A Service for Audio Icon and Audio Books in the Mobile Tourist Information System (TIP) via the Greenstone Digital Library

A thesis

submitted in partial fulfillment

of the requirements for the degree

of

Master of Science in Computer Science

at

The University of Waikato

by

Xin Gao

Department of

Computer Science

7 March 2007

Abstract

This project provides an audio notification about nearby tourism place to visit (named sight in this thesis), a chapter based Audio Books related to the current sight and involving Digital Library to provide text for the Audio Books for the Tourist Information Provider on a mobile device (TIP). The current system plays a background sound for the sight only when the system displays the specific information for that sight after user selects it. This has been improved to provide a notification by which to receive audios from the recommendation service, and then keep sending audio data to clients on real time. So users can know the sight nearby before they look at their screen. The limitation of current Audio Books is that it only provides Audio Books when the books start from the current sight. This problem is solved by providing a list of books that has any chapter related to that sight, and users can add them into a now-playing list. The Travel Planning Service has been involved to place the Audio Books chapters into the now-playing list based on the order of the visiting sight in their plan. The TIP/Greenstone Service, which can load particular text from Greenstone Digital Library into TIP, has been involved in this project to provide related chapter-based text for those Audio Books. The implemented prototype has been evaluated on effeteness and performance based on the purpose of this project. The result has been discussed to prove it has effectively solved the problem described above. Finally, the result of the experiment on distinguishing audio, and technology for implementation and audio transfers, has been left for future study.

Keywords: Audio Icon, chapter based, Audio Books, Greenstone, Tourist Information Provider (TIP).

Acknowledgement

Firstly, I would like to thank my supervisor Annika Hinze and my co-supervisor David Bainbridge for their supervision of this thesis. Form my dissertation to the end of this thesis they have been providing valuable support and guidance.

I would also like to thank Katherine Don for help me to solve my technical difficulty about the Greenstone Digital Library.

I give thanks to all the people in the Information System and Database Group of the University of Waikato for involving me as a developer of TIP system. I would like to specifically thank Quan Qiu for the help that let me to know the unacquainted TIP system right at the beginning, and Xiaotie Huang for introducing his system to let me access the Travel Plan Service easily.

I would like to thank those who participated in my user survey for completing the questions and putting forward excellent ideas.

I would like to thank John Hillary for proofreading my thesis and helping me with my English writing.

Many thanks to all of the academic staff of the Computer Science Department for teaching me and give me valuable knowledge over the last two years. I would also thank all of the general staffs in the University of Waikato for providing a wonderful environment for my studies.

My stay in New Zealand is supported by my parent who I should thank for giving

me a chance to let me study in New Zealand for some years.

Last, but not least, I would like to thanks all the friends and teachers who was kind to me during my studies in New Zealand.

Table of Contents

List of Figures

List of Tables

Chapter 1

Introduction

The development of telecommunication and computing technology has made more and more practical information available on the Internet. And it is faster and more plentiful than any physical library or information centre. The advanced mobile technology allows people to use the Internet on their mobile phone or their Personal Digital Assistants (PDA) in the same way as it is on the desktop computer. This means they can access the Internet from their mobile phone or PDA to view information on the web, use online banking, book a hotel or check flight timetables, even being able to watch live TV. When the mobile location system and the Global Positioning System (GPS), which has been widely used in traffic direction systems for boat or plane, are developed into mobile phone and PDA, information can be delivered to people based on their current location, such as the local time, weather, and news.

This fast developing mobile phone technology has brought many information systems into the mobile phone. The information can be delivered based on their current location and their personal context. There are many existing examples in today's real world. Hotels.com is a web site, available from both desktop and mobile phone, for tourists to book their hotel rooms around the world. What tourists need to do is to turn their GPRS enabled mobile phone on and explore the hotels.com web page. The system stores information on about 70,000 hotels, including location, check in times, and the number of rooms and guests. The site includes sorting options, and pictures of properties can be viewed. When tourists find their chosen hotel they can just click the book icon to book the room. That

makes it unnecessary to print and carry the itinerary with them because they are all available on their mobile phone.

The other example is the MSN, which is used widely as online chat software. If users have a wirelessly enabled mobile phone they can download and install MSN Pocket to make the MSN service available from their mobile phone. Users can use their mobile phone to access their hotmail to send and receive mail. The inbox is updated on real time. MSN Messenger is also available on this package. Users can send and receive messages and view online content by their mobile device. So they can connect with their buddy anytime even if they are not in front of their computers. Mobile technology allows people use the Internet anywhere and thus improves information delivery by making it available without the limitation of location.

Tourists using a mobile tourist information provider can therefore receive more information for their travel and do not have to rely on physical guidebooks, maps and real guide persons. The application of the mobile tourist information provider can give tourists recommendation of sight based on their interest and some other physical conditions, such as weather and time. In additional, digital libraries, Audio Icons, and Audio Books, have been developed to help the mobile tourist information system. The Digital Library service helps the system to provide more information for tourists, a situation that is similar to a tourist carrying some additional books about the place they travel to. So they do not need to carry so many heavy books with them when they travel. Audio Icons will play automatically as a route sign to tell users they are close to some place without users having to ask. Therefore they will never miss any interesting point, a situation that is similar to a real guide person to notice tourist some sight is close by. Audio Books are able to provide audio of books related to the users' current location, a situation that is similar to a real guide person telling about the place.

This chapter will introduce the existing Audio Icon and Audio Books Service and the Greenstone Service. The problem with the service currently employed in the Tourist Information Provider (TIP) will be identified. Then the usage scenarios of the new system, which is going to be an evolution from the current system, will be described, and finally the needs for the new system will be identified.

This thesis covers three main functions, which are Audio Icon, Audio Books and Digital Library. So the name Audio Icon Service, Audio Books Service and Greenstone Service may be used when the single function is being described.

1.1 The Current System

The Audio Icon and Audio Books Service and the Greenstone Service, have been implemented rudimentarily. The service they provide can only support a part of tourist needs.

1.1.1 The Existing TIP

The Tourist Information Provider (TIP) is a mobile tourist information provider that delivers tourist information about sight based on the user's context, including the user's current location, profiles describing their interests, and their travel history (Hinze, Malik & Malik 2006, Hinze & Buchanan 2006). Users need a wirelessly enable mobile phone or PDA to receive the information, a situation that is similar to people accessing the Internet on their mobile devices. GPS on users' devices provide user's current location for the system, so the system can provide

information about sight that are near the users' current location. The main function of TIP provides information about sight. When users arrive a particular place there are many sight around them, such as cathedrals, sculptures, and buildings. Users can identify their interests in their profiles to receive information about the sight that interest them. So TIP only delivers information about sight based on users' interests and filter out other information. Some of the contexts are demanding other information such as weather and time. This also applies to the delivery of information about sight.

The TIP system provides many services such as a map service, recommendation service, greenstone service, and so on. The map service can provide a map to tourists and indicate their current position on the map (Hinze & Voisard 2003), and also gives basic information, recommendation information, and future information. The recommendation service can provide information for tourists based on their interests, their travel history, their current location, and recommended sight that other users liked who had similar interests to the current user (Junmanee 2005). The TIP/Greenstone service thus basically helps the TIP to provide more information for tourists, a situation that is similar to a tourist carrying some additional books about the place they travel to (Gao 2005).

1.1.2 The Existing Audio Icon and Audio Books Service

The existing Audio Icon Service has been implemented into the TIP. When users arrive at a particular location the system provides a list of recommended sight names on the screen. When a sight is selected, the system plays the sound that is based on the user's current location, as with the location service of TIP. The content of sound will be related to the background environment.

A) Missing Direction Problem

The Audio Icon was originally designed to play automatically, and should do this as a direction, which is similar to a guide person who tells tourists some sight is getting closer to them. However, the current Audio Icon has to be clicked by users to play the audio, after they already know the sight is close by. So the present Audio Icon service does not function until tourists notice themselves that new sights are getting closer.

The existing Audio Books Service has been implemented into TIP. This service can provide a list of books, as does the Audio Icons, which are related to the tourists' current location. The service gives the user choices to select a book to listen to. The service plays the book and gives information about it, such as the author and publisher.

B) Chapter Sequence Problem

The played books are related to the user's current location, but some chapters of the book could relate to other locations. Users naturally only want to be played the chapter related to their current location. So, if the chapter related to the user's current location is placed at the end of the book, the user has to listen to the whole book.

C) No Text Display Problem

The audio file is stored in the database as an MP3 file without the text of the books. The books in text are not supported by the system. Therefore users are unable to read the text of the played books.

1.1.3 The Greenstone and Existing Greenstone Service in TIP

The Greenstone Digital Library is software that is used to create, maintain, present, disseminate, build, and distribute digital collections (Don, Bainbridge & Witten 2002). This software is a tool to build a Digital Library. Users can build from their own information into their own Digital Library. Many file formats are accepted, such as Microsoft World, PDF, or text. The Digital Library built by Greenstone is available from the Internet. End users of Greenstone can search the information in the collections, a situation that is similar to using a search engine on the web. The users of Greenstone can be other software instead of human users. TIP is one of the systems which can be a user of Greenstone. TIP will ask the pre-built Greenstone Digital Library for information about a user's location, and pass the information to the user. So users can receive the information in the Digital Library that contains tourist information, a situation that is similar to a tourist carrying some additional books for their travel.

Free Eyes Needed

The text of books is displayed on screen for tourists to read, so tourists have to keep their eyes on the screen. But they will want to look around when they travel. Thus it is necessary to connect the books in text to Audio Books so their eyes are free when they travel with their TIP enabled mobile device.

1.2 Application Scenarios for the New System

The problems of the current Audio Icon and Audio Books Service and TIP/Greenstone Service have been identified above. More functionality needs to be added to the current Audio Icon and Audio Books Service. The following

application scenarios present the new functionalities of the new system that can solve the existing problems in the current Audio Icon and Audio Books Service and TIP/Greenstone Service. These application scenarios are used as reference scenarios throughout this thesis.

Tom, who is an overseas tourist, arrives in Hamilton without any tourist guidebook, but he does have a wirelessly enabled mobile phone with him. He decides to have a look at the city centre this afternoon and go to another place in Hamilton tomorrow. He stops at the Hamilton information centre to ask for some tourist information. The reception person advises him to access the TIP system, and then use the new version of the Audio Icon and Audio Books Service and TIP/Greenstone Service. He signs up to TIP by filling the new user details and logs into the system. When he gets to Victoria St. he switches the TIP system to the Audio Icon and Audio Books Service. He puts his mobile phone into his pocket with out any thought. When he walks close to a sight the system plays a sound to bring to his notice that some sight that interest him are just nearby. Tom can pay attention to his mobile phone and click on the TIP system to see what is close to him. He finally finds the actual sight that is displayed by the system. When he hears his mobile phone sound beeps his look at his mobile phone again. The system shows a book chapter about this place is available, so he clicks to play this chapter of the book related to his current location. He can walk along the street and look around while listening to the book. When he wishes to read the text of the book he clicks a link on the screen to go to the TIP/Greenstone service. This service displays the book text for him to read. So Tom never misses any sight even when he does not pay attention to his mobile phone.

In this application scenario the Audio Icon and Audio Books Service can give the user notice without them having to ask. That is the missing functionality of the current system. The Audio Books can be played to users based on particular

chapters of their interest, rather than the user having to listen to the whole book. The TIP/Greenstone service allows users to read the text version of the books in audio by simply clicking a link on the screen, thus dealing with the missing functionality that users cannot find the text of Audio Books. So the problems of the current system have been fixed in the new application scenarios.

1.3 The Structure of this Thesis

This thesis starts with an introduction of this thesis. The chapter starts with the situation of using a mobile device, and of the current TIP system and other related systems. The user scenario for new TIP system is explained to give user a general ideal about the Audio Icon and Audio Books Service.

The second chapter covers the background of the service, include the concept of Audio Icon, Audio Books and Digital Library. It also describe the current TIP system specifically, including a user scenario to show its usage, TIP core concepts about the design idea, its architecture, and the technical detail to prepare for the implementation..

Chapter 3 is used to provide a user scenario for the new Audio Icon and Audio Books Service. This scenario will show the functionality of the new service and provide the idea for the requirement analysis and design.

An analysis will follow of the functionality requirements in Chapter 4. All of the necessary requirement will be detailed and made ready for the design of the new system in later section.

The related works will be presented in Chapter 5. Those will reference many

existing system that has similar functionality with the new Audio Icon and Audio Books Service. Some experience will be extracted form those existing system. The knowledge from the experience will be used to design our new Audio Icon and Audio Books Service for TIP system.

In the Chapter 6 will be a describe of the design of the new Audio Icon and Audio Books Service based on the analysis result, the functionality requirement, and the experiment from similar existing systems.

What will be provided in the Chapter 7 is the implementation detail for the implemented new Audio Icon and Audio Books Service via Digital Library, include the architecture.

Chapter 8 contains the evaluation detail include the qualitative evaluation about the functionality test and the quantitative evaluation for the implementation of the project. Figures and data will be provided to present the evaluation.

Finally, we will summaries and conclude this whole project at the last section of this thesis. Future development will also be discussed in this section.

Chapter 2

Background

In this chapter we introduce the concept of Audio Icon, Audio Books and Digital Library. The usage of the three concepts will be analyzed to identify the possible solution that they work with TIP system. In the next, we review TIP system include the existing Audio Icon and Audio Books Service and Greenstone Service.

2.1 Concept of Audio Icon

Audio Icon is a kind of icon on user interface of software which can present audio when it is clicked. It usually is used on some situation which direct user there are a piece of audio available. The presented audio related to the text which around the Audio Icon. Users use the Audio Icon when users already know what the audio is but they do not know what the sound hear alike. Such as, people use Audio Icon to listen to the pronunciations of some foreign words which are found in dictionary software.

The Audio Icon used in our project is different with normal Audio Icon. The Audio Icon is used to alter user to pay attention to their device and give them a general ideal about the meaning of audio by presenting the audio. More functionality will be added to the normal Audio Icon, such as selection of audio, anti-overlap and other requirements. This will be introduced in the Functional Requirements chapter of this thesis. In this situation we may name it as audio alter,

but we still use Audio Icon in this thesis to keep the same with previously version of Audio Icon Service which describe in later section of this chapter.

2.2 Concept of Audio Books

Audio Books are a kind of audio recorder of book reading in electronic format. The electronic signal can be saved on CDs, tapes or files of computer. When people use Audio Books they do not need to look at the text of the book. This is usually used to free reader's eyes for some blind and partially sighted people or for some people who need their eyes free. Audio Books are widely used in language learning process with text of the books attached on.

The Audio Books used in our project are in the case of making people's eyes free when tourist on their travel route. The audio files loaded from wireless network need to be played in tourists' mobile phone or PDA. More functionality will be the new Audio Books in our project to make the service are available for tourists. That which is about more functionality will be introduced in the Functional Requirements chapter of this thesis.

2.3 Concept of Digital Library

Digital Library is an information management tools for digitized collection. People can use it to create their own digitized collection with services. Users can search information and knowledge by several kind of search provided by Digital Library, such as full text search, search by title and search by author. Greenstone which is going to be used in this project is one of the digital libraries.

The Digital Library in our project will be used as a server to provide some tourist information based on the query that passed by TIP system. The greenstone itself will not be modified in this project. Some interaction between the Digital Library and TIP system will be developed in this project. More descriptions about this will be explained in the Functional Requirements chapter of this thesis.

2.4 Current TIP

The background of TIP will be described in this section. This section will cover the basic usage of TIP with a usage scenario, the core concept of TIP, the Architecture of TIP Service and the technical detail of TIP.

The Tourist Information Provider (TIP) (Hinze & Buchanan 2006, Hinze & Voisard 2003) combines an event notification service and a location-based service to deliver tourism information to users on their hand-held devices. The users' interests are identified in their profiles, such as the route to the nearest restrung which fits users' food style. User current locations can be identified by GPS on their mobile devices, so TIP can provide tourist information based on the user current location. Whenever the location of the users is changed, a notification will be send to users' device to new information. When a user arrives at a particular place, the information about this place that matches their profile will be sent to them. Users will not get the same information each time, except when they want to review some loaded information. (Hinze & Voisard 2003) The delivered information should be limited in size and focused in content due to the limitations of the display device. So the dynamic information should be presented to user as one event. To provide an event-based communication, TIP supports selecting relevant dynamic information to deliver the mobile device user. So TIP can

deliver information based on tourism needs.

2.4.1 TIP Usage Scenario

A story about a tourist named Tom who was appear in the early sections of this thesis will be told to explain the usage of TIP. Tom wants to have a look the plant and animal world in New Zealand. In this usage scenario he only used the location service of TIP which is the basic function of TIP.

Tom arrived in Hamilton with his mobile phone which had been set up for a TIP client. He planned a trip to Hamilton to see New Zealand plant and animal life. He set up his sight type profile as a garden and zoo to describe the sight of event, and also set up his topic profile on botany and zoology.

When Tom arrived at the gate of Hamilton Gardens TIP system had delivered the general introduction of the Garden, such as the number of the garden collections and their design purpose. When he walked into one of the garden collections TIP system provided the information about this garden collection. Additionally, he found he could browse the information on garden collections around this current location to decide whether to go to that garden collection or not. When he finished his garden visiting he planned to visit Hamilton Zoo the next day. During this process Tom can only get the information which is based on his profile and current location; for example the information about the cemetery in Hamilton Gardens, which is not affected by his profile, will not be provided to him.

In conclusion, we can see what kind of information the user needs as additional information delivery. As with the information that is given by TIP system, users need the introductory collection when they arrive in their chosen area, and then

they need some more specific collection information when they arrive at each particular place.

2.4.2 TIP Core Concepts

TIP delivery information is based on users' context, such as their current location, interest in a particular sight group and topics, and their travel history. The location can be a city or a street or a particular building. The sight can be a type of museum or building with an information topic such as history or architecture. The travel history is at the locations the user visits and from the feedback of other users.

TIP Core system combines an event-based infrastructure and location-based service to deliver information dynamically. Figure 2.1 shows the architecture of TIP core system. It has three databases, (1) Profile DB, which is used to store user profiles and system profiles, (2) Events DB, used to store events-related information, and (3) Spatial DB to store sights and other spatial data. TIP Core also includes two main filter engines. These filter engines can select the appropriate information from those three databases, based on users' profile and the location engine provided. (Hinze & Buchanan 2006)

When the mobile devices with TIP client send its new location to TIP server, the filter engine will load users' profile and sight context from the Profile database. The event, which is only relevant to users' profile and sight context, will be loaded from the Event DB. The location engine will provide geo-spatial functions. When the information based on users' profile and sight context is ready it will be sent to the user.

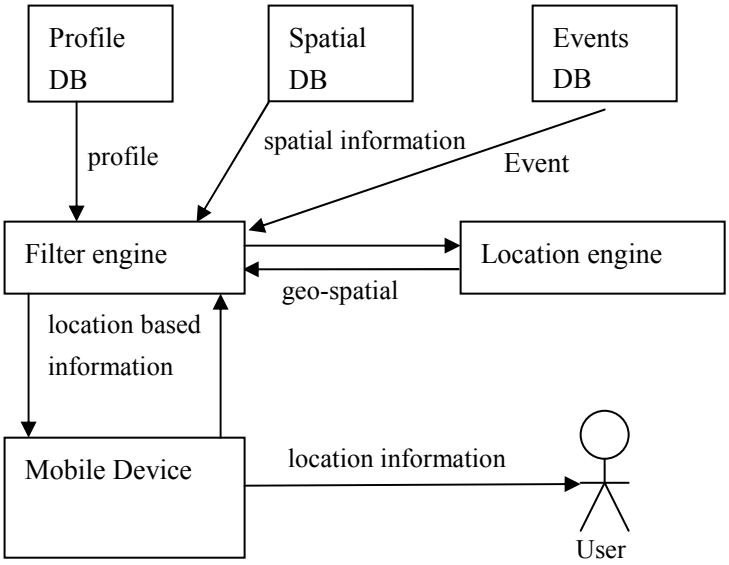


Figure 2.1. Conceptual architecture of TIP

2.4.3 The Architecture of TIP Service

TIP service is designed as a layered conceptual architecture, which includes a Service Layer, Communication Layer, and Data Layer, as the Figure 2.2 shows. The supporting interactions of different applications via those layers enable TIP system to connect many different services, such as the GPS location service, map-based display service, recommendation service, and TIP/Greenstone Service.

