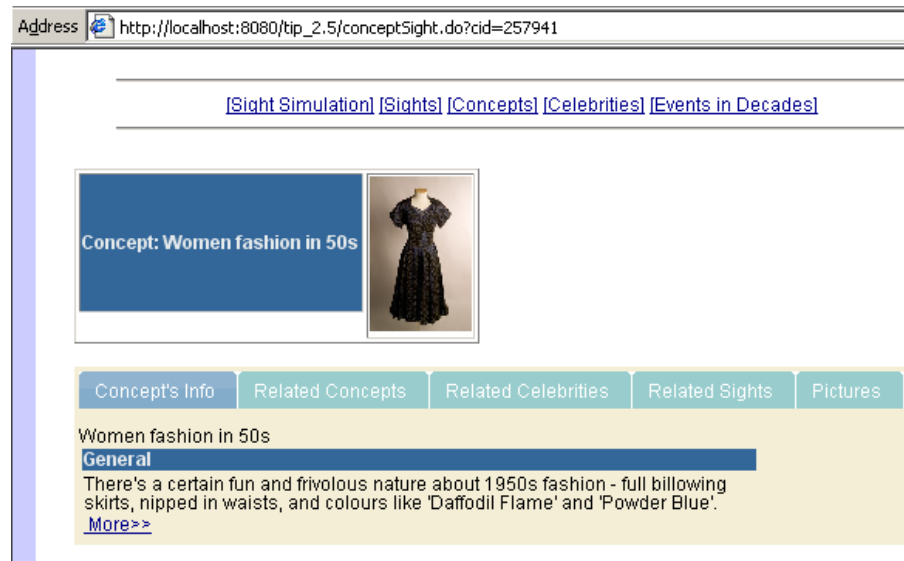


Figure 7.18: Concept: Women Fashion in 1950s

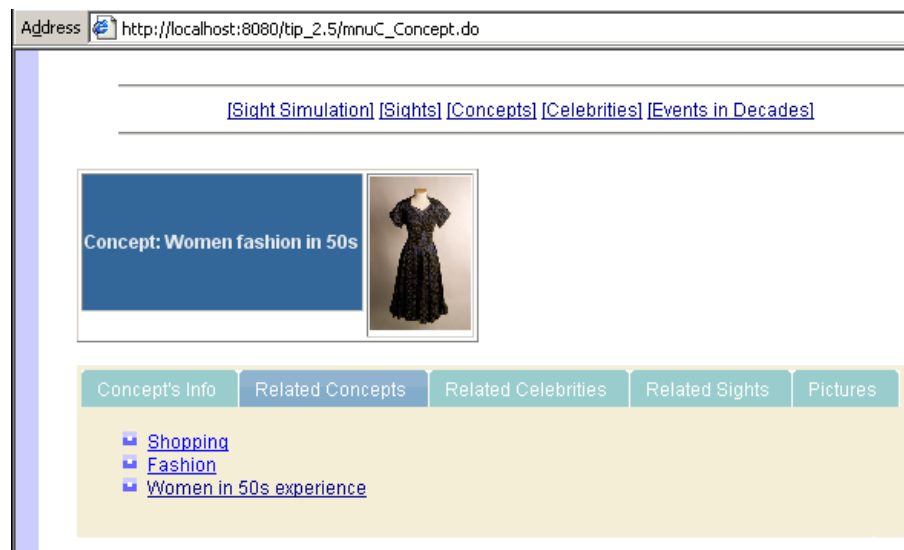
Figure 7.19: The Related Concepts of *Women Fashion in 1950s*



Figure 7.20: Pictures of 50s' Fashion

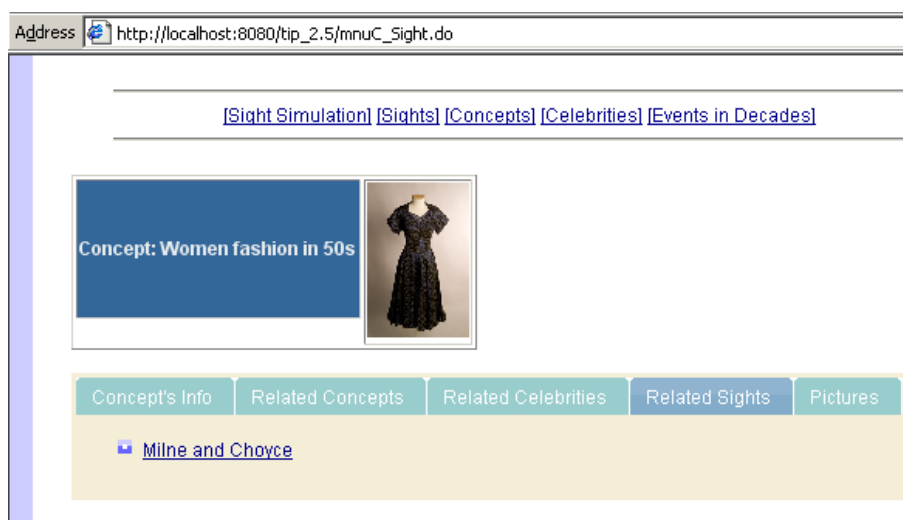




Figure 7.21: The Related Sight of the Concept *Women Fashion in 50s*

Address  http://localhost:8080/tip_2.5/historySight.do?hsightid=257931

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)

Milne and Choyce (From 1950 to 2003)

231 Victoria Street,Hamilton



Sight's Info	Location History	Concepts	Celebrities	Related Sights	Pictures
<p>Milne and Choyce</p> <p>General</p> <p>Milne and Choyce was a chain department with one store in Victoria Street, Hamilton, selling men's and women's fashions It was founded in Auckland in 1866 and was in operation into the 1970s.</p> <p>Architecture</p> <p>Milne & Choyce Hamilton was designed by Fredrick Earnest Smith. Fredrick E. Smith began practice in Hamilton towards the end of the 1800s. It is believed that My Smith was the first full-time architect to work within Hamilton. His style is easily identified and characterized through the use of heavily decorative facades an ornate parapets in the Neo-Classical Mode.</p> <p>History</p> <p>Milne and Choyce was a popular department store on Victoria street in the 1950s. More>></p> <p>Other Services</p> <p>Matched Profile Sights Matched Profile Near By Sights Change Profile</p>					

Figure 7.22: The Information of Milne and Choyce (Old Sight at L4)

Address  http://localhost:8080/tip_2.5/mnuLocation.do

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)

Milne and Choyce (From 1950 to 2003)

231 Victoria Street,Hamilton



Sight's Info	Location History	Concepts	Celebrities	Related Sights	Pictures
<p><input checked="" type="checkbox"/> Granite Restaurant (From 2004)</p>					

Figure 7.23: The Current Sight at L4

Address  http://localhost:8080/tp_2.5/historySight.do?hsightid=257937

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)

Granite Restaurant (Since 2004) 

231 Victoria Street,Hamilton

[Sight's Info](#) [Location History](#) [Concepts](#) [Celebrities](#) [Related Sights](#) [Pictures](#)

Granite Restaurant

General

Granite restaurant has been operating since 2004 in the old Milne and Choyce building. The restaurant is open 7 days a week and is a popular choice in the south end of Victoria Street. The facade of the building has been radically altered.