The communication layer provides all communication based on a one event message. The message can be transferred to the respective components or services on this layer. The Data Layer is used to restore data such as user and event data, which are related to sight data based on location. That data is often

time-dependent; for example opening hours could differ in different seasons. The Service Layer provides an interface for different types of service. Those services can be used by the end user as well as provide interaction between users and TIP system.

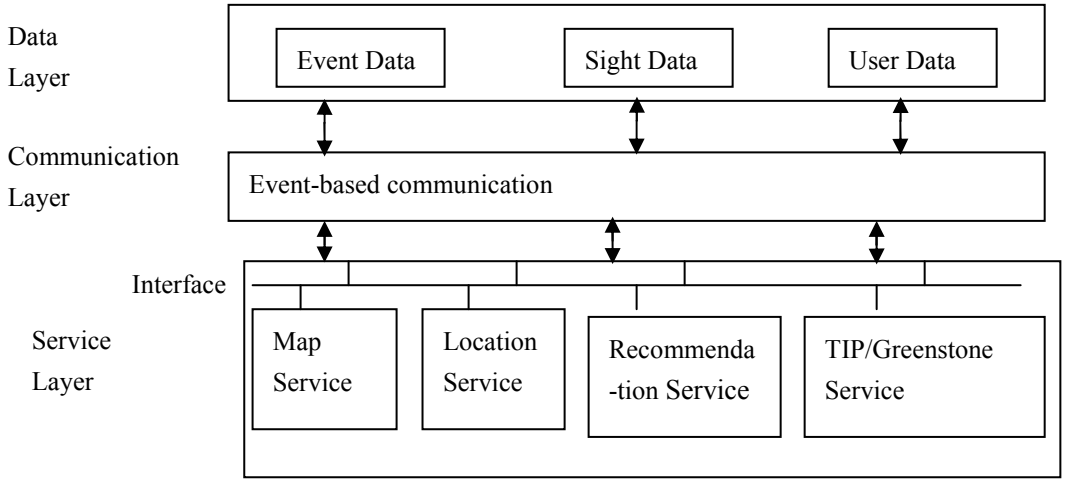


Figure 2.2. Design of TIP

(Based on Hinze & Buchanan 2006)

2.4.4 Technical Detail of TIP

TIP server uses the PostgreSQL database to implement its own database. It uses Apache's Jakarta Struts framework as its control layer. It supports are an application model, a view model, and a controller. TIP provides desktop standard brows, and a mobile device browser and TIP browser. Different types of service can run on a separate run-time environment and communicate with each other via TIP server. They are managed by an additional broker process.

2.5 Greenstone Digital Library

The Greenstone Digital Library (Don, Bainbridge & Witten 2002) is software that can help organize and publish information electronically. It can organize many types of electronic documents such as text, html, pictures, music, and audio or video (Don, Buchanan & Witten 2005, Witten, Bainbridge, Paynter & Boddie 2002). Metadata will be extracted by Greenstone from those source files, and then they will be entered into a database for searching. For full text searches, key words will be added into indexes. Greenstone provides a GUI for users who build their Digital Library, and a WEB based interface for users who use the Digital Library. When users search for information in Greenstone, it will list those documents that match the searched key words. The links to the document or the links to specific paragraphs of documents will be displayed to users.

The architecture of the Greenstone Digital Library uses an agent structure, as described in (Don, Bainbridge & Witten 2002, Don, Buchanan & Witten 2005). SOAP communication has been used to enable communication between these agents. This SOAP communication can also provide interfaces for third party software to allow Greenstone communication with other software.

In my early project (Gao 2005), a Greenstone Service has been implemented into TIP to provide location-based information for mobile users. The Greenstone Digital Library has been used as a server to search and deliver the information based on the user's location and profile. The service will be described in advance in the next section.

2.6 Current TIP/Greenstone Service

This section will describe the current TIP/Greenstone Service, which has been implemented in the process of my early project (Gao 2005). Other services of TIP can also provide information for tourists. The difference between the TIP/Greenstone Service and other services of TIP is that the information of the TIP/Greenstone Service comes from a Digital Library whereas the information in the other service comes from the TIP database. At this stage, the TIP/Greenstone Service can provide location-based information for users. The TIP/Greenstone service helps TIP to provide more information for tourists, a situation that is similar to a tourist carrying some additional books about the place they travel to. This service uses the user's location and profile to create a query, which will be sent to the Digital Library to search for possible documents. In advance, Greenstone documents are prepared for location based search by the place name recognition package, which is a sub-program of the TIP/Greenstone Service. This package adds location mark-up to the document. The Service connects to the Greenstone Digital Library via SOAP communication to transfer both the query and the search result.

The Service can search for information by keywords that refer to the user's current location and their profile information. Search results are listed to the user by title and general introduction. The document that was selected by the user is shown. All place names in those document texts have been hyper-linked to place names in TIP and Greenstone. The link to new searches can then be processed by the selected words as a new query so the process can be repeated.

2.7 Current Audio Icon and Books Service

During an earlier project, an initially Audio Icon and Audio Books has been implemented into the TIP system using the concept described in Tim's honor project (Tim 2005). As per the description in the previous section, the TIP system will provide location-based information to users by providing a listed sight around users' current location. When users select and read the information about a particular place, an audio related to that place will be played to them. Users can know from the sounds what kind of place they are standing. These Audio Icons use sounds related to the environmental background. For example, when a user arrives at a church, the system play a bell sound that is related to this place. So the user is allowed to listen to the bell sound that a church makes. Originally, the sound was planed to be automatically started without user's interaction.

The audio linked page may also be a book related to the place. The overview of the Audio Books will be displayed to users with the title, authors and summary. The books can be played as an MP3 file by clicking the book icon. The book depend audio files are not fully supported at this moment.

2.8 Travel Plan Service

The Travel Plan Service has been developed in the thesis named "Development of a map service" (Huang 2005). It is client side program based on Java Application. Its main functionality is providing users a tool that can help them make their travel panel, as a new service of TIP system.

This component provides a zoom-able map for users to make their travel plan.

The map will be displayed based on users' current location. It is able to scrolled in any direction and change the zoom based on user choice. Users may set up their parameter and draw out their route on the map. In this case user may identify the main together of their trip. When the system gets the route form users, it will try to guess what other place this user can visit on the way they to go the main together. The main together can be one or many, so they can by some milestone on the routes. Some of the sight will be displayed near users' route on the map. Users are able to click the sight on the map to see some more specific information loaded from TIP database. When they decide to save the route the sight will be listed in a table to describe the travel route. Users can decide which place they are going to visit and save into the route. The details can be kept in the database. The other functionality of this component is that it can receive some message from TIP system and provide a map to users about the specific location.

This component is a client-side application, which is different to any other TIP service, but it shares the same database with TIP. So all data created by this component can be used by the other service.

Chapter 3

Usage Scenario for New TIP

A usage scenario for new Audio Icons and Audio Books will be explained in this section. Tom has installed the Audio Icon and Audio Books Service on his mobile phone. He comes to Hamilton for the visit.

When Tom arrives at Victoria Street; he switches the TIP on his mobile phone to the Audio Icons and Books, and then walks down this street. He sets up the audio notice to option 2 which present multi sound at same time. When he walk close to a bus station he hear the sound of bus, but he does not do any thing with the system and continue walk. Until he hears church bell is running on his mobile phone, he stops and looks at his mobile phone. Tom find two hyperlinks, which marked as bus station and church, are available, so he click on the church the system show the information about the church as same as the TIP location service.

When Tom continue walk down the Victoria Street and his mobile phone sound beep, he know there are some books available. He looks at his mobile phone and find some books name has been hyperlinked. After he choose one to click the system show a general introduction of the book and start to play the chapter based on his current location. The system advices him to click the “Select Chapters” look at other chapters. He clicks the hyperlink and goes to “Select Chapters” which list all of the chapters of the books. The system tells him this is a literature book which is able to use Chapter Map. He clicks to go to the chapter map and draw his route to make a sequence of chapter to read. When he clicks the play button the system direct the state to Audio Control Panel which can control the

audio playing, such as playback and volume setting.

When Tom select next book to listen he click on one of chapters then a popup window appeared. He clicks the “Read Greenstone Text” and the system directs him to TIP/Greenstone page with Text-to-Speech on. So Tom can listen to the book reading and read the text at the same time.

Tom continues to walk down the street and he receives more notices from his mobile phone so that he can look his interesting objects.

Chapter 4

Functional Requirements

The needs of TIP are to combine and extend the TIP/Greenstone Service and the Audio Icon and Audio Books Service. The Audio Icon will play automatically as a route sign to tell users they are close to some place without users having to ask. More functionality needs to be added for the new service, rather than the simply the sum of the two existing services. The detailed requirements are explained subsequently.

4.1 Audio Icons

The functional requirements of Audio Icon are different from normal Audio Icon, because it must alter user that some sights are close to them. As an Audio Icon it must give users information about the thing it presented. The volume is still need to be controlled to fit user's hearing.

4.1.1 Basic Audio Icon Service

The main requirement of this service is to provide audio triggers as an additional function of the location service of TIP. A range needs to be identified for the objects. When users enter this range the system will play the audio to tell the user that they are within the range of the object. Therefore the distance from the user to

the object needs to be detected. The Audio Icon needs to be activated automatically without the usual interaction with users. The playing Audio Icon needs to stop when users have already heard the icon. Thus the Audio Icon can provide a guide for users similar to a route sign.

4.1.2 Source can be Distinguished

The type of the sound should be related to the object to let users know what it is. For example, when the user hears a church bell ringing that means they are close to a church, and in the same way an opera sound means the user is close to an opera house. It is more practical than using the same sound for different objects.

4.1.3 Volume Control

To give users more control, some user parameters are needed in the system. Users need to set up the basic volume to fit their hearing and the environment they are in. User can turn the volume up and down when the audio is playing. The volume depends on the volume which users set on their user parameters and their control in any time.

4.2 Audio Books

The books include Audio Books via MP3 file and the books in text loaded form Digital Library. The functional requirements of books are that the Audio Books and books in text are linked to each other. In additional, they need perform their

own functionality which is gong to be introduced in this section.

4.2.1 Books via MP3

The functional requirements of Audio Books will be discussed in this section. The requirements include the stage to play the Audio Books and the stage to select chapters.

4.2.1.1 Books Playing

Reference books and literature related to the user's current position and profile may be provided in MP3 files. Those books need to be played to the users by audio. But before they are played the system must let users know a book is going to be played, so users are given the choice to have it played or not.

4.2.1.2 Chapter Based

The chapters that are going to be played particular chapters of books are linked to certain location related to user's current location and their interesting. The service should let users know it is a reference book that is not necessarily in chapter order or begin at the beginning. The MP3 files based on the chapters is loaded from database which is selected by system. In additional, the MP3 files are able to be loaded based on users' choice. This is to give the user the choice to listen to the previous chapter or stay on the current chapter.

4.2.2 Books via Digital Library

Books via MP3 should be available in text via the Greenstone Digital Library. Users can also access the book, which is played in MP3, from the Greenstone Digital Library in text. The books are able to be searched based on chapter or paragraph. These texts are able to be converted into voice by Text-to-Speech software.

A) Text-to-Speech

Books may be offered as text via Digital Library. Those should be read to user instead of the additional text to display to user. Books are loaded based on user's current location and their profile information. When the texts are loaded form Digital Library, a Text-to-Speech software convert the text to voice. So the system can provide Audio Books to users with Text-to-Speech software.

B) Text-to-Speech and Text Display

The texts which are converted to speech described in last paragraph are able to display to user in text. User can decide to read the text, listen to the speech or use both of the tow option at same time.

C) Audio for this Book

The MP3 files is loaded from database and independent of text. The source of audio are sound in digital format instead sound presented by Text-to-Speech software. When the system decides to play a chapter of book the audio of this chapter will be loaded form database and play on a user's device. In addition, a link will direct the state to the books via Digital Library

There are some hyperlinks, which connect the books via MP3 and books via

Digital Library, place in the two components. Users can click to switch between audio independent text and Text-to-Speech. So that same books are available in both of the modes.

4.3 General

Overview the functional requirements about the Audio Icon and Audio Books, some general functional requirements still need to be added to the Audio Icon and Audio Books. Those general functional requirements include Anti Overlap, Interaction and location and profile based notification. They will be discussed in the following sections.

4.3.1 Anti Overlap

Users need to be able to choose to interrupt an audio or not when another object comes into their sight or a book needs to be read. This is similar to people being on a telephone call they can hear some beep from the phone so they can know they other phone is come in and waiting on the phone line. The system should be able to tell users that some new information are available and ask users to switch to listen the new audio or still listen to the current audio.

4.3.2 Interaction

A) Audio Control

This is similar to other audio player has volume control and play back function.

User can fix the volume whenever they listen to the audio. They can use the play back function to reverse the audio and listen again.

B) User Parameters

Some of parameters are need to be setup rather than user's profile. These parameters are including the audio volume and accept interrupt. Basic volume is use to set the volume for the audio in the beginning, user can control the volume by Audio Control function. Accept interrupt is able user to choose want the notice for new information or not. When accept interrupt is set on the system will not tell user some new audio are available. User parameters are stored in database and loaded again when users use the system for next time.

C) Audio Books Control

Before the system plays an Audio Books the system needs to give notice to users by sound to let them know a book is about to be played. A dialog box should popup to ask if the user wants it or not, or whether they want to go to the previous chapter or continue to listen to the current chapter if it is a literature. So users can control the playing of books according to their ideas.

D) Anti Overlap Control

When new audio are available and the system is playing the current audio, the anti overlap function will be actived. A dialogue box should pop out and ask user to continue listening the current audio or jump over to Audio Icon or Audio Books. This action can be done by press a button on their PDA, it is possible without eyes on.

4.3.3 Signaled place based on users' interest

In addition, the content of the sound should be based on their profile, because only one audio can be played at the same time. Users should not get to much information which they do not interest. So that the system should only give users signal by the place they are interested in.

4.4 Text-to-Speech Assistance

As described in Section 4.1.2 users should distinguish the source of Audio Icon. But it is difficult for people to recognize what that sight is related to in the audio. This problem is caused by many reasons. Firstly, users do not have any knowledge about the sight that the system is going to tell them about and they do not know what is going to come up. So users can not imagine what audio is related to the sight. For example, if a church bell rings, the guess may be that the audio is a clock tower. Secondly it is difficult to find some audios to describe some sight for developer; for example, it is not possible to find a sound for museum which does not make any sound at all.

So it is important to use another way to notify user of any up coming sight before they read the screen. It is possible to add some speech in the audio to help in this, but that may lead to expensive of data storage, because if a speech is added into an audio, this audio can not be reused for another sight even if they sound the same sound. Text-to-Speech is therefore used to solute this problem. The Audio Icon Service can have a Text-to-Speech program as an assistance program to speech the sight name to notify user. So in this way users can get notifications that identify the sight accurately.

Chapter 5

Related Work

The requirements identified in Chapter 4 have already been recognized in several existing tourist guide systems which employ audio as guide for travelers. This study will compare fourteen requirements which are important factors for building an audio guide component, and these are listed as R1 to R14 in Table 5.1.

As many mobile tourist guide systems have employed various audio systems we consider that the systems use audio as a guide. Some papers which study audio for other purpose are not what we want, such as the (Aoki, Grinter, Hurst, Szymanski, Thornton & Woodruff 2000) that describe more interaction between more devices in an open air environment. Our project study Audio Icon, which gives users notification about new available location, and Audio Books, which present chapter based books in audio, we do not focus on Audio Navigation, which direct user to their target by audio. Audio Navigation has been described in several papers, such as (Warren, Jones, Jones & Bainbridge 2005, Holland, Morse, Gedenryd & 2002).

This related work begins with the introduction of tourist guide systems. The comparison and discussions will be described subsequently and be summarized in table.

R1: Provide basic Audio Icon service	R8: Audio for this book
R2: Source can be distinguished	R9: Anti overlap
R3: Volume control	R10: Audio Control
R4: Books playing (play a digital record)	R11: User Parameters
R5: Chapter based	R12: Audio Books Control
R6: Text-to-Speech	R13: Anti Overlap control
R7: Text-to-Speech and text display	R14: Signaled place based on users' interest

Table 5.1. The list of functional requirements in Chapter 4

5.1 Tourist Guide System with Audio

In this section, six tourist guide systems have been considered for this study. Those existing system involved some functional requirements that partially mach the requirement described above. They will be identified to prepare for the analysis in a later section.

A) AccessSight

AccessSight has been described by (Klante, Krosche & Boll 2004). This Mobile Tourist Information System is designed for both the sighted users and blind users. Sighted users are guided by both visual information and audio, but blinds have to rely auditory information only. (R1) To navigate the blinds, the audio information which are digital records has been build into a mental model of area. (R4) The different sound families are related to different types of objects. The hearcon used in this paper are present the same concept with Audio Icon in our project. Hearcon,

which give each place of interesting a unique sound, has been used in this system. (R2, R12) Speech out, which can convert text to audio, has been used to identify places of interesting for blinds, also it can be an additional service for sighted user.(R6, R7, R14) The text which was speech out are not based on chapters(R5), So it do not need Audio Books Control(R12). The text are unable to link to any audio for it.(R8) A function has been implemented to let blinds decide when to hear the audio information to anti overlap.(R9, R13) Sound will getting louder when the user is close to the object. (R3) The playing of audio can not be controlled, such as play back. (R10) This system does not set parameter for audio. (R11)

B) Augmented Audio Reality System

This system has been introduced by (Hatala, Kalantari, Wakkary, & Newby 2004). A large part of this paper focuses on studying visitors' behavior to control the audio playing and infer users' interesting. But here we concentrate on the navigation of audio and interactions. The system provides basic mechanisms of navigation and orientation which are digital record of voice.（R1, R4） The system does not use Text-to-Speech. (R6, R7, R8) The auditory information is based on the museum artifacts which are in the front of user. (R2) The audio are controlled by the movement of user, such as stop and slow down. (R13) Audio will be played inseparably so that it do not based on chapters(R5), so it do not support Audio Books Control.(R12) Sound radius and volume is increased for those artifacts which related to the current user's interesting. (R3, R14) The system does not give control of audio. (R11) To anti the overlap of audio, the number of the audio has been controlled by the walk speed, for example, user walk through a room quickly the audio related in this room will not be played to the current user. (R9) Because walk through quickly mean the user is interested in those artifact. The Anti-overlap control based the movement of user instead the interaction with user.

C) Tour Guide for Travelers

This system has been described by (Bellotti, Berta, Gloria & Margarone 2005). It is a mobile tourist guide system which delivers high-quality multimedia information and service to users' palmtop computer. Tour Guide can assist users in the real time event, such as in a museum, walk in a city or on a car trip. When a user get close to a place of interesting the system will alert the user by audio earcon, which is as same as the Audio Icon, and an indicator. (R1, R14) Different types of earcon are associated with different type of interest information. (R2) The system will ask user that whether they want to visit the signaled place. This is similar with Audio Books Control which ask user whether want the book or not. (R12) In the next the user can push a button on screen to view more information about the signaled place. The paper does not tell what the system does when new information comes. (R9) This system does not use Text-to-Speech and digital record so that it does not support the requirements related to Books via MP3, Books via Digital Library and most of interactions. (R4, R5, R6, R7, R8, R10, R11)

D) GUIDE

As (Cheverst, Davies, Mitchell & Friday 2000) described, GUIDE can provide tourist information to city visitor with their hand hold device. GUIDE employs a button which is used to display information pertaining to user's new location. To help user to remember needs to press a button on the mobile device or on GUI, a hyper media page describing the relevant attraction has been developed to present a sound which notice user to trigger the application. (R1) It always present same sound for different type of object and same volume in any time. (R2, R3) The act of pushing new information could overwrite the information which users are reading. GUIDE has employ two stages to anti overlap, one of the stages is that users simply press a back button, the second stages is that force the current information to remain on the screen and alert the user that some new information

is coming. The alert can be a waving flag on the screen stay with the current information. (R9, R13) The paper does not tell weather need to set any user Parameters. (R12) Those information presented by GUIDE are all text all graphic which are not considered in our project, but the stages for pushing in new information and anti overlap are useful for our project. (R4) This system does not use Text-to-Speech and digital record so that it does not support the requirements related to Books via MP3 and Books via Digital Library but it support the Anti Overlap Control of interactions in advance. (R4, R5, R6, R7, R8, R10, R11, R12, R13) The paper does not till the new information based on users' interest. (R14)

E) Automated Tour Guide

This system has been described by (Benjamin 1995). This system is a museum guide system which can play the descriptions of museum artifacts. (R1, R2) The audio will be triggered by walking close to the artifacts and stop by waling away. So the audio does not based on users' interest. (R14) Infrared transmitter placed in the ceiling can provide accurate positions to play only one audio about the nearest artifacts to anti overlap. (R9) But the anti overlap does not take interaction with users. (R13) The volume can not be control by user or system. (R3) There can be a button to play the audio that direction users to other place of the museum, for example, restore room. The additional information are similar to Audio Books Control that mean users play it when they need. (R12) In this system, users carry their own audio source which are digital record so that the descriptions can be heard on the user's time schedule. (R4) This system does not use Text-to-Speech and digital record so that it does not support the requirements related to Books via MP3, Books via Digital Library and most of interactions. (R4, R5, R6, R7, R8, R10, R11).

F) Current TIP

The current TIP system are can provide location information based on user's

current location and interesting which identified in their profile. It supports location service, map service, advance recommendations service, trust-based recommendations and Greenstone service. The current Audio Icon can only be activated by clicking a link in a user's screen, when the system display the place based on users' interest. (R1, R14) The source of audio are related the environment where the user clicked in to. For example, when a user clicked on a church, the user will hear church bill ringing. (R2) Audio Books work on the state as same as Audio Icon. Audio Books are inseparable so it does not based on chapters. (R5) The played audio are loaded digital record of voice from database, so that the audio independent of text. (R4) Currently the Greenstone Service provide text only, it does not connect to any audio. (R6, R7, R8) Users need to click to play the audio so the anti-overlap means nothing to this service. (R9) What users need to do is that click the link and listen to the audio, so there are no interactions between system and users. (R10, R11, R12, R13)

5.2 Tourist Guide System without Audio

Many tourist guide systems do not provide any audio; they only use text and graphic to provide information for users. In this section two of the existing systems have been described as an example.

A) Cyberguide

Cyberguide described in (Abowd, Atkesen, Hong, Long, Kooper, & Pinkerton 1997) is a tourist information system on mobile devices. This system support map, information, communication and position service based on users' current location. All of the information provide to user are all on text and graphic, so it does not provide any audio service.

B) Crumpet

Crumpet described in (Poslad, Laamanen, Malaka, Nick, & Zipf 2001) is a mobile tourist information provider. This system employed personalized services, multi-agent technology, location-aware services and transparent model data communication. It does not only provide information but also collect information from users' to help user to identify users' profile. The interfaces are still text and graphic, so no audio service is provide by this system.

5.3 Analysis

The Table 5.2 shows the comparison of the six systems on the fourteen requirements. All of the six systems provide basic Audio Icon except GUIDE that uses the sound to notice user new information is available and current TIP need user to click to play.

All of the systems provide sound based on their source except GUIDE that always uses same sound to notice users. AccessSight and Tour Guide for Travelers use different sound family for different type of group. Augmented audio reality system and Automated Tour Guide provide the descriptions for the particular object. Current TIP can provide audio related to the clicked location. So that the source of audio can be distinguished easily. AccessSight and Augmented audio reality system can provide the volume navigate which can increase the volume when users are getting closer the place of interesting.

All of the systems can play digital record of voice, except GUIDE which only uses beep to notify users. This function is similar with books playing of TIP system. They load sound file from their database so that the sound does not

	Audio Icon			Books					General					
				Books via MP3		Books via Digital Library				Interaction				
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
AccessSight	+	+	+	+	-	+	+	-	+	-	-	-	+	+
Augmented audio reality system	+	+	+	+	-	-	-	-	+	-	-	-	+	+
Tour Guide for Travelers	+	+	-	-	-	-	-	-	?	-	-	+	?	+
GUIDE	+	-	-	-	-	-	-	-	++	-	+	?	+	?
Automated Tour Guide	+	+	-	+	-	-	-	-	+	-	-	+	-	-
Current TIP	-	+	+	+	-	-	-	-	O	+				+

Table 5.2. The comparison of the six mobile tourist information systems on the requirements

Symbols:

+ The system meets the requirement.

++ The system strongly supports the requirement.

- The system does not meet the requirement.

? The paper does not tell the anything about the requirement.

o Requirement does not apply

depend on text. (Klante, Krosche & Boll 2004) does not tell what type of source provides those descriptions in audio for AccessSight. But currently no one of them can provide audio based on chapter. Only current TIP system support Books via Digital Library, but it can provide text only. GUIDE does not support R4, so that it does not support R5 – R8.

It is vital that the system can anti overlap of audio, otherwise the audio guide will become impracticably. GUIDE has give two stages to avoid the overlap of text and graphic, such as, setting a back button on or holding the current information and give user a notice. The two stages are possible to be employed into audio guide. AccessSight provide an interface to let users decide when to listen to the audios. Augmented audio reality system employs some stages to reduce the number of audios. Current TIP does not support R1, so that the R9 does not apply to it.

GUIDE provides a back button and holding current page with notice of new information, so it has a great interaction with user. AccessSight give users a choice that when they want the audio. Tour Guide for Travelers can give user a choice whether they want to visit it. Augmented audio reality system and Automated Tour Guide interact with users by their movement. Current TIP system need user to click available audio to listen.

Cyberguide and Crumpet are tourist guide without any audio. They still can give provide a guide for users, but they are unable to notify them of changes happening on the device when users do not read their screen.

All of the systems can provide audio on users' interesting, except Automated Tour Guide which provides information only on user's locations. Augmented audio reality system can identify and correct users' profile information by users'

behavior. The paper of GUIDE does not tell that whether the information based on users' interest or not. Other systems need users to identify their interesting in their profiles.

Chapter 6

Design

This chapter describe the design for the Audio Icon and Audio Books Service via Digital Library. This design is based on the result of the functional requirements and the experiment of the related works in previous chapters.

This section first describes the design of Audio Icon, followed by the design of Audio Books, and last the design of new TIP/Greenstone Service will be described.

6.1 Audio Icon

Due to different situation of users' current location and different operation of users, the Audio Icon has been separated to four options. Each option was placed in a sequence of time slot which depend on the changing of users' current location. Those option start by a same searching page and begin the processing.

As the Figure 6.1(a) shows, the line is the travel route of users and the four point with litter on mean the point where users has moved to different sight of different object. The map in Figure 6.1(a) has been converted to Figure 6.1(b). The row line means the travel route of users. The dashed mean the point where users have passed. In the real world user meet more sight object on their travel route, but two sight objects has been used in this figure as an example.

For option 1 in Figure 6.1 (b), the audios are played in a sequence when there are more object come in to users' sight. The bus sound will be played in each 15 second when users pass the point A and the bus station has entered users' sight. When users pass the point B and enter the superpose area of bus station and church the sound will be played one by one, and then rest for 15 second for next loop of playing. When users pass the point C and leave the sight of bus station the sound of bus stop playing. But the sound of church still going on until user pass point D and the church is out of the sight of users.

The option 2 is similar to the option 1, but it plays more than one sound at same time in each 15 second. The sound related to the sight objects when users enter a sight affected by multi sight object, such as between the point A and C. It is similar with the real word. People can hear more than one sound at a place around by multi objects, which are able to make noise. As the Figure 6.1(b) described, when user is out of the sight of bus station and pass point B the sound of bus station stop playing and the system will only play the sound of church until users pass point D the church is out of the sight of church.

The option 3 is presented with the interactions between users and system. The system play the sound as described in option 1 and 2. When the user click a link of the sight object to view more information about it, the sound of this sight object will stop playing. The sound of object which has not been clicked will still going on until it is clicked or the users is out of the sight of the object. The model of sound playing can be the model in option 1 or in option 2.

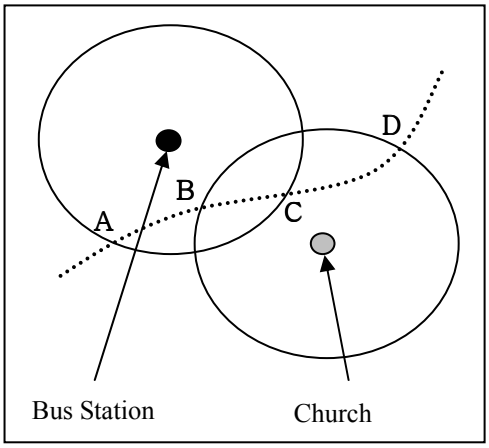


Figure 6.1 (a). Map for Successive Screen of Audio Icon

The option 4 happed when users just want to stop the audio simply. When the system is playing the sound as described in option 1 and 2, user may stop playing of one or more audio. A stop audio option will provide to the user. Users are able to choose the audio that they want to stop or stop all of the audio. The audio that have not been stopped by user will still going on until the sight object out of the sight of user.

Text-to-Speech function should be available as assistance to the Audio Icon. The Text-to-Speech should be in synchronization with the Audio Icon, but it uses the speech of sight name to notify users instead of the audio from database. This function is able to be turned on and off base according to users own choice.

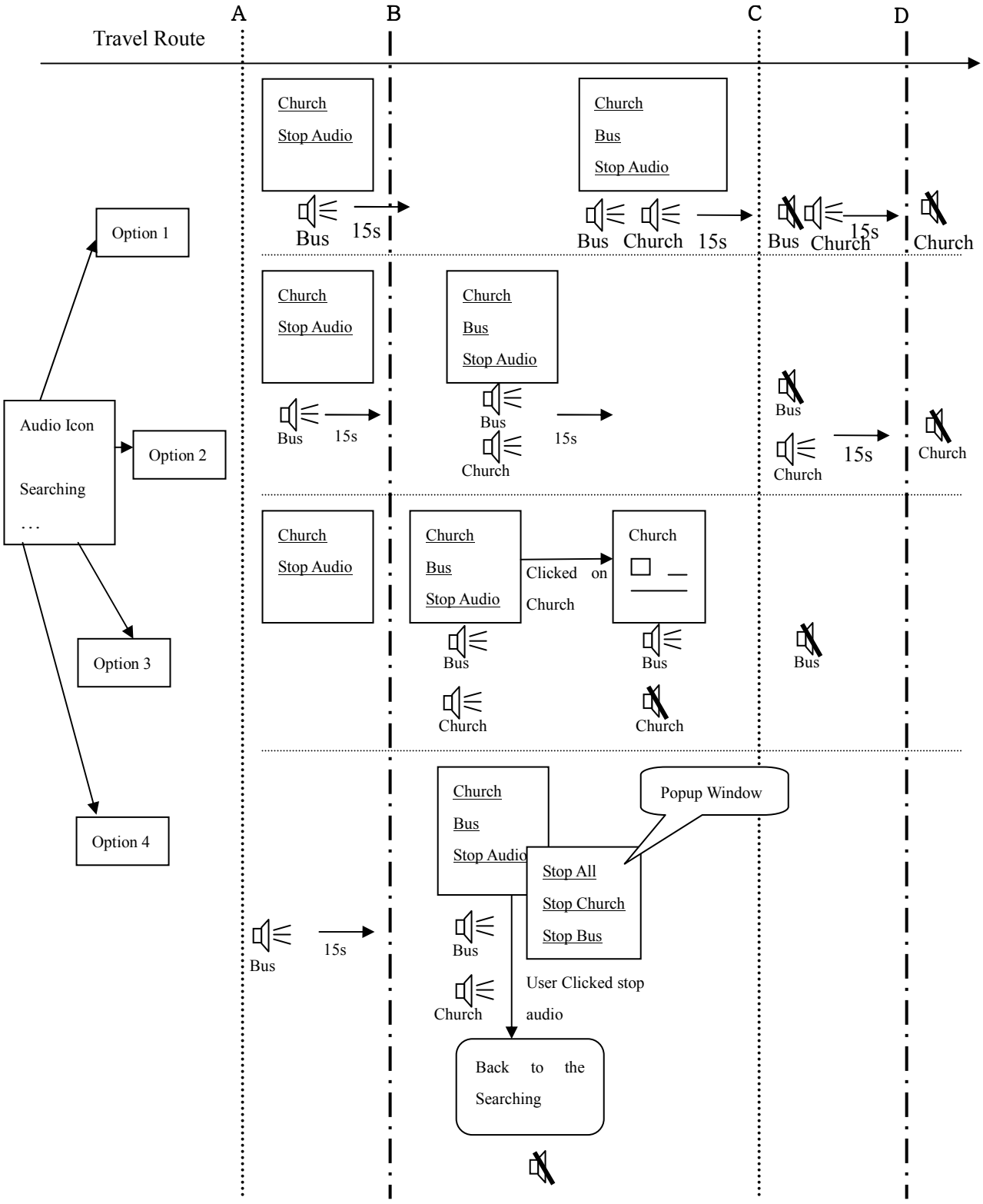


Figure 6.1 (b). Successive Screen of Audio Icon

6.2 Audio Books

This section will discuss the design of the Audio Books Service. By reference to the functional requirement and the experiment from future works, the design of Audio Books Service has been figured out. In the following paragraph we will introduce the design of the service with its related figures.

The Audio Books service has been described in Figure 6.2. This service is able to provide a list of books responding to the user's current location with a beep to catch their notice. When the Audio Icon is going on, Audio Books should be provided at same time. These Audio Books need to relevant to the sight provided in the Audio Icon function. The Audio Books need to be selected based on chapters. If any chapter of a book related to a sight in the Audio Icon list, this book will be selected. A link grouped with an Audio Icon need to be provided to uses and give notification by a different sound with another Audio Icon.

When users click a hyperlink of an Audio Books, the system can provide an interface to select that Audio Books for user. All related Audio Books will be listed with general detail of the chapters for users to press the select chapter to select other chapters. All the Audio Books will be identified as to whether they are a reference book or literature. The select chapter related function is only available for literature books, because users do not need to read other chapters of a reference book. At the Select Chapter Page the system will list all the chapters of the selected book. The chapter related to the selected sight must be recognised. So the system can give users an interface to select their chapters. When the hyperlink of chapters is clicked a popup window will appear to enable users to select the service they want. These services include play book in MP3, view Greenstone Text, and read Greenstone text by Text-to-Speech.

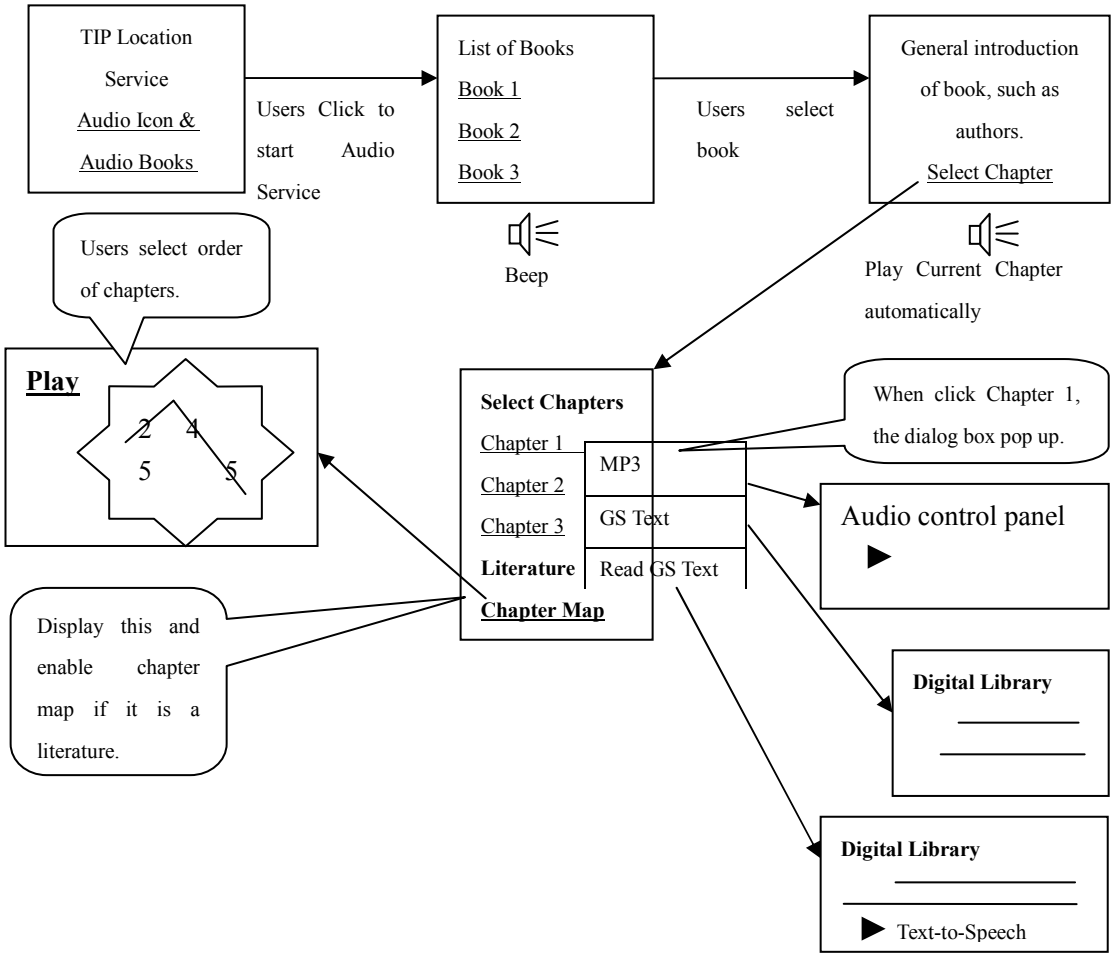


Figure 6.2. Successive Screen of Audio Books

When users select the option to play the chapter by audio, the system will bring them to the audio control panel, which is simply used to control the audio, such as play and stop to give user some control for the playing audio. There should also be a now-playing list provided, so that when user start chapter in the now-playing list the Audio Books Service play the selected chapter in audio.

When users select the option to show the Audio Books in text in Greenstone, the system will direct them to the TIP/Greenstone Service. The Digital Library page provides the text of the book for users and a Text-to-Speech option is available to read the book. This component will be introduced in the following subsection.

An additional function named Chapter Map is available in the Select Chapter page if it is a literature book. The Chapter Map offer users the chance to play these chapters on a sequence based on their travel route. As the Section 2.8 described, the Travel Plan Service can save the travel route in database. Users draw the route on a map to plan how they move between those sights on the map. The travel route can provide a group of sight around the route. When the Chapter Map function is used the system should list all of the routes related to the current user. The sights on each route and the chapters related to any specific sight should also need to be listed. When users select any travel plan the system should add all of the chapters based on the order of the related sight on the route. If more than one chapter is related to one sight the chapter related to this sight can be only add once. When the audios are added in to the now-playing list user can control those function, just as with other playing model.