Other Services

[Matched Profile Sights](#)
[Matched Profile Near By Sights](#)
[Change Profile](#)

Figure 7.24: The Information of Current Sight at L4

Experiment 4: Travel by sights

This experiment is to simulate using the system to explore the sights one by one (see Figures 7.25 to 7.32). The user firstly comes to L1, which is "St Peter Cathedral", then the system displays the information page of this sight as Figure 7.25. After that, the user walked to the L2, then the system shows the information page about "The Bank Bar and Brasserie" (see Figure 7.26).

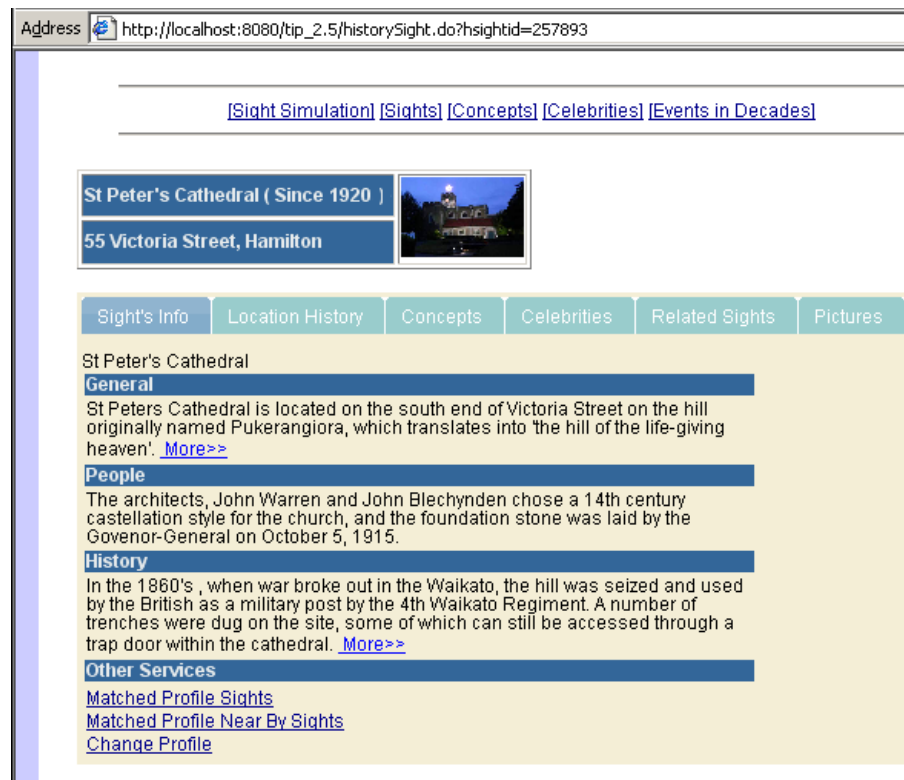


Figure 7.25: Current Sight at L1

As the user walking close by L3, the next information page shows on screen is about sight "Alexandra Building" (see Figure 7.27). When the user is close by the L4, then the system presents the information page about "Granite Restaurant", as Figure 7.28 shows. Lastly, the user walked to the L5, the information page of the current sight "Riff Raff" is shown as Figure 7.29.

Apart from the information page of each sight, the user can find out historical sights of the current location by clicking the "Location History" tab. We take "Riff Raff" as an example, we can know from Figure 7.30 that the historical sights are "The Embassy Thearte (1950 to 1991)" and "The Theatre Royal (1915/3/11 to 1950)".


For the information about those historical sights, the user can click on one of the links. Form Figure 7.31, the user can find out the related person of a sight within the "Celebrity" tab. Moreover, when the user gets into the page for the selected person, the user can find out the related concept of this person.

Address http://localhost:8080/tip_2.5/simulatelocation.do

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)

The Bank Bar and Brasserie (Since 1994)

117 Victoria Street,Hamilton Corner of Victoria and Hood Street



Sight's Info	Location History	Concepts	Celebrities	Related Sights	Pictures
--------------	------------------	----------	-------------	----------------	----------

The Bank Bar and Brasserie

General

The construction of 'The Bank' building on the corner of Hood and Victoria Street played a highly significant part in the development of the commercial and social side of the city. The position of the building on the western side of the river, rather than the eastern, also promoted the majority of business to migrate over the river.

Architecture

The construction of the Bank of New Zealand building situated on the corner of Hood and Victoria Street began on April 9 1877, and was overseen by Edward Messange of Hamilton. The building was eventually completed in late March 1878. The total construction cost of the building came to 3900 pounds, well above the original tender of 2769 pounds 10 shillings, and is believed to have contributed to Edward Messanges bankruptcy in the early 1880's. [More>>](#)

History

The construction of 'The Bank' building on the corner of Hood and Victoria Street played a highly significant part in the development of the commercial and social side of the city. The position of the building on the western side of the river, rather than the eastern, also promoted the majority of business to migrate over the river. [More>>](#)

Other Related Resource

[The Bank Home Page](#)

Other Services


[Matched Profile Sights](#)

[Matched Profile Near By Sights](#)

[Change Profile](#)

Figure 7.26: Current Sight at L2

Figure 7.32 shows that "Theatre" and "shows/movies" are the related concept to the famous person "Richard O'Brien". If the user wants to get back to the information page of the current sight "Riff Raff", the user just needs to click the link "Back to current sight (Riff Raff)".

Address  http://localhost:8080/tp_2.5/simulatelocation.do

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)

Alexandra Building (Since 1903) 

221 Victoria Street,Hamilton

Sight's Info	Location History	Concepts	Celebrities	Related Sights	Pictures
--------------	------------------	----------	-------------	----------------	----------

Alexandra Building

People

Fredrick E. Smith began practice in Hamilton towards the end of the 1800s. It is believed that My Smith was the first full-time architect to work within Hamilton. His style is easily identified and characterized through the use of heavily decorative facades an ornate parapets in the Neo-Classical Mode. [More>>](#)

History

The latter part of the 1800s saw a time of immense growth within the Hamilton commercial centre. The business community moved up from the area around the wharf at the foot of Grantham Street up to the current Hood St and Victoria St intersection. [More>>](#)

Other Services

[Matched Profile Sights](#)
[Matched Profile Near By Sights](#)
[Change Profile](#)

Figure 7.27: Current Sight at L3

Address  http://localhost:8080/tp_2.5/historySight.do?hsightid=257937

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)

Granite Restaurant (Since 2004) 

231 Victoria Street,Hamilton

Sight's Info	Location History	Concepts	Celebrities	Related Sights	Pictures
--------------	------------------	----------	-------------	----------------	----------

Granite Restaurant


General

Granite restaurant has been operating since 2004 in the old Milne and Choyce building. The restaurant is open 7 days a week and is a popular choice in the south end of Victoria Street. The facade of the building has been radically altered.