The Audio Control Panel was only designed for some basic function, as there was no wish to implement something that normal audio players already have, because this project does not concentrate on player.

6.3 New TIP/Greenstone Service

This section will introduce the next component of this project, the TIP/Greenstone Service. The existing Greenstone Service has been introduced in the Section 2.6. To fit the needs of this project, some new functionality needed to be added into the TIP/Greenstone Service.

Firstly, we need Greenstone to search the selected books based on chapter in a numbers of document. The query needs to be selected and used to search the document. In the previous version of the TIP/Greenstone Service user was asked to select a region of their current location, and then the place name can be a query to search the document related to that place. Now the need is to get some document related to the chapter, so it is good idea to use the chapter title to make the query. But the system needs to recognise whether the query is place name or chapter title. Greenstone can build the index based on chapter title and display document based on chapters. So the TIP/Greenstone Service is able to work for the Audio Icon and Audio Books Service.

Secondly, this project needs a Text-to-Speech function to read the text of books. The mail part of Text-to-Speech is going to build into the server of the Audio Icon and Audio Books Service. That is to enable a communication to transfer the text between the TIP/Greenstone Service and the main system of this project.

Thirdly, the control panel is necessary. As with the Audio Books in audio function it is still need for the Text-to-Speech. As the audio player is not the main part of the project, it was decide to use some hyperlink to control the audio.

In the following we need an interface for the new TIP/Greenstone Service. The

interface of the pervious version of TIP/Greenstone Service can still work for the new version with some functional attached. All of the functionality of the pervious version will still work in the new version. When the new version TIP/Greenstone Service work with Audio Icon and Audio Books Service it should direct the user to the select collection section instead the process for selecting region. Other processes should be same as the previous version. Users need to select a collection that is a group of indexed document, and then select the searched documents from a list of searched result. When users select any of the documents, the content of the document will appear. The intention is to use some sample hyperlinks to active the communication with Text-to-Speech component that is in the main part of Audio Icon and Audio Books Service, and will control the Text-to-Speech.

The new TIP/Greenstone Service allow users to find the text of Audio Books and hear a Text-to-Speech of them. All of other functionality of the previous version of TIP/Greenstone Service will be still active when working with the Audio Icon and Audio Books Service.

Chapter 7

Implementation

The implantation of design, which is described in the previous chapter, will be presented in this chapter. It begins with the overview of the TIP implementation in general followed by the architecture of the Audio Icon and Audio Books Service. Then the user interface and the components of this service will be introduced, specifically including their functionality and cooperation with other components.

7.1 Overview of Existing TIP Implementation

The prototype of TIP 1.0 is built on a client server-based technology to run on a mobile phone, PDA, or desktop computer (Hinze & Voisard 2003). This prototype has been implemented as the algorithms and concept mentioned in Section 2.4. Figure 2.1 in Section 2.4.2 shows its algorithms. The most important components of this system are the location and filter engines. These two engines are working around with a physical database that comprises three different aspects according to their functionality. They are the event database, spatial database, and profile database. Whenever the user's location is changed the location engine will be triggered by the data collection through the interface between the server and the client. Event and sight will be load from event database and spatial database. The filter engine, depending on the user profile in the profile database, will select the events and sights. The event and sight information will be sent to the client by the information distribution component. The prototype of TIP 1.0 provides some

location services such as a simple recommendation service and a map service. The audio service has not yet been added to the system.

The TIP 2.0 has been extended to implement more functionality and it is still under development. Until the TIP 2.5 comes, more functionality has been added to the TIP or has been extended, such as an advanced recommendation service, a trust-based recommendation service, a travel planning service, and a Greenstone service. Most of the services components run on the server side, as the client side only provides the presentation function by thick or thin client (Hinze & Buchanan 2006). Some of the services are an application run on the client side, such as the Travel Plan Service. However the Audio Icon and Audio Books Service has been implemented initially in the current version of the TIP system. When any filter engine and notifier provides location information the Audio Icon and Audio Books Service component will load the audio and books information about this location. If there is no Audio Icon and Audio Books information available it will search in an extended region. The file information of Audio Books and Audio Icon will be passed to a media player embedded on the page that has location information.

The relationship of the components and architecture of the current TIP system has been presented by Figure 7.1. The TIP system uses Tomcat as a servlet engine for the Java servlet technology that provides the connection between the server and the client. The components group is the main part of the TIP system. It divides into some software packages written on Java, which is deployed by the TIP development group to provide the service. Postgre SQL 7.3.4 has been entered into the TIP to restore all of the data related to this system. The JSP pages appear ready to provide the interface of the service for user. The Tomcat and Java receive data from the component group and compile the JSP pages into HTML in order to send data to the users' browsers.

The browser can be a desktop browser as well as a browser on a mobile device. It will provide the service to final users. The client application did not exist in the early version of TIP until the Travel Planning Service appeared. It is one or more Java programs executed on the client side and access the database or its part of components on the server by network instead of going through the Tomcat. In the new Audio Icon and Audio Books Service we will still use some client application.

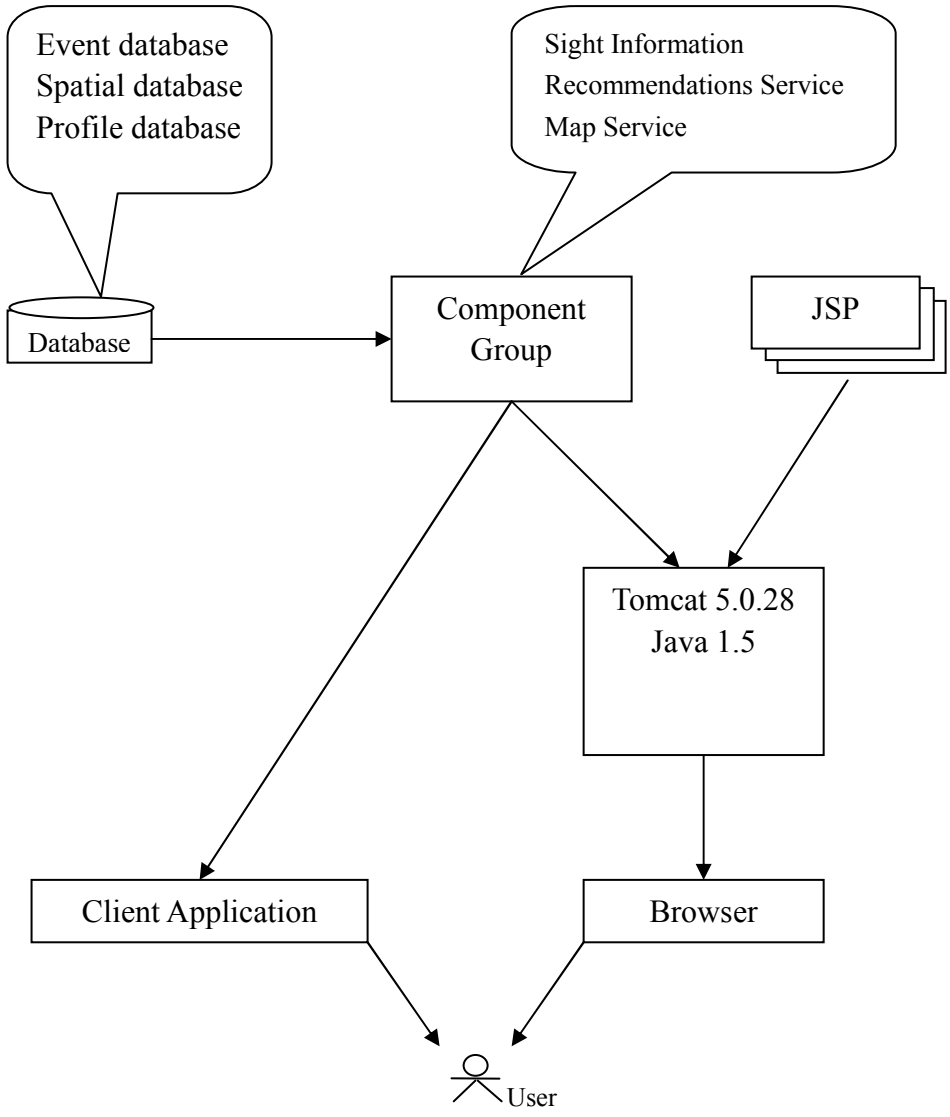


Figure 7.1. Architecture of TIP

7.2 Architecture of New Components

Figure 7.2 shows the architecture model of the Audio Icon and Audio Books Service for the new TIP system. On the client side many interfaces are provided to users on vision and hearing. The *Nearby Location & Playing Indicator* and *Audio Setting* are related to Audio Icon Service, as are the *select books and chapters*, *chapters map,* and the *Audio Books Control Panel*. The Travel Plan Service will be used as an interface for the Audio Books Service. The TIP/Greenstone Service will be used as the interface to display text of Audio Books for user and to provide those texts to *Text-to-Speech*. *Audio Remote Control*, *Audio Receiver,* and *Text-to-Speech,* will be used for both the Audio Icon Service and Audio Books Service. In the real world the TIP system runs on a user's mobile device with a GPS (Global Positioning System). In the lab we use a *GPS simulation* component instead of the real GPS. The *GPS simulation* is on this architecture model of this prototype.

When the *GPS simulation* gets to a new point the *recommendation component* will be triggered. A list of recommended new locations, which are provided by the *recommendation component*, will be provided to the *Notifier*. The *Notifier* will provide the recommended location information to the *Recommendation Information Manager*, *Audio Icon Manager*, and *Audio Books Manager*. The *Audio Icon Manager* will direct the *Audio Sever* to send an audio stream to the *Audio Receiver* on the client side based on the *Audio Setting*. The *Nearby Location & Playing Indicator* on the client side will check regularly with the *Recommendation Information Manager* for new location information. It will also check with the *Audio Display Manager* to identify the audio that is currently being played. The *Audio Display Manager* will receive from the *Audio Server* the information about the audio currently playing.

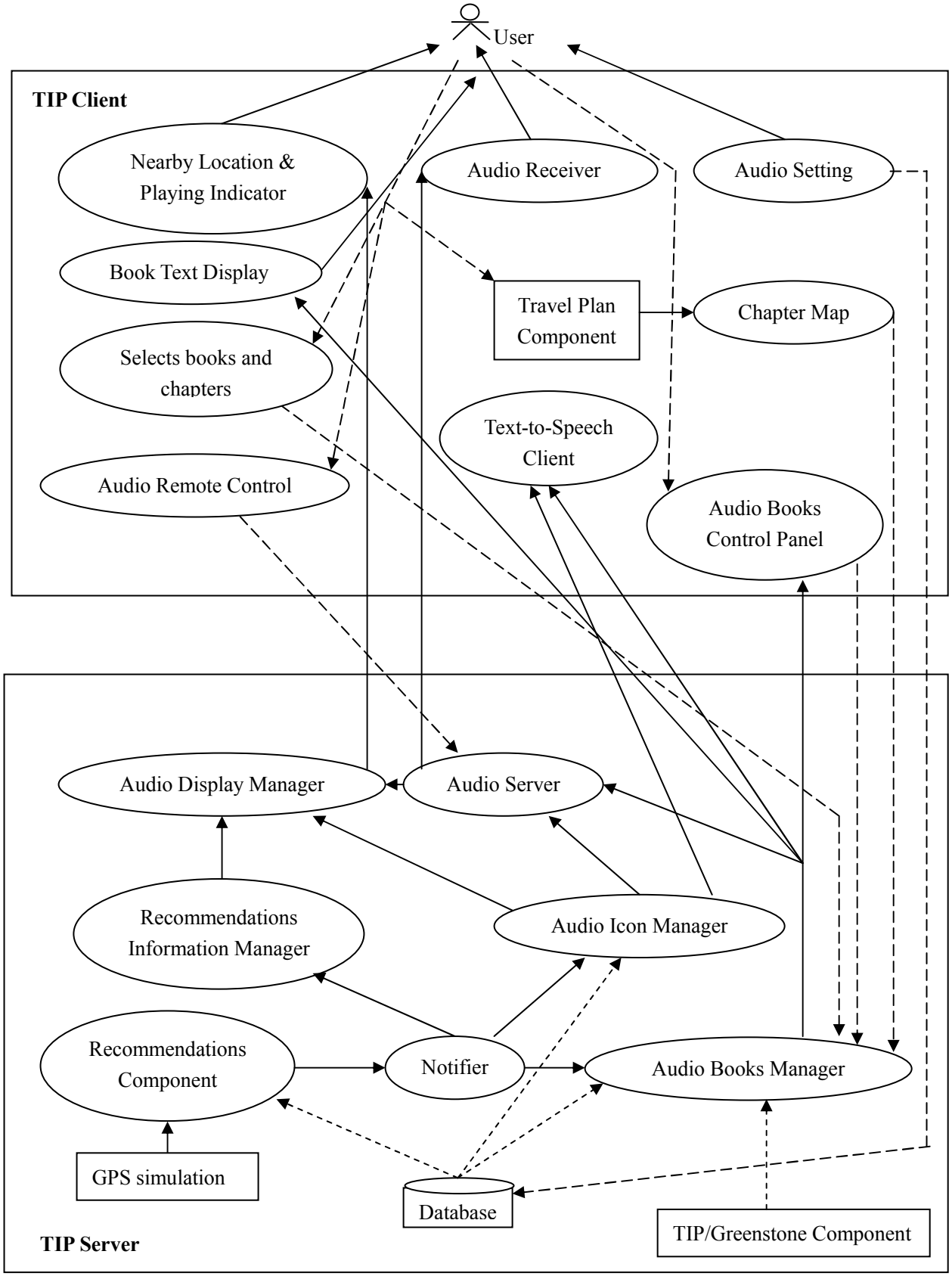


Figure 7.2. Architecture model of Audio Icon and Audio Books Service

The *Audio Books Manager* will receive location information from the *Notifier* to provide a list of available Audio Books to display on the interface, named *Select Books and Chapters*. Then it will receive the user's selected chapter chosen from the *select books and chapter*, as well as receiving a list of book chapters ordered by travel plan component, and forward these to the A*udio Server* to play Audio Books chapters the user selected manually or by travel planning service. Audio Books Control Panel is able to provide an interface that enables the view and control for the now playing list of Audio Books. The *Audio Icon Manager* can send text to *Text-to-Speech* on the client side to enable the text to function as speech. To enable the Digital Library to function for the Audio Books Service, the TIP/Greenstone service mentioned in Section 2.6 has been connected to the Audio Books Service to provide Audio Books texts from the Greenstone Digital Library. The *Audio Books Manager* can query the TIP/Greenstone service, so that the text from the Digital Library will be displayed to users on the *Text of Audio Books Display* interface. The text from the Digital Library can be also sent to *Text-to-Speech Client*, so that the Text-to-Speech function can be operated for the Audio Books text. The database stores and provides user settings, audio file information, and audio about location information for the whole system.

7.2.1 User Interface

Figure 7.2 shows the Audio Icon and Audio Books Service require a lot of cooperation with the users. The interfaces include the screen-displayed message, which is usually used in software, and the hearing interface, which is unusually used. The main design purpose of the Audio Icon and Audio Books Service is to give users notification and to read Audio Books to users when they arrive at a particular place. The interface in audio is only a little window that is unnecessary for users to see, but it will play the audio for them. Audio Control is an interface

used to control the audio, such as stopping it when users already hear the sound and do not want to hear it any more.

Usually the audio can only give users a general ideal about the place, such as church bells for a church and bus noise for a bus station. People could get the wrong idea from the same sound if the location information from the audio becomes inaccurate. So that when an audio is going users really want to know what it specifically means, so two more interfaces are used to solve this problem. The first interface is still using hearing to give the user information about the place. It is a Text-to-Speech application to tell the user the place name or names around this place. The second interface is a visible web page, embedded into the TIP location system. It can provide all the recommendation information and renew itself when the user's position changes.

On the side of the location information there are some graphics to indicate the audio that is playing currently. As Figure 6.1(b). shows, the user can click to look for more information about the place and stop the audio at the same time. The *Audio Setting* page is a web page that asks users to set up the user parameter for this service, such as the remaining time between each audio and to set the playing model to play the Audio Icon either one by one on the same time to imitate the real world. Figure 6.2 shows the *Audio Books Control* interface that allows users to select a book and then chapters from the Audio Books that relate to their location. The *Travel Plan Component* is so users can make a plan to listen to the Audio Books based on their travel plan. *Book Text Display* is used to direct user to *TIP/Greenstone Component* based on the current book to view the text of the playing book, if this book is available from the Digital Library. The *Text-to-Speech Client* is still on an invisible interface to read the text to the user as an additional service of *TIP/Greenstone Component*. It may be sharing the same interface with the Audio Icon.

7.2.2 Animated Web

A normal JSP page can only request a server and display the response on the client side. For the Audio Icon Service, the system needs to update the web pages dynamically to fit the interaction needs because the system needs to synchronise the playing audio on vision and on hearing. There is a picture to direct the audio that is playing for each location. The picture will appear near the location information when the audio is playing for this location. This animated web will check with its server at each particular time. If the server response is new information the animated web will pass the new information onto the web page. If there is nothing changed on the server side the system will do nothing to the web page. The location information will be changed only when the user's position is changed, or instead of that the audio director will be changed when the playing audio ends, due to a different frequency for updating on location and audio playing. The animated web separates the location information and playing audio display. The update information will only affect the updating area of the web page. The area out of the Audio Icon and Audio Books Service will never been effected, so that the web page can display the information at the same time as the audio is playing.

7.2.3 Location Information Notifier

Figure 7.2 shows how the *Notifier* receives information from the *Recommendations component* and provides notification and new information for the *Recommendation Information Manager*, *Audio Icon Manager,* and *Audio Books Manager*. When the user current location is changed the *Recommendation component* will be triggered. Recommendation information will be generated

based on the recommendation argument (Junmanee 2005). The recommendation information content is all the information about the recommended location, including the description, place name, and GPS coordinate, but excludes the Audio Icon and Audio Books information. The *Audio Icon Manager* and *Audio Books Manager* can process that information for the interfaces. The functionality of the *Notifier* is limited to notifying and passing the recommended information to the tree manager when the user's current location is changed.

7.2.4 Recommendation Information Manager

This component is responsible for managing the information from the *Notifier* for the interface. This component is not the Recommendation Manager in advance recommendation service. The Audio Icon and Audio Books Service use the recommendation information that was mentioned in the previous section as providing nearby location information. This generated information needs to be forwarded to the interface, which is a physical web browser. Based on current technology we are unable to push anything into the browser. The information must be kept in the server and wait for the browser to request the information so the web page will get updated. The *Recommendation Information Manager* provides this functionality. It receives the information passed by the *Notifier* of Location Information and waits for the interface to ask it for new information. If the information is new it will send it to the *Nearby Location & Playing Indicator*. If the information is not new it will send a no change message as a response. The *Nearby Location & Playing Indicator* will not do anything when it receives a no change message in the response. So the interface can display the user's current nearby location information in words based on the recommendation component.

7.2.5 Audio Icon Manager

The *Audio Icon Manager* plays an important role in this service as the central controller of the Audio Icon function. When the *Audio Icon Manager* receives a notification from the *Notifier* it will select from the database the audio about the location. The *Audio Icon Manager* will search for the Audio Icon for the specific sight. If there is no audio specifically for the sight, it will go up a level of region to search for it or give the audio of the sight group as a response. The sights in a sight group are all same type of sight so they may use the same audio. This method inherits the arithmetic from the previous version of the Audio Service (Tim 2005). For example, when the audio of the central library is required and there is no audio for it, the system will search for Waikato University or the system will reply with the audio detail of campus buildings. A default audio will be given if there is no audio at all for the sight. The audio ID will be passed to the Audio Server and continue to update when the user's location is changed, causing the *Notifier* to send notification again.