Other Services


[Matched Profile Sights](#)
[Matched Profile Near By Sights](#)
[Change Profile](#)

Figure 7.28: Current Sight at L4

Address  http://localhost:8080/tip_2.5/simulatelocation.do

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)

Riff Raff (Since 1991)



222 Victoria Street

Sight's Info
Location History
Concepts
Celebrities
Related Sights
Pictures

Riff Raff

General

In 2004, Hamilton City Council honoured O'Brien's contribution to the arts with a statue of Riff-Raff, the character Richard played in *The Rocky Horror Show*, on the site of the former Embassy Cinema. His love of horror and similar genres can be traced back to the countless afternoons he spent watching double feature horror sci-fi films at the Embassy before he moved back to England.

[More>>](#)

People

Richard O'Brien (born Richard Timothy Smith on March 25, 1942 in Cheltenham, Gloucestershire, UK) is a writer and performer. He is best known for writing the musical *The Rocky Horror Show* and its 1975 film adaptation *The Rocky Horror Picture Show*. The stage show has been in almost continuous production since, and the cinematic version is one of the best known and most ardently followed cult films of all time.


Other Related Resource

[Riff Raff Statue Home Page](#)

Other Services


[Matched Profile Sights](#)
[Matched Profile Near By Sights](#)
[Change Profile](#)

Figure 7.29: Current Sight at L5

Address  http://localhost:8080/tip_2.5/mnuLocation.do

[\[Sight Simulation\]](#) [\[Sights\]](#) [\[Concepts\]](#) [\[Celebrities\]](#) [\[Events in Decades\]](#)

Riff Raff (Since 1991)



222 Victoria Street

Sight's Info
Location History
Concepts
Celebrities
Related Sights
Pictures

- [The Embassy Theatre \(From 1950 to 1991 \)](#)
- [The Theatre Royal \(From 1915/03/11 to 1950 \)](#)

Figure 7.30: Historical Sights at L5



Figure 7.31: Related People with Current Sight at L5



Figure 7.32: Related Concept with Richard O'Brien

Experiment 5: Browse sights by time period

In this experiment, we look at how to browse the sights by time period. The screen shots are shown in Figure 7.33 and Figure 7.34. We assume the user wants to look at the sights starts from 1950 (see Figure 7.33). Then a list of sights, which start from 1950, is shown in Figure 7.34. If the user wants to know the information about one of those sights, by clicking the sight name, the information page of the selected sight will be displayed.



Figure 7.33: Specified the Time Period for Sights

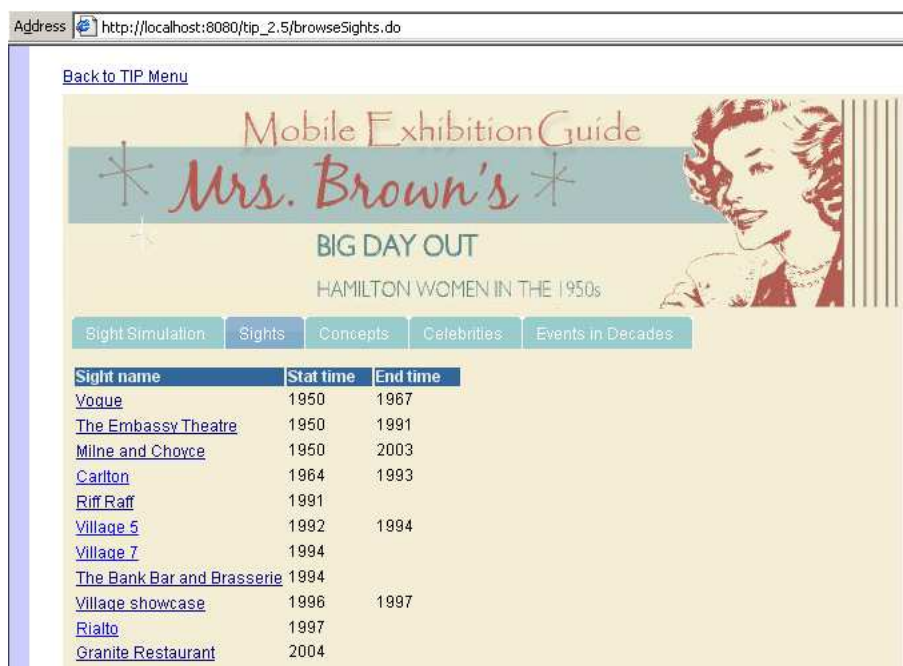


Figure 7.34: A List of Sights in the Time Period

Experiment 6: Browse the sight information by time period

The last experiment is about browsing the sight information by time period. As Figure 7.35 shows, the user can browse the events happen in a certain time period. For example, "Events in 1980s" is clicked, then a list of events is shown with "sight name", "Topic", "Information", "start time" and "end time".

Sight	Topic	Information	Start Time	End Time
Ripples	People	Neil's career, to date, has focused on the production of large-scale, and site-specific, sculptures in New Zealand, Australia and Asia. He is best known for his suspended sculptures, the first of which was Echo in 1981. In 1989, he created his first suspended sphere, Globe, for the exhibition Magiciens de la Terre at the Pompidou Centre in Paris. Neil went on to use the basic form of the suspended sphere in several more works, most notably Ferns, installed in Wellington's Civic Square in 1998 as one of now five suspended sculptures in the capital. He was also commissioned by the Olympic Coordination Authority to produce an artwork for the 2000 Olympic Games in Sydney, the result of which was Feathers and Skies, situated above the main entrance to Stadium Australia. In his hometown of Christchurch he is perhaps best known for Chalice, an 18m-high conical structure installed in Cathedral Square in 2001. Neil describes his work as "an obsession, like it is for the majority of artists," adding that he "continue[s] to be excited by new projects." In the 1998 catalogue for Ferns, Jim and Mary Barr say his work offers a "multiplicity of views that people can create for themselves as they move beneath or around his sculptures," emphasising that while "Dawson has used the interplay of the constant and the serendipitous in many of his works, in the spheres the combination has proved inspiring."		
The Bank Bar and Brasserie	History	1988 Plans submitted to redevelop bank into restaurant and marketplace nothing resulted.	1988	1988
The Bank Bar and Brasserie	History	1980s - Vacated by Bank of New Zealand	1980	1989
The Bank Bar and Brasserie	History	April 1987 - Protection notice issued to prevent destruction or removal of the building so as to avoid the loss of the character building	1987/04	1987/04

Figure 7.35: Screen Shots of Browsing Sight Information by Time Period

7.1.3 Discussion

To conclude the qualitative evaluation, the results of this evaluation are positive: The implementation of the mobile exhibition guide satisfies the high-priority requirements that we identified in Section 4.3. By carrying out the experiments above, the location identification functionality has been demonstrated that the user can retrieve the information about a location when he/she is close by the location. Furthermore, the experiments also examined how the system can present information in a time context: The system can not only provide the information about the current sight, but also inform the user about historical sights in the same location. In addition, the feature of cross-links between different aspects (e.g. sight, concept and people) has been shown by Experiment 1 to 4. Therefore, the user can obtain information from multi-dimensions. Lastly, to present information in different modes has also been demonstrated in Experiment 1 to 4.

In addition to the aspects already shown in the functional evaluation, the system fulfills Ch3 and part of Ch4 (as mentioned in Section 3.1) in the implemented interface and the integration of the TIP services (as described in Experiment 1 and 2). Although the results of this evaluation show the system's functionality, additional qualitative evaluations could be carried out as further research (e.g. usability test). This will be discussed in Section 8.3.

7.2 Quantitative Evaluation

In this section, our focus is to evaluate the performance of the mobile exhibition guide from its efficiency characteristic. We carried out seven experiments on a desktop computer with AMD Athlon(tm)XP 2700+ processor(2.16GHz) and 512MB of RAM. We measure the response time of the system under different parameters. The measured response time represents the average time that elapses from sending out a request to the return of the required data. In our evaluation, the response time(t_r) is calculated by the equation $t_r = t_e - t_s$. In which, t_s represents for the time when the request generated. t_e represents for the time when the required data received. In this evaluation, each the response time is the average of 500 times testing. In addition, we decided to use 10,000 records in the "sight" table as our test data. This is because, typically, the number of exhibits in an exhibition is from several hundreds to several thousands. For this particular exhibition, the number of our test data is an appropriate amount. We carried out seven experiments. In the following subsections, we describe each experiment in detail from test objective, hypothesis, test setting, results and analysis.

7.2.1 Experiment 1: Response Time vs. Number of Sights

The experiment measures the response time depending on the number of sights in the database. Our hypothesis is that the response time will linearly increase with the number of sights increasing. To observe the influence, the test setting is shown as follows:

Variable	Test Data Range	Increment	Constants
# sights	from 0 to 10,000	increasing 1,000 sights	scale=0, close-by sights=0

Table 7.1: Experiment 1: Test Setting

In the setting, $scale=0$ represents the system use the default area to search the close-by sight. $Scale$ is a factor that is used to indicated the size of the geometric area for searching close-by sights. When the scale is no specified, the default coordinations of the square are defined as $(x - 0.001, y - 0.001)$ and $(x + 0.001, y + 0.001)$. x and y are the coordination of the given current location. 0.001° is equal to 0.111km . $close-by\ sights=0$ means there is no other sights that is near to the current sight within the default search area, which is $(0.111 * 2)^2\text{km}^2$.

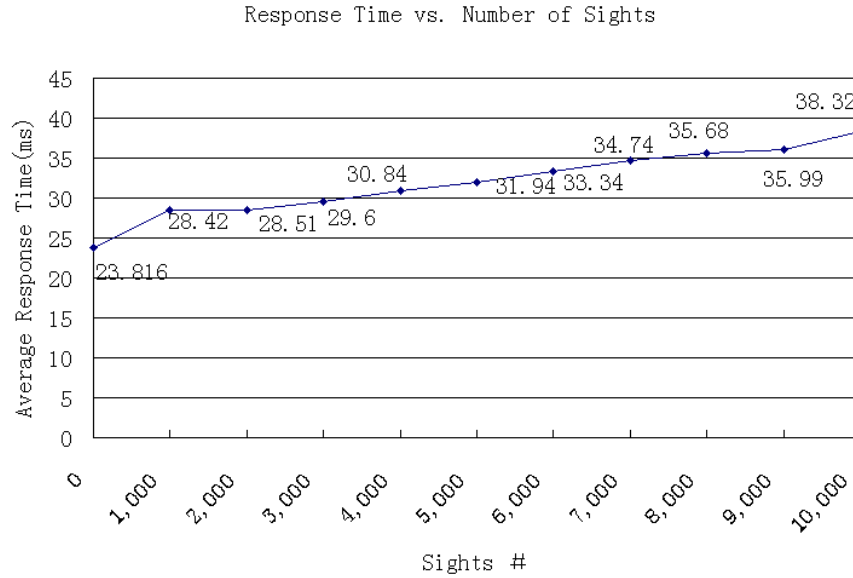


Figure 7.36: Experiment 1: Response Time vs. Number of Sights in TIP Database

(scale=0, close-by sights=0)

The results are shown in Figure 7.36. As it turned out, the overall trend linearly increases with the number of sights increasing. It can also be seen from the figure that the response time at 1000 sights and at 2000 sights are almost the same. The response time slightly increase from 3000 sights to 10,000 sights. The results proved that the number of sights in the system affects to the response time. Our hypothesis is proven.

7.2.2 Experiment 2: Response Time vs. Close-by Sights within Five Scales

The experiment measures the response time depending on the number of close-by sights within five scales. The number of close-by sights increases equally within each scale. That is, the scale does not influence the number of close-by sights. Therefore, our hypothesis is that the response time will linearly increase with the number of close-by sights increasing within five scales. *Scale* is a factor that is used to indicated the size of the geometric area for searching close-by sights. There are two points for defining the geometric area, which coordinations are defined as $(x - scale * 0.002, y - scale * 0.002)$ and $(x + scale * 0.002, y + scale * 0.002)$. 0.002° is equal to 0.222km. The side length of the searched square is $(scale * 0.222 * 2)$ km. The test setting is shown as follows:

Variable	Test Data Range	Increment	Constants
# close-by sights	from 0 to 1000	increasing 100 close-by sights	sights=10,000, scale=1,2,3,4,5