7.2.6 Audio Books Manager

The *Audio Books Manager* is similar to the *Audio Icon Manager*, but it manages the book chapters instead of the audio streams. Books are stored in the database separately, based on chapters. When the *Audio Books Manager* receives a notification from the *Notifier* it will select from the database the book chapter or chapters that relate to the location. The *Audio Books Manager* will search the book chapters for each specific sight that is provided by the *Notifier*. If there is no book chapter specifically for this sight, it will identify this sight as having no book chapter, and instead the *Audio Icon Manager* will search the sight group for an

audio, as otherwise users will get many same books for the same sight. When the *Audio Books Manager* gets any book chapter for any sight, it will notify the *Audio Display Manager* to display a link and play an audio as notification for users on the *Nearby Location & Playing Indicator*.

When users select any book from *Selects books and chapters*, the *Audio Books Manager* will provide the chapter names related to this book for the *Chapter Map*, which will allow users to choose the chapter they like. The chapter related to this sight will be identified.

When the *Audio Books Manager* receives an order from the *Chapter Map*, it will send the audio of the books to the *Audio Server* to play this chapter. The *Audio Books Manager* will send the state of play to the *Audio Books Control Panel*, and it will receive the control from *Audio Books Control Panel*.

The *Audio Books Manager* will cooperate with the *TIP/Greenstone Component* to get the text for the selected chapter. It is able to send those texts to the *Text-to-Speech Client* to play this chapter in speech.

7.2.7 Audio Display Manager

The *Audio Display Manager* works the cooperation between the *Audio Server* and the *Nearby Location & Playing Indicator*. It receives the audio information that is currently being sent to the client by the *Audio Server*. The *Audio Sever* is similar to an Internet radio program that the audio will be continue sending to and playing on the client side by this program. This *Audio Server* component is going to be introduced specifically in a later section. As mentioned in an earlier section, the *Nearby Location & Playing Indicator* uses a little icon to direct the place that the

audio is directed for. The Audio Display Manager directs the displayed icon. The *Animated Web* will check with the *Audio Display Manager* to find out which audio is playing currently. When the *Audio Display Manager* receives the request from the *Nearby Location & Playing Indicator* it will access the *Audio Sever* and load the audio ID that is currently to be sent to the client. Those audio ID will be compared with the place information in the *Recommendation Information Manager* to identify the place that the audio is directed for.

An array will be created from the comparing between the audio ID and the place information to describe the audio playing. This array has the same size as the number of the recommended location. When an audio is playing for a recommended location the element of this array in the same index will be marked as playing. This kind of element can be more than one, because the system can play more than one Audio Icon at the same time based on the user's setting. This array will be replied to the *Nearby Location & Playing Indicator* as a response. The *Audio Display Manager* will receive a request more often than the *Recommendation Information Manager*. Because whenever the *Audio Server* jumps to the next audio to play, the *Nearby Location & Playing Indicator* will update with the audio currently playing. This is so that the *Audio Display Manager* can complete the management of the system display icon on the interface to direct the currently playing audio.

7.2.8 Audio Server Component

Based on the design of the Audio Icon and Audio Books Service, it requires much functionality to complete the task in order to play audios in many different ways. The Audio Icon Service needs to be able to play more than one audio file at the same time. The playing audio needs to be changed frequently, include the audio

file and the number of audio files. That means the system has to be able to mix more audio into one before sending it to the client rather than open more audio stream in the client side. The audio that is playing on the client side needs to be under the control of the *Audio Icon Manager* and *Audio Books Manager*.

Due to the requirement complexity, this component is unlikely to be completed by implementing it on a JSP struct. This component of Audio Icon and the Audio Books Service is therefore developed by the Java application instead of JSP, so that it cannot identify users by identifying the different information in the session. It uses a Java socket as its communication package to communicate with clients. When more users access the same *Audio Server*, those different users need to be identified.

To carry out the requirement described above, the audio server has been implemented as the architectures shown in Figure 7.3. A central controller named *Mix Control*, with a *Mixer* as its main part, has implemented this component. Also the *Audio File Loader*, *Audio Sender*, *Remote Control Receiver*, and *Interface* with the Audio Icon and Audio Books Service will cooperate with the *Mix Controller* and *Mixer* to complete the functionality described at the beginning of this section.

The *Audio Mixer* is able to mix more audio stream into the one audio stream by the direction of the *Mix Controller*. When the Audio Icon and Audio Books Service decide to send or update audio information to the *Audio Server,* the system will pass that audio information to the *Interface* with the *Audio Service*. This information can include anything that can be used as directions to the audio, such as audio ID, play, and stop. This audio information will be passed to the *Mix Controller* as information related to a specific user to direct the *Mixer*. In addition,

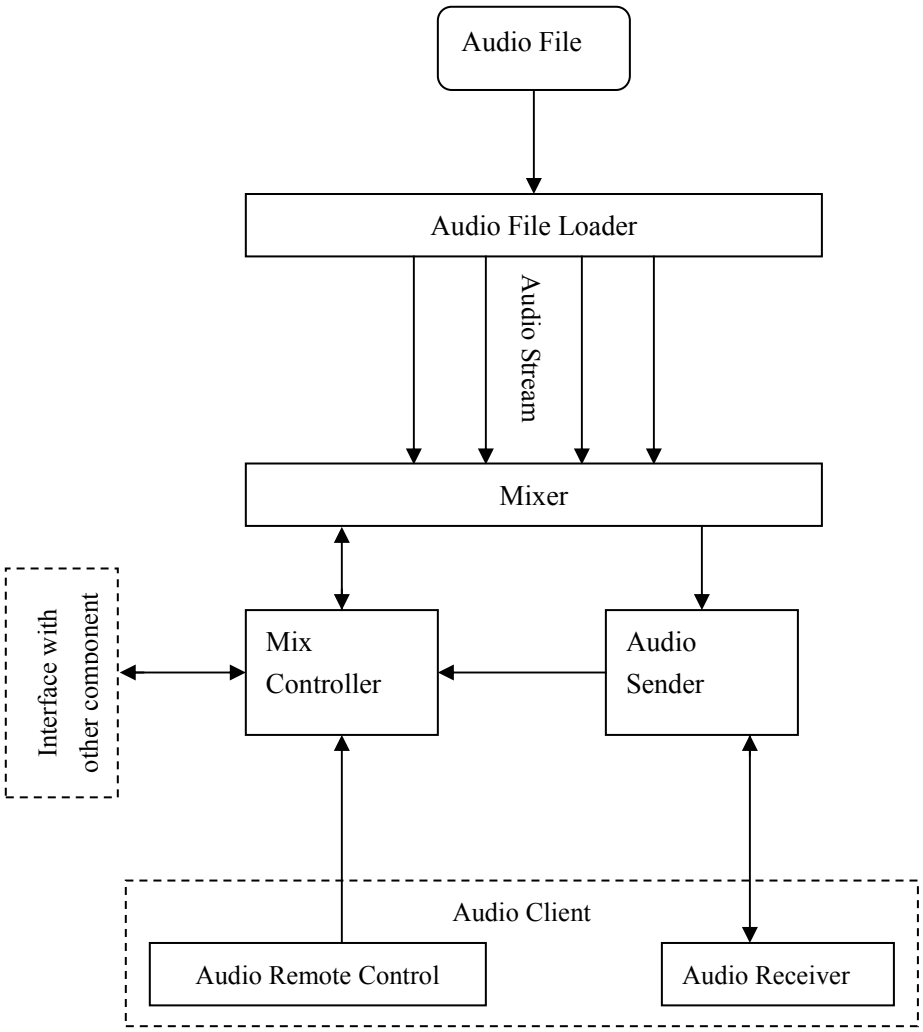


Figure 7.3. Architecture model of Audio Server

the *Mix Controller* can reference each user's setting to direct the *Mixer* to mix audio in a different model, such as to play the Audio Icons one by one or play them at the same time. The information to mix audio for a specific user is ready in the *Mix Control* and waits to be loaded.

When users turn on their *Audio Receiver,* as in Figure 7.2, it will request through the *Audio Sender* where the *Audio Server* component is when it completes the playing of the last package of audio data. Each request sent by the *Audio Receiver* will always include the user's ID. Once the *Audio Server* component receives a request through the *Audio Sender*, the user ID will be passed to the *Mix Controller*, which will direct the *Mixe*r to do the audio mixing based on the current information of this user as described above. The *Mixer* will load the audio stream from the *Audio Loader* on a specific length of data stream for each audio detail related to the data in *Mix Control*. The *Mixer* will mix those data streams with its part of each audio stream and carry the mixed data to the *Audio Sender* in one single data package. The Audio Sender will then send this data package to the *Audio Receiver* as response to the specific request. Java Socket pairs the request and response, so only the client who sends this request can receive this particular data package. This is the way to identity users in Java application instead of the session in Java struct.

Based on Java socket technology, those requests related to those clients will stand in a queue to wait for the process. Rather than the control through the interface with Audio Icon and the Audio Books Service, the *Mix Controller* can also receive some control information from the *Remote Control Receiver*. This is an interface to communicate with *Audio Remote Control* as in Figure 7.2. When users try to control the playing of audio by triggering the *Audio Remote Control*, the *Audio Remote Control* sends a message, the contents of which is this user's identification and the action they want to take through the network to the *Remote Control*

Receiver. The *Remote Control Receiver* will forward the message to *Mix Controller* to change the audio detail, such as to stop playing a specific audio. Once the audio detail in *Mix Controller* is updated the detail will be used to direct the *Mixer* to mix audio data in real time. The M*ixer* mixes audio on a specific length of data instead of the whole audio stream, so the audio can be controlled on real time instead of sending a whole audio to the client.

7.2.9 GPS Simulation Component

As a prototype in the lab the system needed a device to provide a GPS point to trigger the location engine, instead of using the real GPS on the mobile device. To solve this problem the *GPS simulation* component was used. This component can read a list of coordinates from files and send them to the *Recommendations* component in a specific period that can be set by a parameter. The coordinate in the session of HTTP will be changed automatically, the same as a click to select the location in the early version of the TIP prototype. This component only changes the coordinate in sessions of HTTP to change the location as a real GPS does. It will not move any information on the web page for users but the Audio Icon and Audio Books Service will notify them that the location is changed, as part of the design purpose of the Audio Icon and Audio Books Service.

7.2.10 Text-to-Speech Component

When the system plays audio to users to tell what kind of place is close to their current location, users cannot catch the implied meaning well. Therefore it is necessary to find another way to tell user the close locations. So the

Text-to-Speech has been used on this project to tell users what is close by. The other functionality of this component is to speak the text of books in the Digital Library. When the Text-to-Speech function is enabled, the *Audio Icon Manager* and *Audio Books Manager* will be able to send the place name and book content in text to the Text-to-Speech component through the network. The Text-to-Speech can play those texts in words to users. The text is sent to the Text-to-Speech component after it sends a request to the server to identify which they are, as the text has to be sent to a specific user.

7.3 Implementation Details

This section will specifically introduce the implementation of detail. It will begin with an overview of the implementation detail, and continue with an explanation of it by using the UML class diagram.

7.3.1 Overview

The early version of the TIP system was implemented using the Struts Framework. Normally the information was provided all display by JSP page. Since more interaction and real time functionality has been recently added to the TIP, the web based TIP system no longer fits the future needs of TIP. To implement more functionality well, more and more Java technology is used on the TIP system, such as Applet, Java Web Start, and the client application that is used on the Travel Plan Service (Huang 2006). This means it needs some additional packages run outside the Struts Framework and cooperating with the part of the TIP which is run inside to the Struts Framework and TIP database. The Audio Icon and Audio

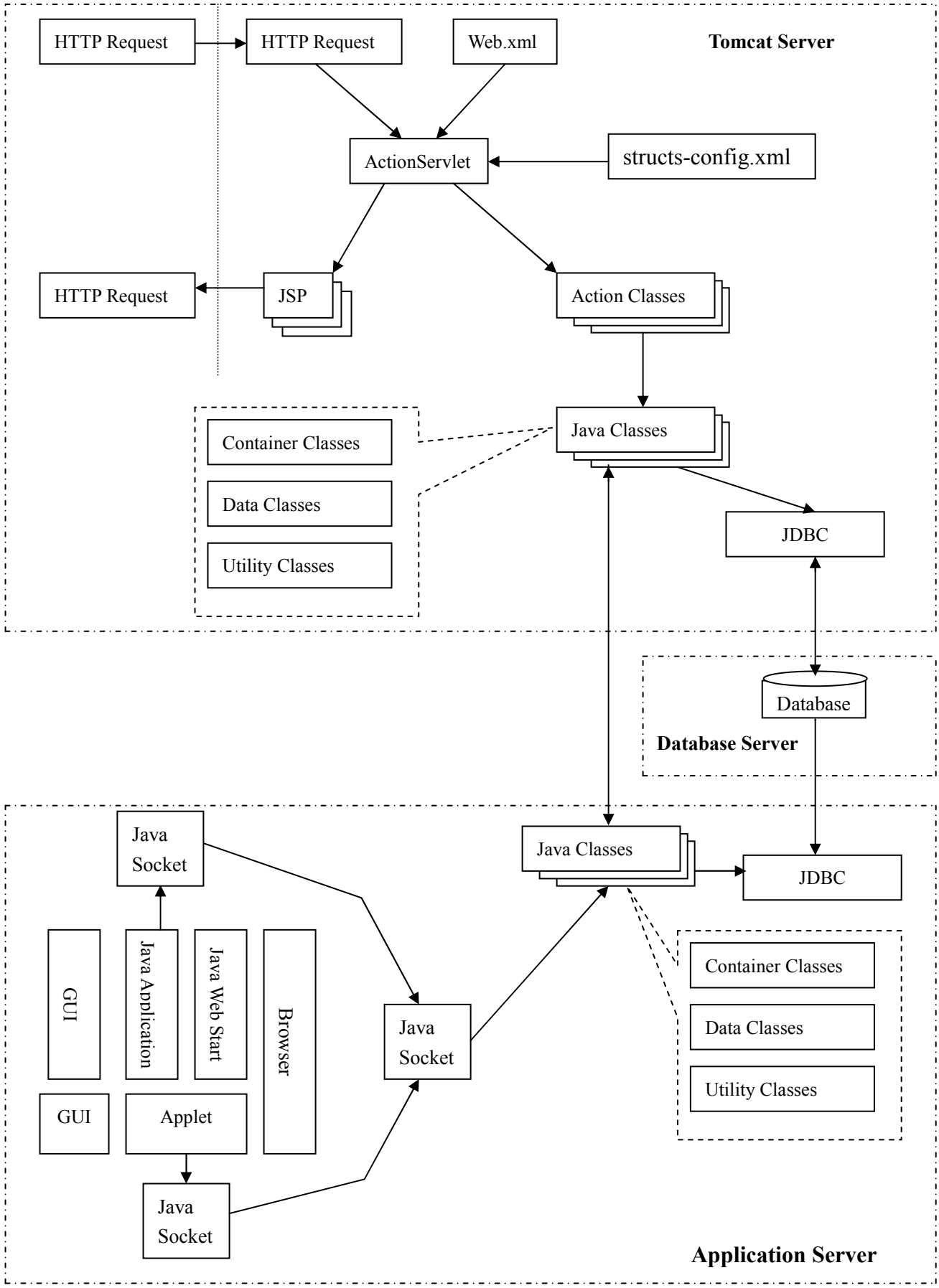


Figure 7.4. Implementation Structure

Books Service use Applet, Java Web Start, Java Application, and DHTML for a dynamic update of JSP.

7.3.2 Implementation Structure

Figure 7.4 shows the implementation structure of the Audio Icon and Audio Books Service. In this figure there are two very different technologies used. One part of the system still uses the same structure as the early version TIP system, but the other part uses the Java application. To implement the greater functionality described in early chapters of this report, this service has been implemented on both the Struts Structure and the Java application program. The flow of implementation will be explained in the following paragraphs.

A) Interface

The interface has been implemented in three different technologies. The first is by typical html page in the browser, which is the main interface of the TIP. The html pages are generated from the JSP. The other two type of interface are all embedded in the browser or pop up from the browser.

A Java Applet that is an embedded component of the browser implements the second type of interface. This interface is built based on GUI as its main interface to allow users to take interactions with the system. The third type of interface is also based on GUI but the next layer stands on the Java application. This Java application program will be carried out and executed on the client side by the Java Web Start.

B) Action Servlet

The action servlet is responsible to implement the *Audio Display Manager* and

Recommendation Information Manager. It will receive the HTTP request sent by the *Nearby Location & Playing Indicator*. It will trigger the related action class to renew information on the JSP, which displays the nearby information. The new information comes from the *Notifier*. Working as an action servlet in Struts, a configuration file is used to find the request action class. This file is named web.xml and deployed in Tomcat. The file structs-config.xml is used to pass a HTTP request from a client to a related action class.

The action classes are a kind of controller component that is written by the developer, and used to complete the mission of the request. In this project the mission is loading information for the new location. The new information includes recommended location details, currently playing audio, and available Audio Books. The coordinate of the new location will be included in the request. This action class will call the recommendation package to get recommendation information, for which it also has to be connected to the database by JDBC. In addition, an action class is responsible for loading and saving the user parameter to the database. This process will be performed with the help of Java class, including the Java class in the *Application Sever* named in Figure 7.4 program that is outside the Tomcat.

The role of the Java class inside the Tomcat is to help the action class to process application and retrieval data. There are three different types of Java class, the *utility class*, the *data class,* and the *container class*. The *utility class* is implemented on the *Audio Display Manager*, *Recommendation Information Manager,* and the *GPS simulation*. They are used to detect and renew the information for the *Nearby Location & Playing Indicator*. The interface will pass the requests to the *Audio Display Manager* and *Recommendation Information Manager* in a specific period. Whenever the interface sends the request the *utility class* will check with the *GPS simulation*. If the location is changed the *utility*

class will call the *Recommendation* component that is developed in Saijai's thesis (Junmanee S. 2005). The *data class* and *container class* help with the *utility class* retrieval information from the database.

After the request is processed, the data will be carried to the Struts Action Servlet. The last task of the *Audio Display Manager* and *Recommendation Information Manager* is to convert the data to html and display it on the *Nearby Location & Playing Indicator*. The Struts Action Servlet will fill the data to the particular JSP based on the configuration of structs-config.xml. The final response will be generated and sent back to the client.

A different type of interface has been implemented based on the GUI (Graphic User Interface) of the Java application program. The GUI is used to activate the real time interaction between users and the system. One type of the GUI is implemented on the applet that is embedded in the browser. But the browser's role is only carrying the GUI to the applet and then to the user. The applet can communicate with the *Application Server* to complete its functionality. The applet uses a Java socket to send and receive data packages with the *Application Server*. This interface is referred to as the combination of the *Audio Receiver* and *Audio Remote Control*. A Java application program was built in the *Audio Receiver* to send the user ID to the *Application Server*, receive audio data, and play the audio. When users make some action on the interface of the *Audio Remote Control*, it will send a data package that contains some control information. So the system can complete some functionality independent on the Struts structure.

The other type of the GUI is implemented on the Java application that runs on the client side based on the JWS (Java Web Starter). The JWS is only responsible to transfer the Java Program from the server side to the client side and keep the program updated. Users only need to download them the first time they access this

function. The downloaded Java application program will run on the client side as a normal Java program and independent of the JWS. This kind of interface is used to implement the *Text-to-Speech Client*. As with the Java application program implemented on the applet described in the last paragraph, the Java application based on the JWS will still use a Java socket to communicate with the *Application Server* on the server side. This kind of Java application program still sends requests to the *Application Server* with the user ID for identification. When the Application Server receives the request, a response will be sent to the JWS based on the Java application program, such as the place name in the text that is being played on audio. This process runs as a Java application program and communicates by Java Socket, so this element of the implementation is independent of the Struts structure.