Table 7.2: Experiment 2: Test Setting

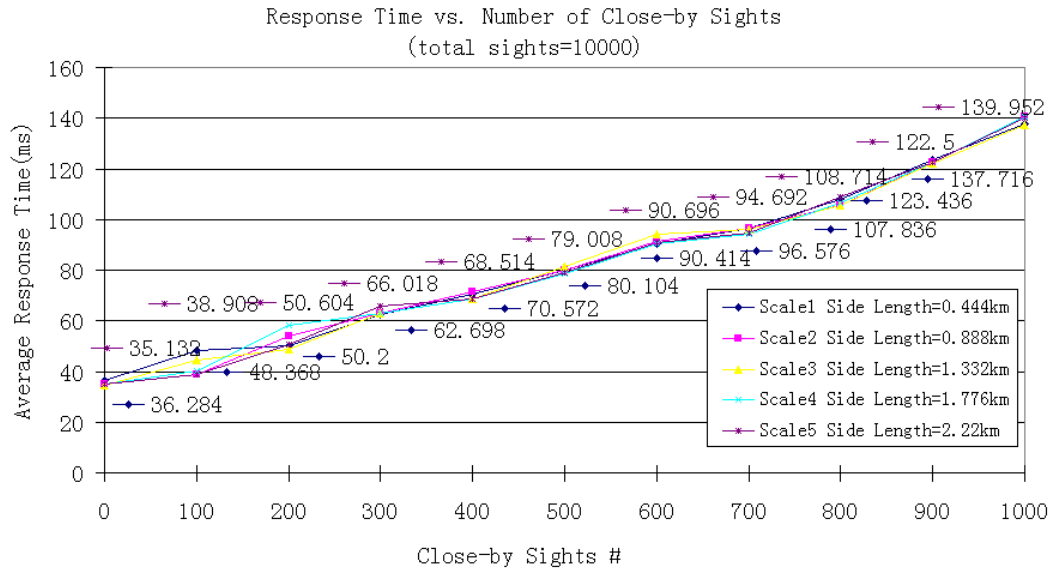


Figure 7.37: Experiment 2: Response Time vs. Number of Close-By Sights within Five Scales

In the setting, $scale=1, 2, 3, 4, 5$ means that we are going to carry out the same test when the scale is equal to 1 (side length=0.444km), 2 (side length=0.888km), 3 (side length=1.332km), 4 (side length=1.776km) and 5 (side length=2.22km), respectively.

The results are shown in Figure 7.37. It can be seen from the figure that the response time linearly increases with the number of close-by sights increasing. Our hypothesis is proven. The increasing rate becomes larger from 700 close-by sights to 1000 close-by sights that a given location surrounding. On the other hand, five lines that represent for one scale of each are almost twist together. In other words, when the test data is linear distribution, the experiment reveals that the increasing size of the geometric area does not play a significant role on the response time influence.

7.2.3 Experiment 3: Response Time vs. Scales with Close-by Sights Evenly Distributed

The experiment measures the response time depending on the scales with close-by sights evenly distributed. Compare with Experiment 2, this experiment analyzes the response time with the scale increasing from different angle. Since sights are evenly distributed, the number of close-by sights within a scale increase relates to the area covered by a scale. Therefore, our hypothesis is that the response time will linearly increase with the square of the scale.

Variable	Test Data Range	Increment	Constants
scale	from 1 to 5	increasing 1 scale	sights=10,000 evenly distributed

Table 7.3: Experiment 3: Test Setting

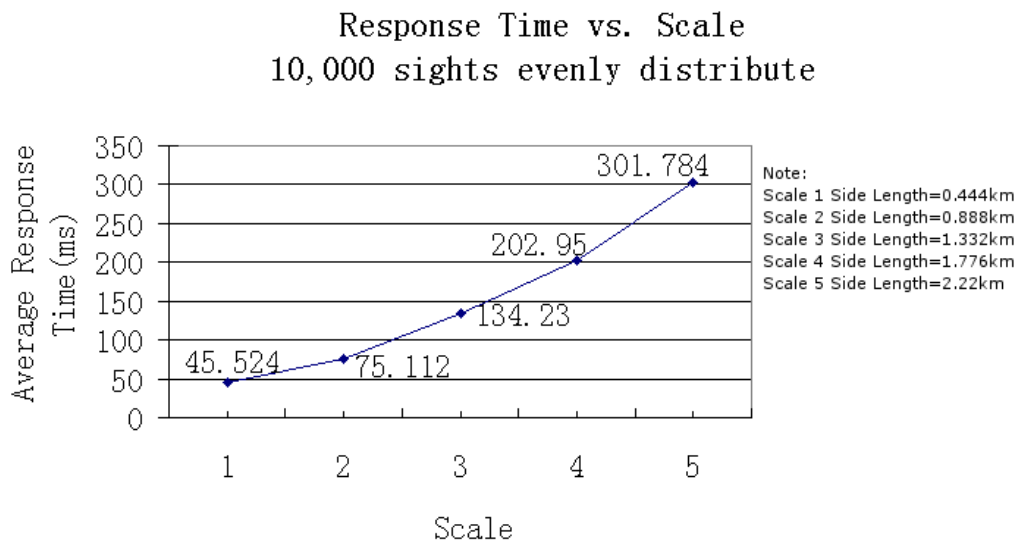


Figure 7.38: Experiment 3: Response Time vs. Scale

Figure 7.38 shows the results. It can be seen from the figure that the response time linearly increase with the square of the scale. Our hypothesis is proven. In addition, compare with Experiment 2, we can find out that the way of the sights distribution affects to the response time.

7.2.4 Experiment 4: Response Time vs. Number of Historical Sights

The experiment measures the response time depending on the number of historical sights. In our system, the *historical sight* means the sights that located at the same location of the current sight and they should have start time and end time. Our hypothesis is that the response time will linearly increase with the number of historical sights increasing. This experiment is used to test the situation when the user clicks on the "Location History" tab as shown in Figure 7.7. The test setting is shown as follows:

Variable	Test Data Range	Increment	Constants
# historical sights	from 0 to 1000	increasing 100 historical sights	sights=10,000

Table 7.4: Experiment 4: Test Setting

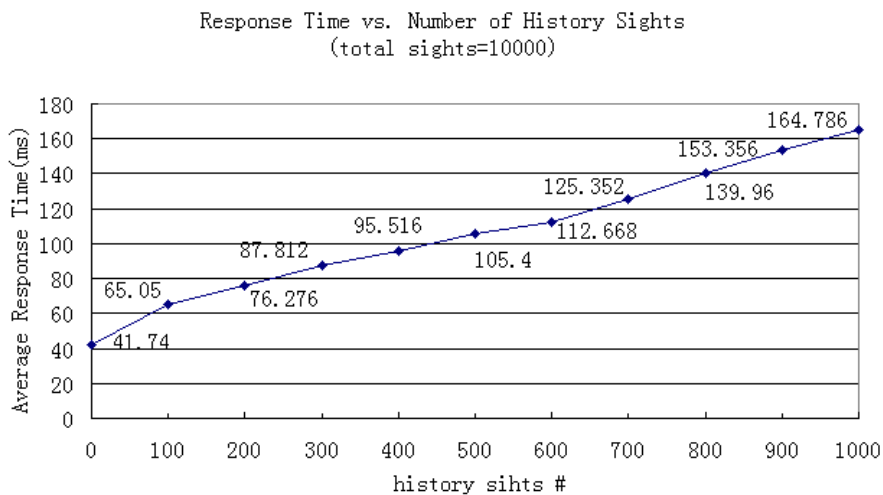


Figure 7.39: Experiment 4: Response Time vs. Number of Historical Sights at the Same Location of a Current Sight

Figure 7.39 shows the results. It can be seen from the figure that the increasing rate of the response time is quite stable. The response time gradually increase from 0 to 1000 matched historical sights. Our hypothesis is confirmed.

7.2.5 Experiment 5: Response Time vs. Number of Related Concepts

The experiment measures the response time depending on the number of related concepts that a sight has. As discussed in Chapter 5, a sight, or a concept, or a person can have relationships with concepts in the exhibition scenario. We test the situation when the user clicks on the "Related Concepts" tab in the current sight page, which is similar with Figure 7.19. Our hypothesis is that the response time will linearly increase with the number of related concepts increasing. The test setting is shown as follows:

Variable	Test Data Range	Increment	Constants
# related concepts	from 0 to 500	increasing 50 related concepts	total 10,000 records contain 5000 sights and 5000 concepts

Table 7.5: Experiment 5: Test Setting

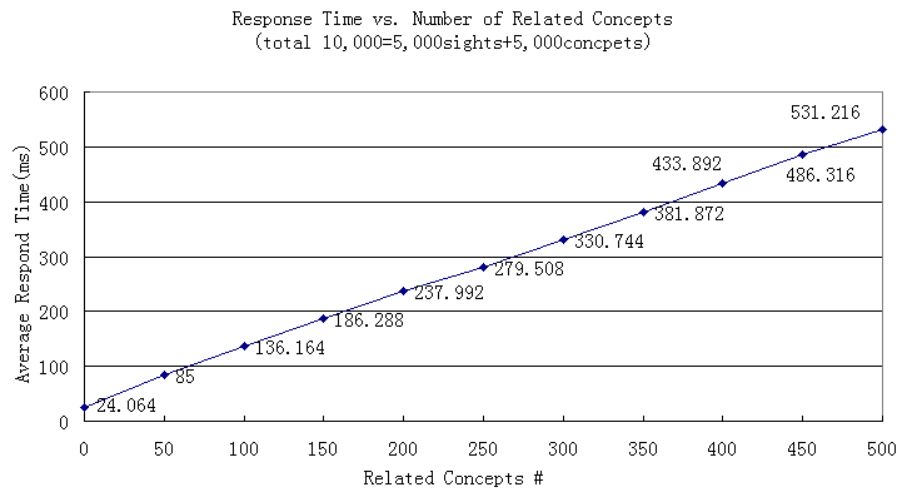


Figure 7.40: Experiment 5: Response Time vs. Number of Related Concepts that Belong to a Current Sight

Figure 7.40 shows the results. The response time linearly increase with almost the same rate. Our hypothesis is confirmed.

7.2.6 Experiment 6: Response Time vs. Number of Related People

The experiment measures the response time depending on the number of related people that a sight has. As discussed in Chapter 5, a sight, or a concept, or a person can have relationships with people in the exhibition scenario. We test the situation when the user clicks on the "Celebrities" tab in the current sight page, which is shown in Figure 7.31. Our hypothesis is that the response time will linearly increase with the number of related people increasing. The test setting is shown as follows:

Variable	Test Data Range	Increment	Constants
# related people	from 0 to 500	increasing 50 related people	total 10,000 records contain 5000 sights and 5000 people

Table 7.6: Experiment 6: Test Setting

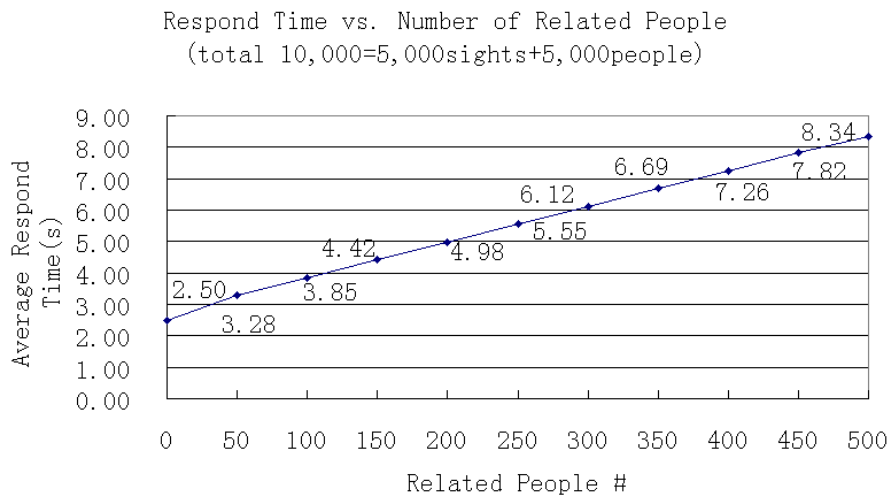


Figure 7.41: Experiment 6: Response Time vs. Number of Related People that Belong to a Current Sight

The results are shown in Figure 7.41 that the response time also gradually increase. Our hypothesis is proven.

7.2.7 Experiment 7: Response Time vs. Number of Related Sights

The experiment measures the response time depending on the number of related sights that a sight has. As discussed in Chapter 5, a sight, or a concept, or a person can have relationships with sights in the exhibition scenario. We test the situation when the user clicks on the "Related Sights" tab in the current sight page, which is similar with Figure 7.21. Our hypothesis is that the response time will linearly increase with the number of related sights increasing. The test setting is shown as follows:

Variable	Test Data Range	Increment	Constants
# related sights	from 0 to 500	increasing 50 related sights	total 10,000 records contain 5000 sights and 5000 related sights

Table 7.7: Experiment 7: Test Setting

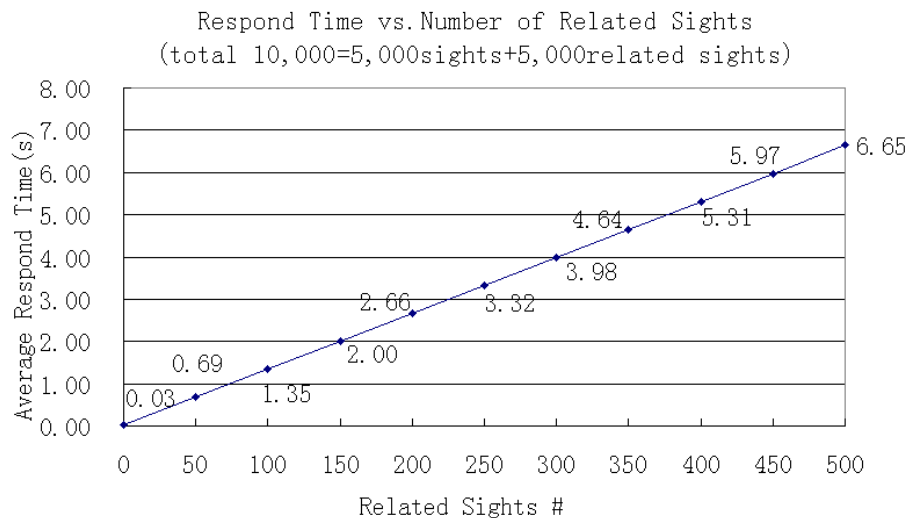


Figure 7.42: Experiment 7: Response Time vs. Number Of Related Sights that Belong to a Current Sight

Figure 7.42 shows the results. similarly, the overall trend of respond time is a linear increment. Our hypothesis is proven.