In this project there is a Java application that plays an important role. It is a developer write Java application package that runs a server outside the Struts structure. As with the normal Java package this software runs a Java class on Java Virtual Machine. This package uses a Java Socket to communicate with the Java Socket of their client. We refer those Java classes to a large part of the Audio Icon and Audio Books Service component, including the *Notifier*, *Audio Icon Manager*, *Audio Books Manager,* and the *Audio Server*. As with the description in the early sections, the Java class can include three different types of class. The *data class* and *container class* help with the *utility class* retrieval information from the database. The *utility class* is the main type of class to develop those components. When the client includes the Applet and Java application on the JWS request to the server and identifies themselves by sending their user ID, they are related to through the network connection and the server will process the request and send back the data package as a response. The request and response can be anything related to the *Notifier*, *Audio Icon Manager*, *Audio Books Manager,* and *Audio Server*. This application server can also communicate with the Java class inside of

the Struts structure by a created instance between the two packages rather than the network connection based on the Java Socket. So these Java classes outside the Struts structure can provide more functionality for the system as an extension of the Struts structure.

We have introduced those elements of the implementation of the Audio Icon and Audio Books Service with the cooperation between the Struts Framework and the Java application, to describe the structure of our implementation. As same as other service of the TIP this service still uses the *Struts Action Servlet* as the main controller of the process of service, with the help of the Java Class. The response will be sent to user's browser via the JSP. The main controller will communicate that the Java application is to control the flow of the process outside of the Struts structure. The Java application has its own controller as a second controller to control other classes related to the *Application Server* to implement more functionality independent of the Struts Framework. The response will be sent to the user on their GUI. The system can be a combination of the Struts Framework and the Java application program to provide sufficient functionality in the design section for users.

7.3.3 Implementation

This section will begin by explaining the class diagram of the implementation. All the classes will be introduced in general to present their functionality and their relation to each other. Then a sequence diagram will be presented to explain the coordination of those classes and the flow of performance.

The implementation structure described in Figure 7.4 has been implemented as in the class diagram presented in Figure 7.5 (a). This class diagram describes all the

classes involved into the Audio Icon and Audio Books Service. Any class that is not related to this service has not been included in this class diagram, so it is not the class diagram of the whole TIP system. The classes include those in the Struts Framework and in the Java Application. The action classes exist inside the Struts Framework, and the Java class and data class exist in both the Struts Framework and the Java application program. All of the action classes are descended from the *org.apache.struts.action.Action* class. Those action classes are related to their Java class to complete their task.

The *audioServiceSettingForm* can generate a form on JSP to allow users to set up their parameter. The *audioServiceSetting* class is able to save and load those parameters from the database with the help of the data class. The *audioServiceSettingAction* depends on the two classes to complete the function of setting the user parameter. The *GPSsimulationAction* is also an action class in the Struts Framework, but is related to the classes outside the Struts Framework. It can read a group of coordinates from a data file to simulate the real GPS on the mobile device. Some instances have been created between this class and other classes outside the Struts Framework to allow those classes to communicate with each other. Whenever the coordinate is changed the *nearByAudio* class will be called. The coordinates are also passed to the *nearByAudio* class, which can then call the Recommendation Component to receive the recommendation information.

The place name will be loaded and passed to the *BroadcastTextToSpeech,* which is a server to send the place name in text to the *TextToSpeech.Speech* class on the client side. The audio information related to each recommended place will be attached on the recommendation information in the *nearByAudio* class. Following that they will be passed to the audio server that is running by *audioQuoteSeverThread* and *audioQuoteSever*. The audioQuoteServer is used to activate the audio server from the *locationAction*, run the *audioQuoteServer* in a

different thread with the Struts Framework, and load the audio stream from audio files. When the *audioReceiverApplet* starts it will create a connection with the *audioQuoteServerThread* class. When the *audioQuoteServerThread* receives data from the *nearByAudio* class it will load the audio data based on the direction of the *nearByAudio*. The extra audio data will be mixed, as in the design in Chapter 6, in the *MixingFloatAudioInputStream* and sent to the *audioReceiverApplet*.

The *audioReceiverApplet* is able to receive the audio data and play it to user. The *audioQuoteClient* perform all of the functionality of *audioReceiverApplet* as its dependence class. The *audioReceiverApplet* class is the class who call *audioQuoteClient* and it allow the *audioQuoteClient* class run on applet. The *RefreshNewLocAction* is responsible to load the recommended sight name and the current playing audio ID from the *audioQuoteServerThread* class, including the relationship between the name and audio. The *StopAudioAction* is used to activate the action to stop a specific audio when users click any of the sight names. This class descends to the *universalRemote* class, which can connect to the *universalRemoteReceiver* on the server side via the network connection of the Java Socket. The *universalRemoteReceiver* is able to control the *audioQuoteServerThread* to send or stop sending some particular audio data, depending on the control data received from the *universalRemote*. The *StopAllIconApplet* class is similar to the *StopAudioAction* class but it is triggered by the applet and stops all of the playing audio. It still connects to the *universalRemote* class to send its control information.

Now we introduce the classes related to Audio Books Service; these classes still cooperate with the class introduced above. *AudioBooksController* class is the central controller of the Audio Books Service. It is responsible to control the processing of classes of the Audio Books Service and pass data between those classes, such as pass audio information to *AudioSever* in order to play audio to

users. It is able to process and pass data to next interface action of the Audio Books Service. The *RefreshNewLocAction* not only display the information for new location but also what indirect Audio Books are available for a sight. The books information will be carried by HTTP session and pass it to *showBooksAction* class, which is able to display Audio Books information to user via JSP struct, include book title and book author, and it is a literature or reference book. This class allow user to select their books at this point. The *SelectChapterAction* is able to display all the chapter of the selected book to user and allow them to choose how to play any of these chapters, such as playing in audio or seeing the text in Greenstone.

The users' decision will be passed to the *AudioBooksController* class to process. *AudioBooksController* is able to recognize the user selection, send notification to the Audio Sever in order to send audio stream to client, restore audio information in the now-playing list, or query Greenstone digit library. If the user selects their order by Travel Plan Service, the *ChapterOnTravelPlanAction* will be activated. This class is able to load the travel plan data, which is saved by Travel Plan Service from database and attach available chapter to the sight, and then provide the travel plan to users. When a travel plan is selected, all of the related chapter will be added to the now-playing list based on the sequence of the travel plan. If users choose play the book in audio, the *AudioBooksController* class is able to provide the play state for *audioBookControlPanelAction*. The interface provide by this action is able to display the now-playing list and allow users to control it. If users decide to use TIP/Greenstone Service, the *AudioBooksController* class will call the TIP/Greenstone Service component. The *AudioBooksController* class is able to make query by the chapter name and other information, and then send it to the TIP/Greenstone Service component.

The TIP/Greenstone Service component is able to provide the text of the Audio

Books. A function has been added to the TIP/Greenstone Service component rather than the early version of TIP/Greenstone Service. It is able to forward the text from Greenstone Digital Library to the *speechBookAction* class. By this class users still have the choice of the speech of the current text or add it in to the now-playing list of speech.

Figure 7.5 (b) shows the group of data classes that are used to save data and access the database to help the performance of those Java classes in Figure 7.5 (a). Most of the Java classes in Figure 7.5 (a) are related to many of the data classes in Figure 7.5 (b), so they are not listed in the same figure.

During the overview described in the last paragraphs, the functionality of classes was introduced. These next paragraphs describe the activity between those classes by using a sequence diagram to complement the class diagram. The Audio Icon, Audio Books and Audio Control System will be introduced separately, because it is difficult to describe the sequence on a same sequence diagram when those sequences may happen at the same time.

Figure 7.6 shows the sequence diagram for the activity of the classes when the system performs the functionality of the Audio Icon Service. This sequence starts with the *GPSsimulation* class, followed by the data exchange of those classes, and ends by the delivery of information to users. Whenever the *GPSsimulation* class generates a new coordinate it will trigger the *nearByAudio* class. The *nearByAudio* class will forward the coordinate to the *Recommendation Component* that is referenced to the Advance Recommendation Service. The *Recommendation Component* is able to provide advanced recommended sight for users, based on argument using three paradigms, collaborative filter, content-based, and knowledge-based (Junmanee 2005). When the *nearByAudio* receives the response from the *Recommendation Component*, this class needs to

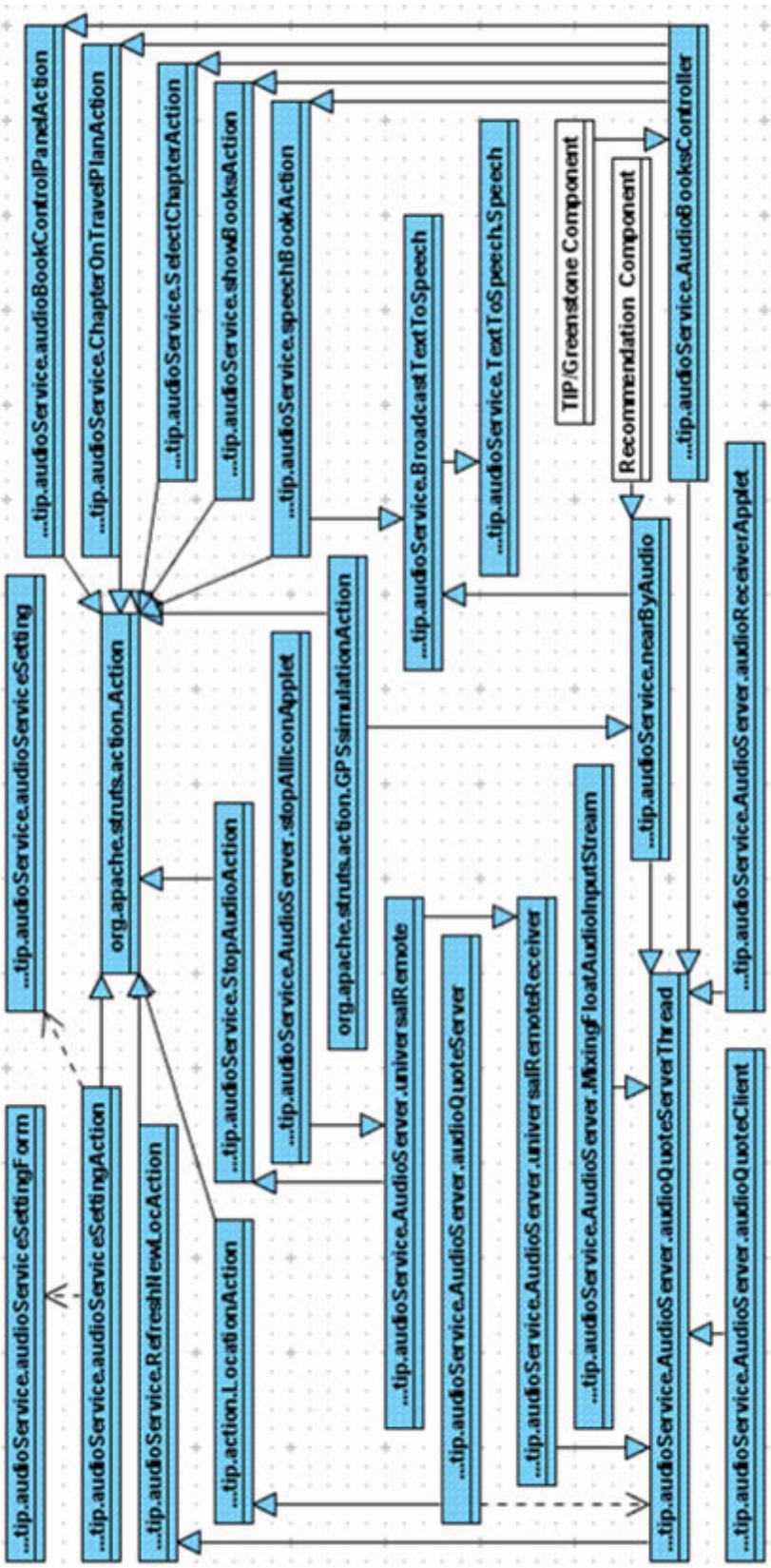


Figure 7.5 (a). Class Diagram of Audio Icon and Audio Books Service

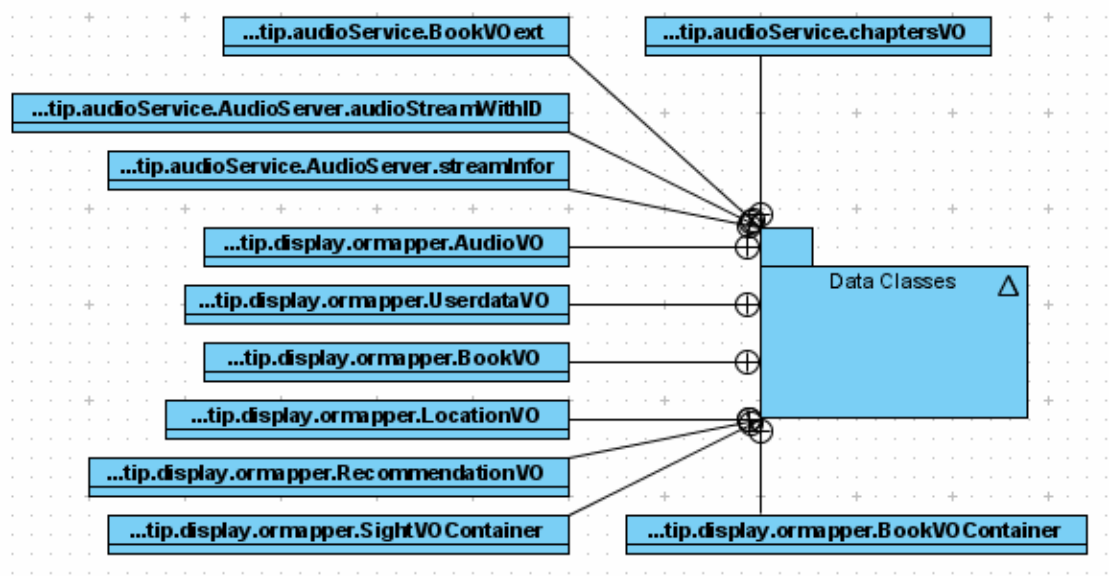


Figure 7.5 (b). Class Diagram of Audio Icon and Audio Books Service

query the database for the audio information of this sight, as the Recommendation component does not attach it. The identifications of the audio will be retrieved from the database, as described in Section 7.2.5, and forwarded to the *nearByAudio* class, so that the information needed for this sight is now ready to send to the user. It should be noted that sequences 6, 10 and 13, as Figure 7.6 shows, happen at the same time. They perform to display sight information and point to the sight name, as directed by the playing audio on the web page, thus notifying users by audio and speech. The recommended sight information will be kept in the memory and wait for the *RefreshNewLocAction* to check for any change. The *RefreshNewLocAction* will check the memory in a particular period to detect the arrival of new information. The information includes the recommended sight and the identifications of the audio that is playing currently. The audio will be paired with the recommended sight that they directed for. This group of information will be displayed to the user on the interface via *org.apache.struts.action.Action* and the paired JSP. Users will know which recommended sight the audio is directing them to.

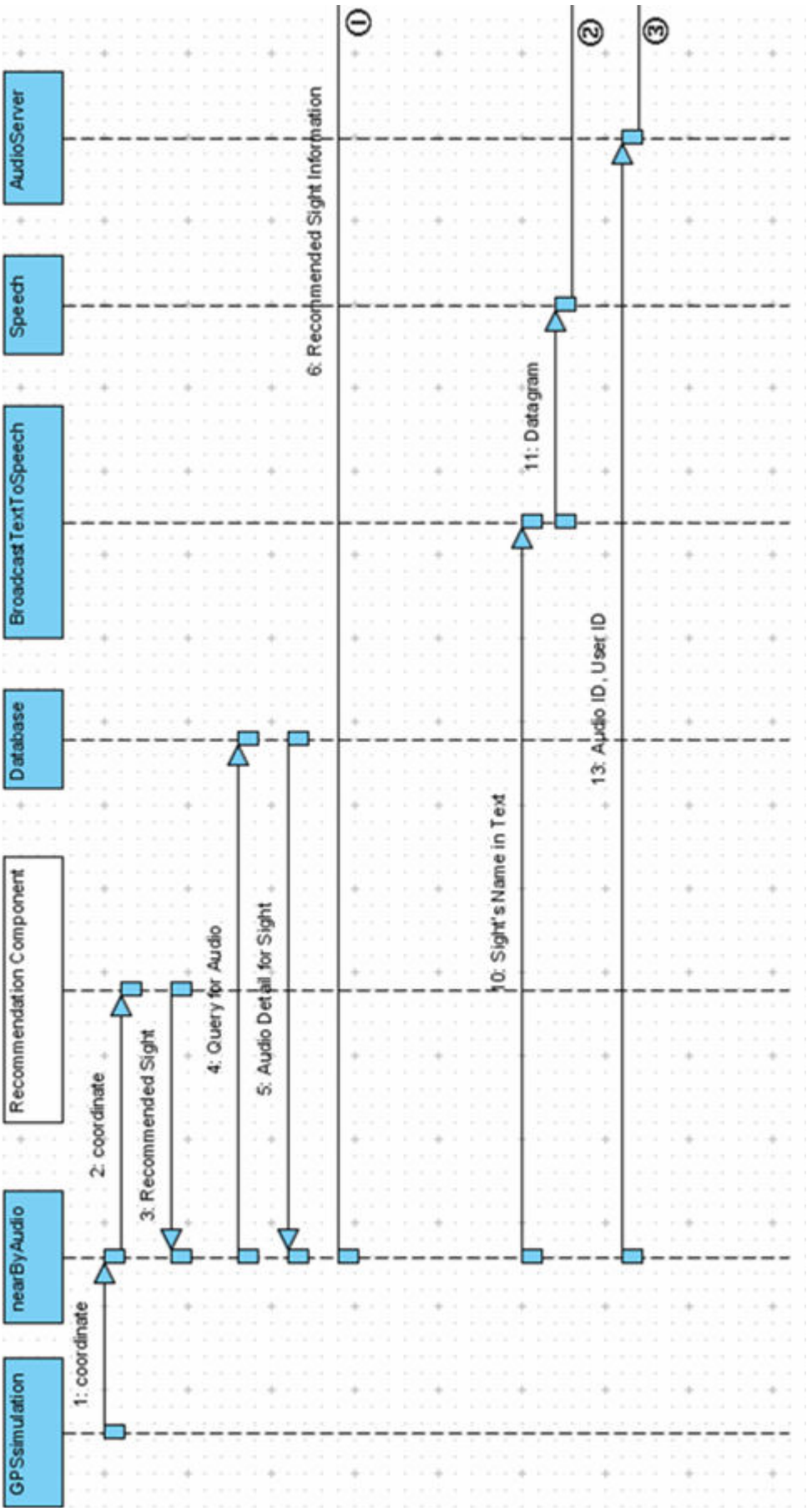


Figure 7.6 (part 1). Sequence Diagram of Audio Icon and Audio Books Service (Performance of Audio Notification)