7.2.8 Discussion

According to the results of each experiment, the response times depending on the variables of Experiment 1 to Experiment 5 are acceptable because they are within milliseconds. However, we discovered that the response time increases significantly when the cross references increase. Take an example from Experiment 7, the response time is 0.69sec when the number of related sights is 50. However, when the number of related sight is 500, the response time becomes 6.65sec, which is ten times as much. Therefore, one might need to find another solution for solving with many cross references. Although the response time increases significantly, the result of Experiment 7 is still acceptable for our application. Since, in the particular exhibition in Hamilton, the number of related sights would be at most around 50 or 100.

7.3 Summary

In this chapter, we have evaluated the mobile exhibition guide from two aspects. The functionality has been proven that the mobile exhibition guide achieved the high-priority requirements defined in Section 4.3. Moreover, we also fulfilled Ch3 and part of Ch4 that identified in Section 3.1. We also measured the response time of the system from several experiments. We describe further aspects that could be evaluated in Section 8.3.

Chapter 8

Conclusion

In this chapter, we draw a comprehensive conclusion to this project. First of all, we summarize the achievements of the project in Section 8.1. Furthermore, there are still open problems that exist in the project, which are discussed in Section 8.2. Lastly, we identify the possible future work in Section 8.3.

8.1 Summary

As stated at the beginning of the report, our project goal is to develop the mobile exhibition guide for the outdoor part of the exhibition "Mrs Brown's Big Day out". By analyzing the typical exhibition guides, other mobile exhibition guides, general mobile guide and the TIP system that developed by our research group (ISDB), we realized that there are a number of advantages that a mobile exhibition guide has and there are a number of commonalities between the TIP system and the mobile exhibition guide. More importantly, the TIP system has a number of features, such as location awareness, mobility, and personalization, which could be applied to the outdoor exhibition scenarios. Therefore, we proposed to develop the mobile exhibition guide by re-using the framework of the TIP system and to develop corresponding services for this particular exhibition. As a result, the features of the TIP system will be beneficial to the proposed mobile exhibition guide. In addition, as a research group, it is an rare opportunity for us to examine the possibility of re-using the TIP framework within other application areas.

Although, from the analysis process, it was proven that re-using the TIP framework is possible and feasible, there were still some challenges that we were facing. Our main concerned challenges in this project were:

- *Ch1*: To identify requirements that visitors and the exhibition organizers have.

- *Ch2*: To model the exhibition data into the TIP database.
- *Ch3*: To present the information under this specific exhibition circumstance.
- *Ch4*: To analyze what should be modified on the TIP system in order to tailor to the requirements of the mobile exhibition guide.

In order to achieve that, we carried out a number of development steps. Firstly, by carrying out the scenarios analysis, we have found out a list of requirements and we categorized the requirements into three different priorities. At that point, Ch1 has been achieved. Since we identified that the high-priority requirements are our main focus in this project, in design process, we comprehensively analyzed the exhibition example data to extract out the exhibition data structure.

Secondly, we identified the similarities between the exhibition data structure and the TIP data structure. As a result, we took the advantages of those similarities to map the exhibition data structure into the TIP database. The mapping strategy has made necessary modifications on the TIP database in order to re-use the TIP database structure. We have quite successfully fulfilled Ch2, which is the most challenges because of the unknown exhibition data. However, there are still unsolved problems in modeling the exhibition data, which is discussed in next section.

According to the design of the system, we have embedded the mobile exhibition guide into the TIP framework. In addition, we developed the information service in the proposed system. The information service allows the user access the sight information from multi-dimensions (sight, concept, people and time). As a result, the users can know more about the building heritage in Victoria Street while they are walking on the street with the mobile exhibition guide. Moreover, we re-used the basic recommendation service and the basic itinerary service in the TIP system, which provide the recommendation based on their profile and the famous people's itineraries to the users. Apart from that, we decided to use TabletPC as the device of the mobile exhibition guide, which overcome Ch8 and Ch5.

Lastly, in the evaluation process, the mobile exhibition guide has been shown to achieve Ch3 and part of Ch4 in terms of functionality. In addition, we also examined the response time of the system. We found it appropriate for a typical setting. Further ideas of how to evaluate the system more comprehensively are discussed in Section 8.3

8.2 Open Problems

Despite having addressed those main challenges and the high-priority requirements, some problems remain unsolved. We identify the following open problems:

- Since the exhibition data is given in an unstructured and unstandardise format, sometime, it is hard to extract the data from a text file and store into a proper place in the TIP database. Especially, when we store the time period of a sight or of the sight information. For example, the information "Pre 1953", we cannot express the meaning of "Pre" in the "starttime" attribute in the "information" table or the "sight" table.
- Since the services in the TIP system are not completely independent to the system, we could not fully re-use all the TIP services into the mobile exhibition guide. We had to modify each of the services. We may find out a more efficient way to re-use the TIP services.
- We discovered that the response time increases significantly when the number of cross references increases. Although, in reality, exhibition data might not have so many cross references, we still need to find a solution for the special cases that rely on large number of cross references.

8.3 Future Work

Throughout the development of this project, we realized that there are still a number of future work that could be done, which are list as follows:

- To develop a service for information provider, which should be able to provide an efficient way to identify the information and store into the TIP database.
- To fulfil the challenges Ch5, Ch6, Ch7, Ch8, and the medium and low priority requirements. As, in this project, we developed an basic mobile exhibition guide. In order to develop an more comprehensive mobile exhibition guide, those medium and low priority requirements should be researched further.
- To evaluate the mobile exhibition guide from different perspective. For example, we could evaluate the system from an HCI (Human Computer Interaction) perspective. Since we are not HCI researchers, the more comprehensive HCI evaluation should be taken by the researchers or in cooperation with researchers from that field.

- To have closer cooperation with the Waikato Museum. Mobile exhibition guide will be one of the new trends in exhibition service, closer cooperation with the information providers will allow the mobile exhibition guide to have more comprehensive development in the future.