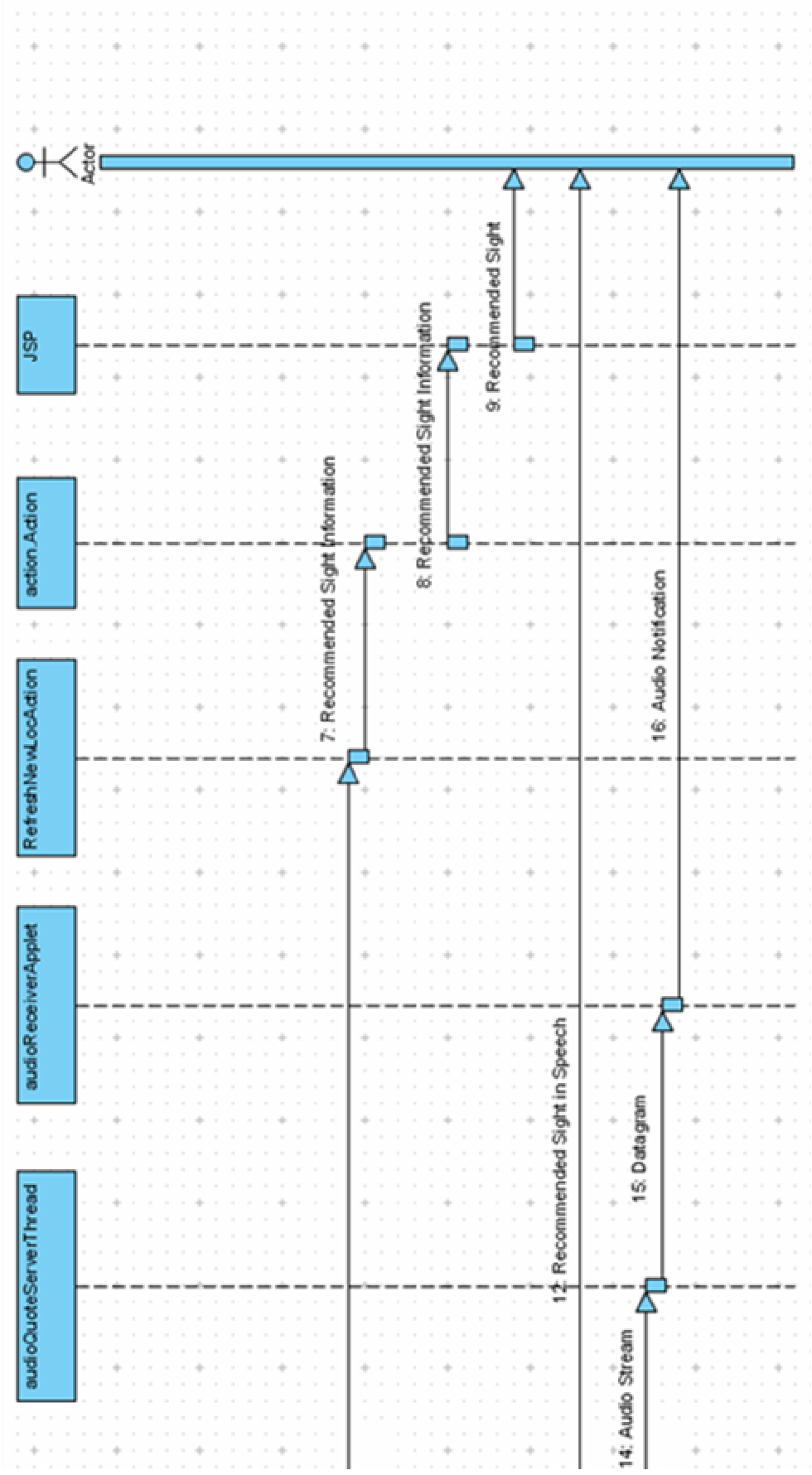


Figure 7.6 (part 2). Sequence Diagram of Audio Icon and Audio Books Service (Performance of Audio Notification)

Sequence 10 carries the sight names from the *nearByAudio* class to the *BroadcastTextToSpeech* class. The *BroadcastTextToSpeech* class is a server to send a datagram, the content of which is the sight name, in text to the *Speech* class as its client. The *Speech* class will connect the *BroadcastTextToSpeech* class with their user ID, so the clients can be identified. When the *Speech* class receives the sight name in text it is able to play the speech to users to tell them the sight name in speech. At the same time, the sequence 13 will send the audio ID related to those recommended sights with user ID to the *audioServer*. The audio files will be loaded and converted to the audio stream by the *audioServer* and sent to the *audoQuoteServerThread* class. The audio stream will be mixed in the *audoQuoteServerThread* class as described in Section 7.2.8. The *AudioReceiverApplet* will build a connection with the *audoQuoteServerThread* by sending the client's user ID, so only that particular user can receive the datagram. The datagram content audio data will be sent to the *AudioReceiverApplet* when it completes the playing of the last datagram to perform the design purpose of real time control, so there is not too much data left in the client side. The audio is able to play to users as notification to implement the functionality of the Audio Icon Service.

Figure 7.7 shows the sequence diagram of the user control function, including the real time control and setting user parameter. The *universalRemote* class and *universalRemoteReceiver* form a server and client pair to carry control information from the client side to the Audio Icon Service server. When users click a button on the client side the *universalRemote* will communicate with the *universalRemoteReceiver* and send control information to the server side. This control information will be forwarded to *audioQuoteServerThread* class to update the audio detail and control the mixing of audio. The mixed audio stream will be changed, based on the control information. Also the control information can be send by the instance created between *RefreshNewLocAction* and

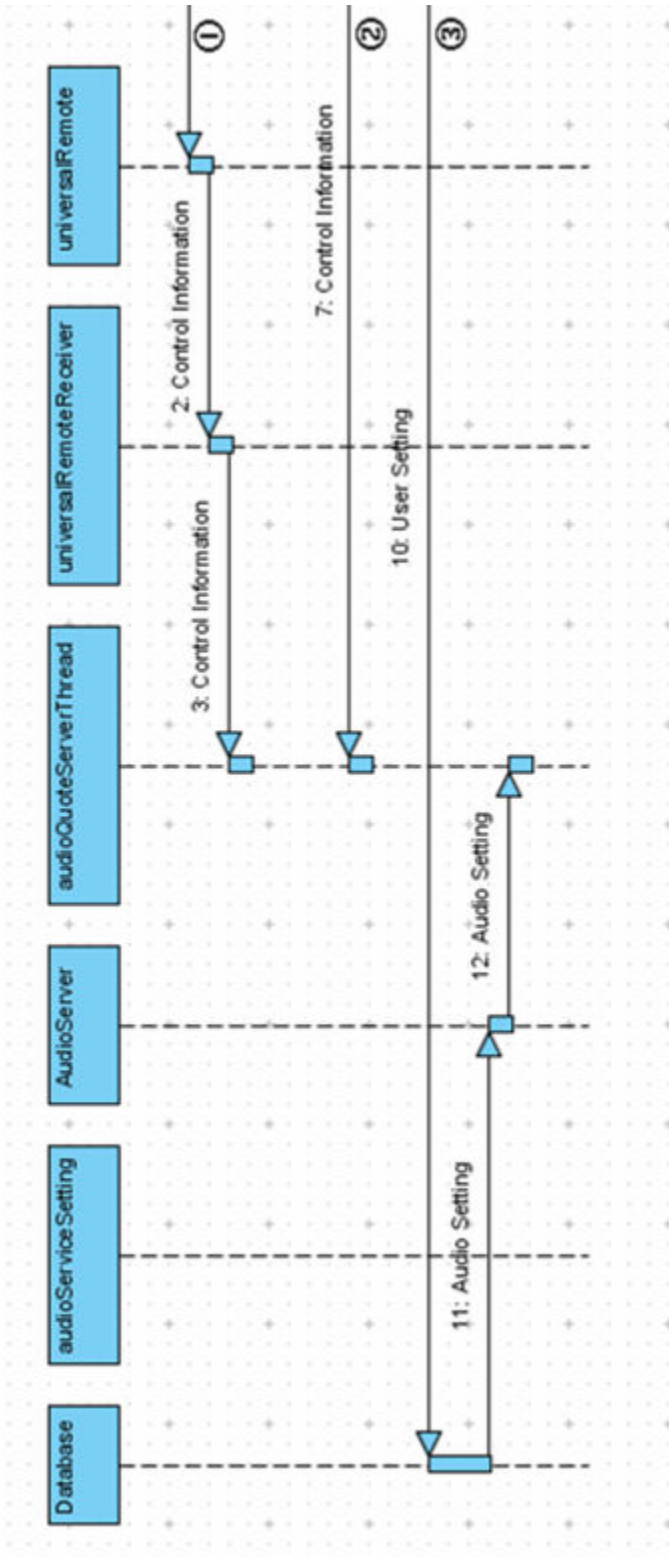


Figure 7.7 (part 1). Sequence Diagram of Audio Icon Service (User Control Section)

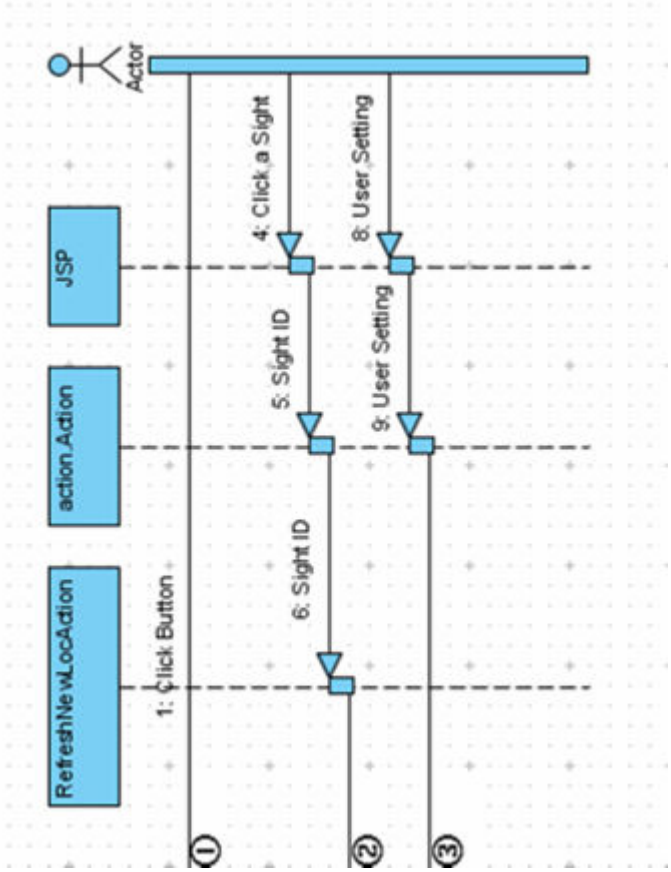


Figure 7.7 (part 2). Sequence Diagram of Audio Icon Service (User Control Section)

audoQuoteServerThread class. When users click on any sight on the JSP the *RefreshNewLocAction* will send control information to stop the audio of this sight. It will perform the same functionality as the *universalRemote*. When users open the audio setting page and submit their setting detail, the *org.apache.struts.action.Action* class, as a normal process of the Struts Framework, will call the *audioServiceSetting* class. The setting will be saved in the database by the *audioServiceSetting* class. When the *audioServer* starts, the setting will be retrieved and loaded to the *audoQuoteServerThread* class. So it can mix the audio stream as the setting describes, such as playing the audio one by one or playing them at the same time, and repeat them in any remaining time.

Figure 7.8 shows the Sequence Diagram of Audio Books Service. This service is controlled by Audio Books Control Panel instead the control system of Audio