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Appendix A

Database Structure of TIP

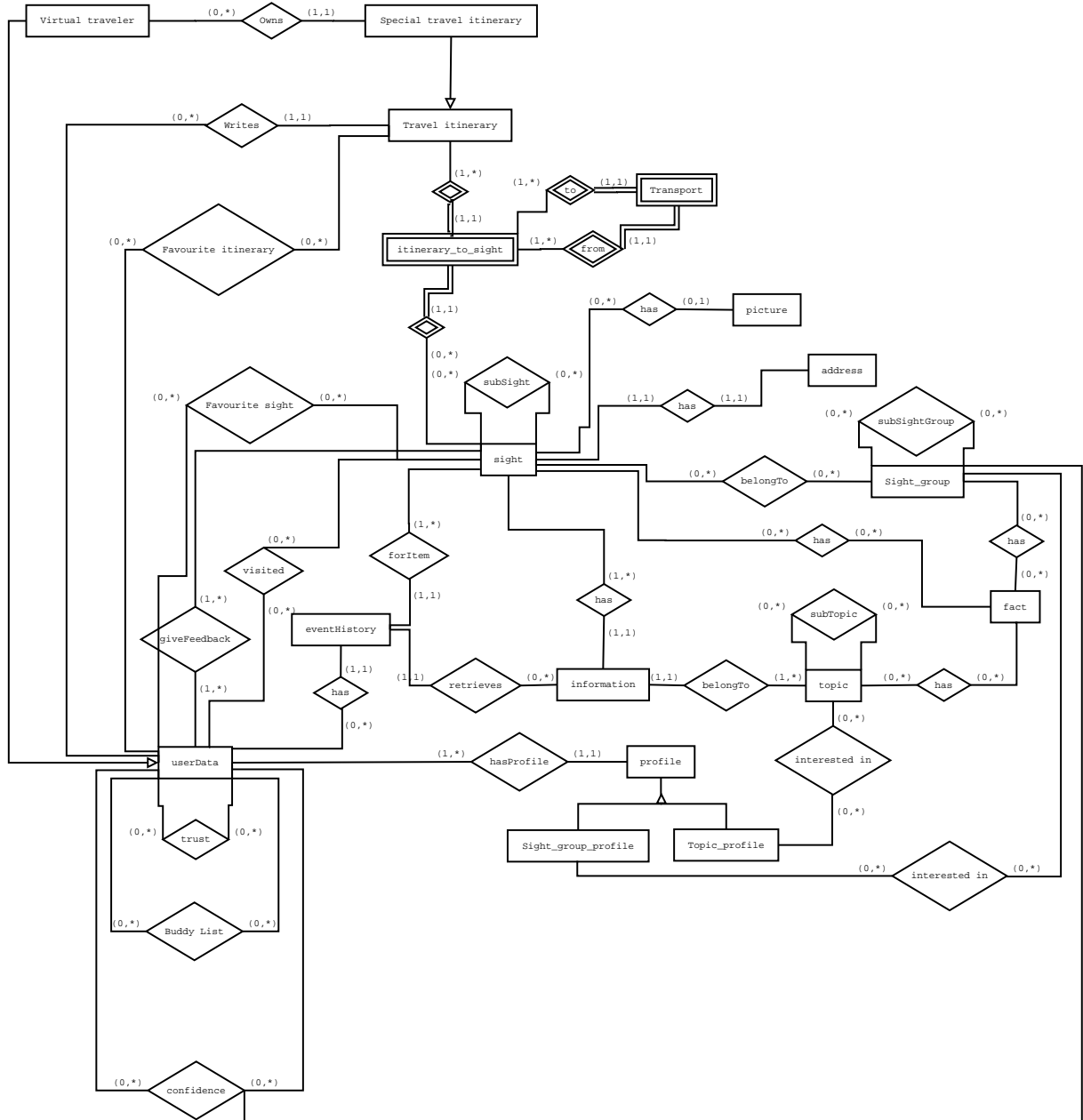


Figure A.1: Entity Relationship Diagram of the TIP Database

Appendix B

New Database Structure of TIP

Appendix C

Example Exhibition Data Information

The following information is provided by the Waikato Museum.

Milne and Choyce:

History of founding families:

The Milne Family

The Milne family originally came from Coalisland within the County of Tyrone in Northern Ireland. On 1 August 1863, the Milne family set sail on the Queen of Mersey from Gravesend Port, England for the colony of New Zealand. Arriving in early 1864, the family settled in Auckland.

The family consisted of the parent, James Stuart and Margery Milne and five children, Mary Jane, Charlotte, Robert Dawson, James Dawson and John Stuart. It is highly probable that Mary Jane began work almost immediately after arrival. She was employed as head milliner in the soft-goods store which had been started by Robert Graham and his brother in 1845.

This gave Miss Milne an insight into the operation of local business, including the trading and banking connections of the town and the appreciation of the value of customers. This business experience no doubt gave Miss Milne the motivation and confidence to set up her own business in July 1867, with the help of her younger sister Charlotte.

The remainder of her family didn't become involved with her business venture. Her younger brothers, Robert Dawson, James Dawson and John Stuart each took up individual occupations that led them away from New Zealand. The only family member within the business, other than Charlotte, was young John Stuart, born 1st September, 1880, who took over the business upon Mary

Jane's retirement in 1908, with the help of Mr. Henry Charles Choyce.

The Choyce Family Connection

Mr. Henry Charles Choyce met Miss Mary Jane Milne through a buyers position within the firm, Archibald and Son. Archibald and Son were the main supplier of Miss Milne's business. After a courtship, the two eventually married and Mr Choyce entered into the business in a formal partnership.

What to wear or what not to wear - that is the question

Why was Milne and Choyce Significant?

Milne and Choyce was a significant fashion provider within, during and up to the 1950s. It sold goods including; skirtings, silks, furs, velvet, tweeds, corsets, suit, ties, baby clothes and linen and the like. The company was highly respected for its good quality clothing at reasonable prices and was often the store of choice. The selection was always plentiful and often helped to introduce the fashions from overseas into the New Zealand market and culture.

Milnes and Choyce in Hamilton.

- Location
- Date of Opening
- Closing

Women, Clothes and Shopping

A day out shopping for women during the 1950s was quite an occasion. Generally these days would be well planned and spent gossiping and catching up with a few friends. Money would generally have been saved from their personal allowance (from their husbands), or possibly obtained through part/full time work.

Typical Purchases:

Purchases were very similar to those of today, though excitement was centered around the multitude of time saving devices that were being released into the market, such as washing machines, vaccumn cleaners and the like. Another exciting appliance released within the 50s was the black and white television, though this was not properly underway nationwide until the 1960s.

Fashions in the 1950s.

Photos

Characteristics

Women and Money

Prices?

Television.

Television, within its early stages, consisted of one channel. This consisted of general audience shows, and would begin viewing around early afternoon and shut down late evening. Families with televisions would often find themselves quite popular in the afternoons and lounges were often filled with friends and classmates of their children.

Personal narrative.

When ever there is an argument over the TV, my father always recites the same old story from 'back in my day'. He tells the story of the average weekday afternoon. As my fathers family were the only family to have a TV in town (for a while at least), my father and his siblings quickly found themselves with a number of new friends. Nearly every weekday after school, students from the local school would pour into my fathers lounge and settle in to watch the television. Due the culture of the time, these visitors were always welcome, and often supplied with a quick sandwiche for afternoon tea, and even sometimes dinner. The entire group would sit happily together on the floor, watching the one channel, until one by one they were dragged home by their respective parents. My father remembers these early childhood days happily, except for one minor problem, ice cream always ran out in one sitting. Kirsty Evans-McLeod