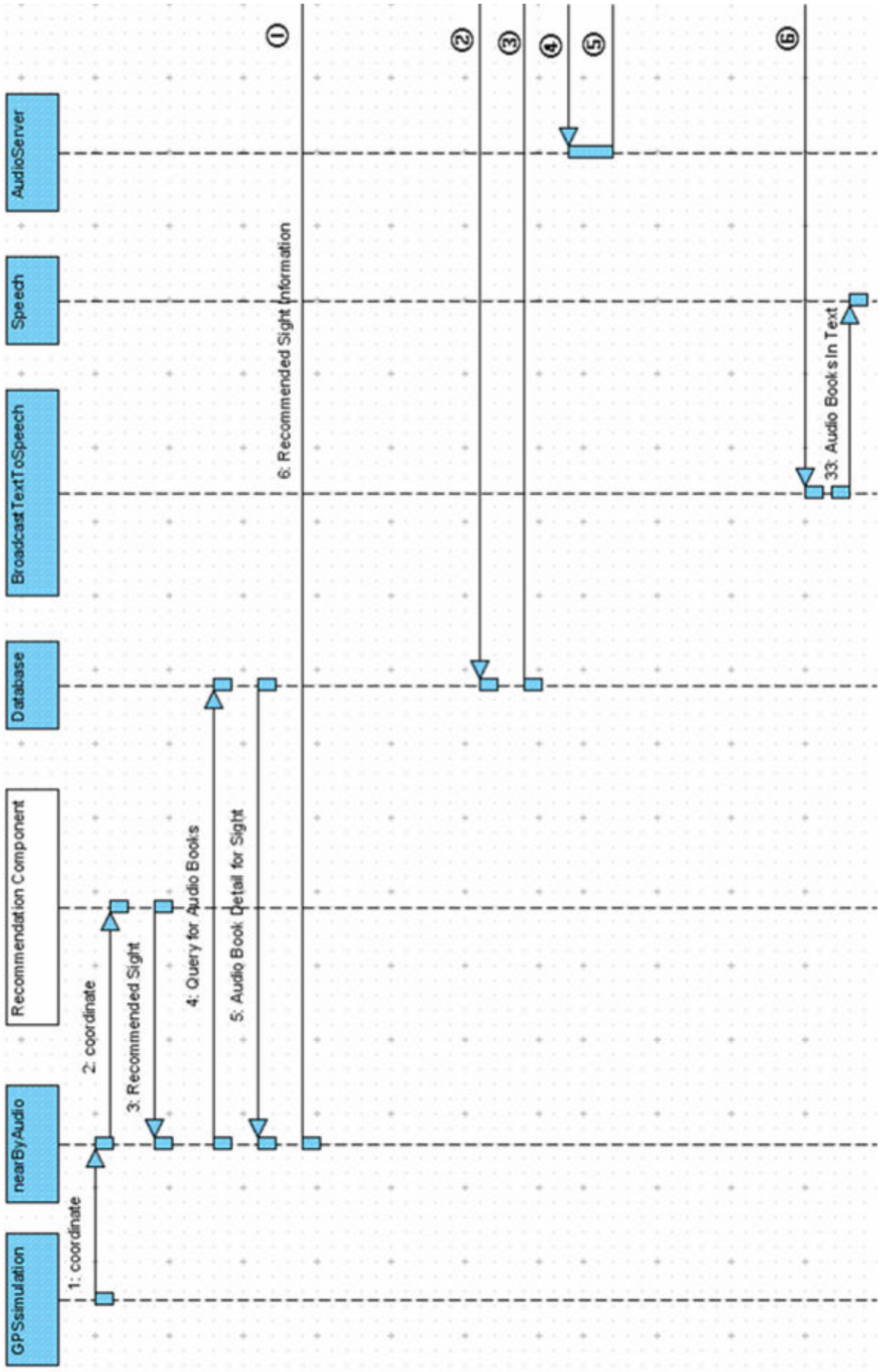


Figure 7.8 (part 1). Sequence Diagram of Audio Books Service

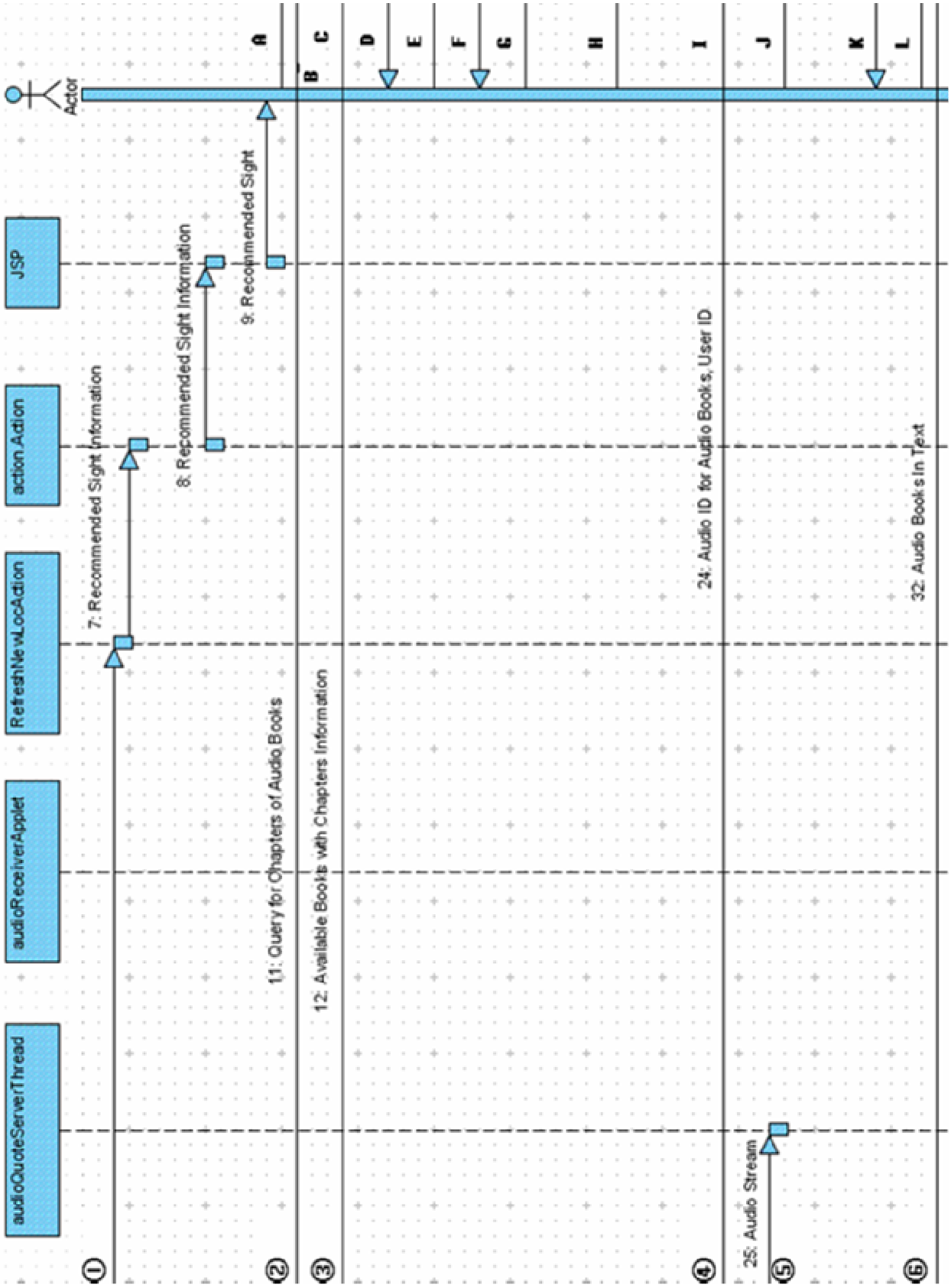


Figure 7.8 (part 2). Sequence Diagram of Audio Books Service

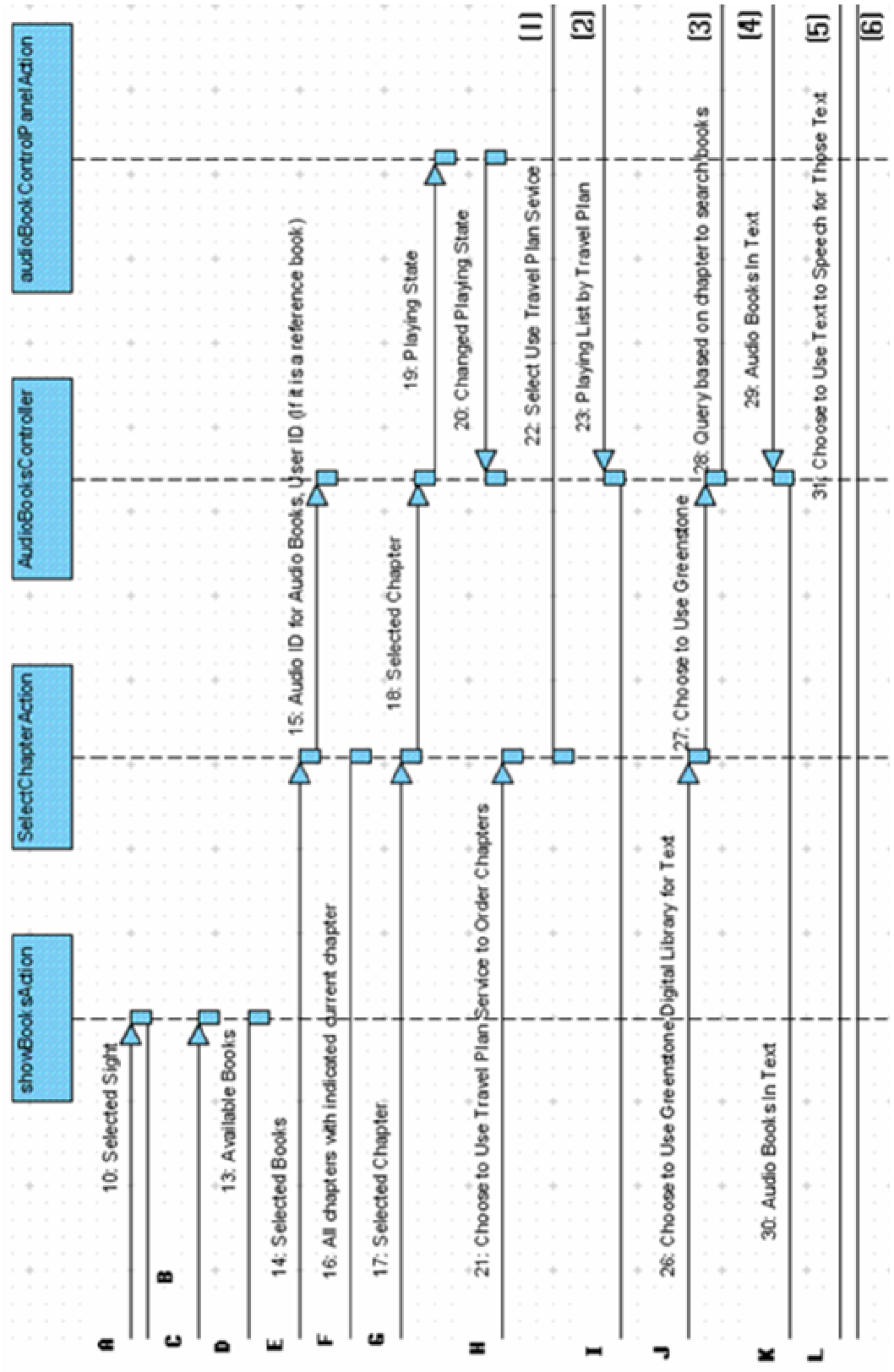


Figure 7.8 (part 3). Sequence Diagram of Audio Books Service

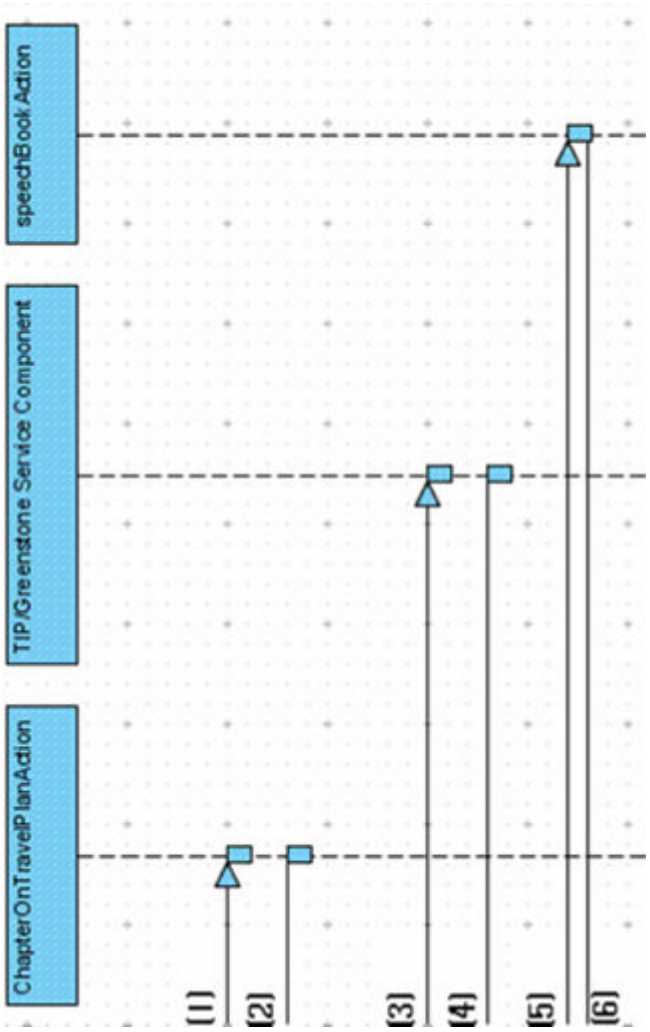


Figure 7.8 (part 4). Sequence Diagram of Audio Books Service

Books described above. As with the Audio Icon service this sequence start at the *GPSsimulation* and activate the *nearByAudio* to call the *Recommendation Component* by passing the coordinate. When the *nearByAudio* receives details of the recommended sight it will attach the Audio Icon information and the chapters of Audio Books that related to this sight. The final recommended sight information will be forward to *RefreshNewLocAction*, and then display the information will be displayed to user thought JSP struct. This process happens between the Step 1 and Step 9.

The interface can notify users by sound and a hyperlink on JSP, if an Audio Books

is available for any sight of the recommended sight. When users receive the notification sound they may click the hyperlink to activate the Step 10. The *ShowBooksAction* will query the database for the detail of the book related to this chapter. As the Step 13 shows, the *ShowBooksAction* will provide all information of the books that have at least one chapter related to that sight, including whether it is a reference book or a literature.

When users select any book the process will turn to *SelectChapterAction*, which is able to list out all of the chapters by chapter name for this book. The chapter that is related to the current selected sight at Step 10 will be display as bold. The users' choice may direct the process to go to different play model. For example, Step 15 which deal with the situation when user select any reference book, Step 17 for when users decide to play the Audio Books normally, or Step 21 for their decision to use the Travel Plan Service, Step 26 when they decide to read the text about this chapter or listen to the Text-to-Speech of the text from the TIP/Greenstone Service.

In more detail, the Step 15 is activated if the book is a reference book and users does not need to read another chapter, this class will forward the audio to the *AudioBooksController* imminently so it can notify the *AudioSever* to send audio stream to a particular user like the Step 24 shows and jump over some steps that process a literature.

Step 17 operates if the user decides to play the normal Audio Books; this book will be added into the now-playing list that is controlled and displayed by *AudioBooksControlPanel*. The last entered audio will be added to the tail of the now-playing list. The interface allows user to view the chapter title that is playing currently and the chapter titles in the now-playing list. Users can decide when to play, stop or remove any audio from the list by clicking a hyperlink on the JSP,

and they are also able to clean the whole list. The audio detail of current playing audio will be forwarded to the *AudioSever* by Step 24, which is the same as other play model that uses *AudioBooksControlPanel*.

Step 21 applies if the user decides to use the Travel Plan Service to make an order to listen to their Audio Books. The books information will be carried to *ChapterOnTravelPlanAction* to make a reading plan. This class will query the database and load the travel planning that was previously saved in database by the Travel Plan Services, so that users may choose one from them. Any of the plans may content a sequence of sight as a travel plan route. The *ChapterOnTravelPlanAction* will search database for every chapters related to the sight in the selected travel plan. (Due to the small space of figure, the query database is not shown in it.) The *ChapterOnTravelPlanAction* will add those chapters based on the sequence of those chapters the related sights appearing in the selected travel route, if users decide to use this route. Here the user may still control those audio in the now-playing list by Step 19 and Step 20. The audio detail will be forward to *AudioSever* as in the last two models.

Finally to be considered is the play model that uses TIP/Greenstone Service. As introduced in Section 2.6, the TIP/Greenstone Service is able to use the place name as query to search related information in Greenstone Digital Library. When users choose to use TIP/Greenstone Service the *SelectChapterAction* will pass a query, as to the content of the chapter titles instead of the place name, to TIP/Greenstone Service by Step 28. The TIP/Greenstone Service will search for chapters based on the query. Users still can still select the chapters from many searched result, just the same as if they are using TIP/Greenstone Service. When the text is listed out users may click hyperlink on the JSP to play the text in Text-to-Speech, or add the text to the now-playing list of Text-to-Speech. In this situation the *SpeechBookAction* will be activated to send the text of the chapter

that is shown to users, to *AudioBooksControlPanel*. Those actions are completed between Step 29 and Step 31. The *SpeechBookAction* will forward the text to the *BroadcastTextToSpeech* and the *Speech* class, which is used to as speech of the sight name in Audio Icon Service, to implement the Text-to-Speech for book chapters by Step 32 and Step 33.

Chapter 8

Evaluation

This project contains not only the design and implementation of the Audio Icon and Audio Books Service via Digital Library, but also an evaluation of the effectiveness of these services. This chapter is an evaluation of the implementation of this project, both qualitative and quantitative.

8.1 Qualitative Evaluation

Qualitative evaluation is used to test the functionality of the Audio Icon and Audio Books Service via Digital Library component. The mission of this section is to test the effectiveness of the Audio Icon and Audio Books Service, and the giving of notification to users. This will start with an explanation of the data that is going to be used in this qualitative evaluation, followed by user scenarios with the screenshot from the TIP system to verify the functionality of the Audio Icon and Audio Books Service component. The detail that forms these user scenarios will be analysed at the end of this section to determine the result of the qualitative evaluation.

8.1.1 Setting of Evaluation

The current data employed by the TIP system will be involved in this study. The

TIP development team has used this dataset for the last two years. The number of sights in the dataset is over one hundred. These sights include public art located in Hamilton, New Zealand, the Waikato University campus buildings, and others. This particular test concentrates only on the audio notification and the presentation of the Audio Books and their additional program, and therefore the sight group that those sights relate to is not included here.

The coordinates are loaded from an html file that is used as a simulation of the GPS, by clicking a place on the web page in the early version of the TIP system. The coordinate will be changed each 30 seconds for testing purposes. The travelling speed is much faster than that of the real tourist.

Audio files are inherited from the early version of the Audio Books and Audio Icon Service and downloaded from some free general audio set web pages on the Internet. The number of audio is counted as 31 audio files. It is difficult to find many free audios related to those sights, so that we use some other audio to do this evaluation instead of the audio that describes those sights. Another reason for this is that it has not yet been figured out what kind of audio is to be used to describe the kind of sights in this project. That is why we use Text-to-Speech to speech the sight name as an assistance program. Those audio can easily be changed when we have enough time for future development. This will be introduced specifically in the section that is used to analyse the testing result.

The Audio Books in text content two books and nine chapters, which have to reach the minimum requirement of this testing. The two books have been built by a component of the TIP/Greenstone Service to recognize the place name in the text, so it will meet the needs of the TIP/Greenstone service, as described in Section 2.6. The processed file will be build by the Greenstone Digital Library as collections. The index of these collections is based on the chapters level to allow

the Audio Books Service to search for the Audio Books in text based on chapters.

8.1.2 Result of the Functionality Test

In this section we will show how the Audio Icon Service notifies users to attend to the new sight around their current place, and how the Audio Books Service provides information by audio. Also, this section will show how the books in text and the speech of text help tourists. So this section is able to show how the TIP gives users a tourist guide in a very different way to the early version of TIP system. The analysis of these results will be discussed in the following subsection. To make the description of the process more clear, the Microsoft Internet Explorer on desktop computers was captured the screenshot to simulate the real mobile devices. Thus we retrieve the user scenarios for the new Audio Icon and Audio Books Service in Chapter 3 and use the real implementation to see how the system helps tourists, rather than the one based on design of the service.

Tom is a Hamilton tourist, and decides to visit the main campus of The University of Waikato to see the campus building. He still has his GPRS and GPS enabled mobile phone with him. As an old user of the TIP system he uses all of other services rather than the Audio Icon and Audio Books Service. When he is close to arriving at The University of Waikato he sets up his user parameters on the recommendation system to get good recommendation for his trip. After that, he uses the Travel Plan Service to make three possible routes to visit the campus and saves them in the system. When he arrives at The University of Waikato he walks on the campus path and tries to follow one of his travel routes saved in his Travel Plan Service system, and walks in the direction of the Department of Computer Science as his first destination. But he did not follow the previously saved plan completely because he disliked having to read the device, and instead watching

the landscapes and walks through the campus accordingly.

This Audio Icon and Audio Books Service use JSP Struct and Java Application, but this service is still connected to server so it needs a network enable mobile device. The Audio Icon and Audio Books Service is able to cooperate with other service of the TIP system, and therefore it is important to set up other services to prepare a better environment for this service.

He does set some parameters into the Audio Icon and Audio Books Service, and arranges the remain time as 10 seconds, which means there was a halt between the playing of each loop of Audio Icon. He also sets the playing model to play the audio one by one. He has not turned on the Text-to-Speech function yet, but he turns on the audio function. He also fixes the volume on his mobile phone to make sure he can hear the audio, but not too loud. Then he puts his mobile phone into his pocket and enjoys the walking on the campus.

When he gets into the campus he hear two audio sounds like a “door bell” and “people running” on his mobile phone. He looks at his mobile phone and sees an icon is directing what place the audio is directed to, as Figure 8.1 shows. He hears this audio again each time after 10 seconds, which he had set before. He clicks the title of the Waikato University, and the system shows the specific information about this sight. The audio for Waikato University is stopped at this time, but the audio for the Education Library is still going on. He keeps walking until the Education Library audio has disappeared.

This scenario of this paragraph is in reference to the Section 6.1. When users get into the region of sight the Audio Icon Service will notify user until they exit this region. The parameter is used to set up the halt between the next loop of playing. The playing model controls the audio to be play at same time or play one by one.

The play one by one model is reference to the Section 4.3.1 anti overlap. This project dose not concentrate on the volume so Tom uses the volume controller on his mobile device when he wants to change it.

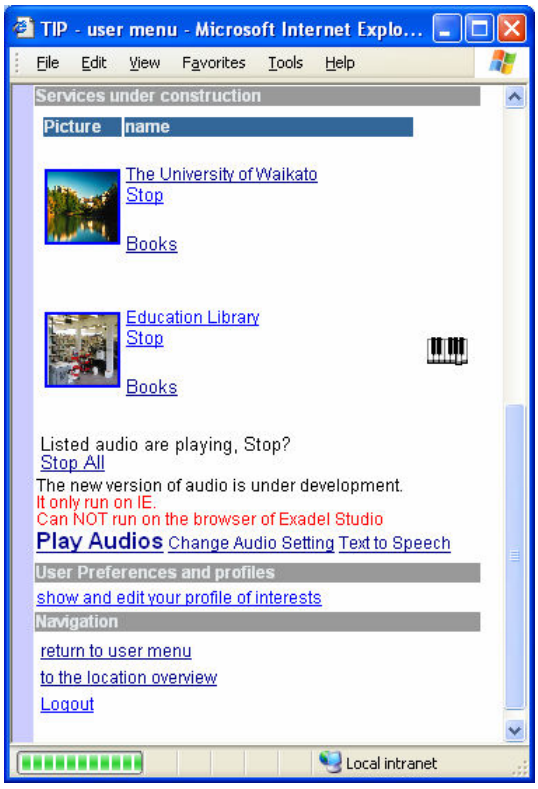


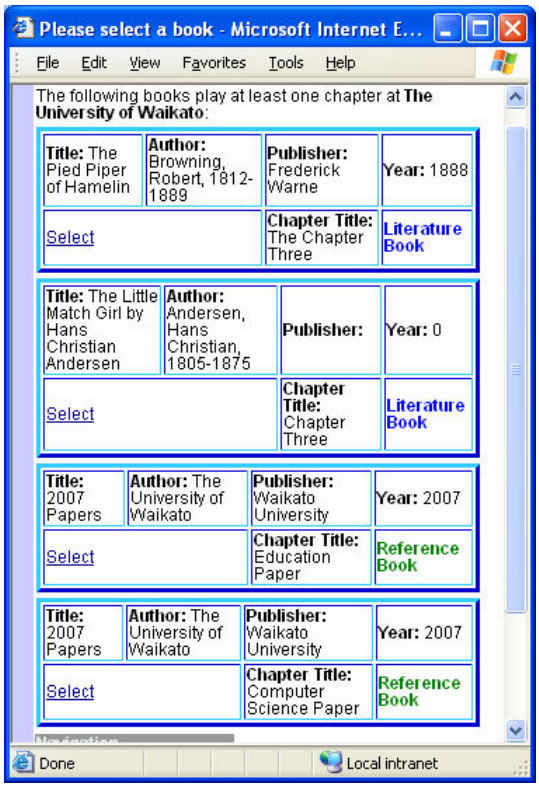
Figure 8.1. Audio Icon play one by one

Figure 8.2. Audio Icon play at same time

He gets more interested with the Audio Icons, and tries to change the user parameters and see what is happening. This time, he sets the remaining time as 30 seconds and the playing model as playing audio at the same time. After that he keeps walking in the campus and still leaves his mobile phone in his pocket.

Tom hears the many audios going on from his mobile phone, such as “electronic sound”, “coin on table”, “police pass by”, and so on. He watches on his mobile phone and sees the icon is telling him many audios are playing, as Figure 8.2 shows. When the audio is ending one by one the icons also disappear one by one.

After 30 seconds the system gets back to the situation and runs it over again. He checks the recommendations service he used before and finds these sights presented by Audio Icon and Audio Books Service are the same as what the recommendation service had displayed. When he clicks the “Stop All” button, all of the audio stops until the next cycle of remaining time. Tom tries to click the hyperlink named stop under the sight name, and the audio for this sight stops. He dislikes it when the audio is playing at the same time, so he changes the playing model to “play one by one”.



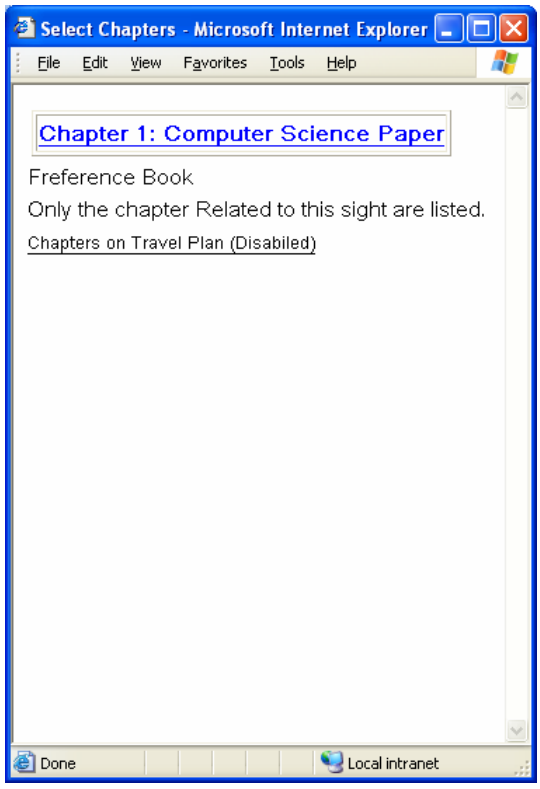


Figure 8.3. List of Audio Books

Figure 8.4. Select chapter section for reference book

The system allows the audio to be played at same time, so Tom will hear the audio start together. Because the lengths of audio are not exactly the same Tom hears the audio was ending one by one. The “Stop All” button is a button on applet of the

audio receiver window. The window popup when user clicks the “Play Audio”, as on screenshot Figure 8.1. This window is necessary to receive the audio from the server, the other functionality of this audio is stop all audio for the current cycle. After the remind time the audio will play as usual. There could be a control panel for future development. Because this window is sample, it seemed best not to put it into the screenshot group.

As Tom keeps walking, he hears an audio that is different to the others, with a sound like a “beep”. When he reads his screen he finds there is a hyperlink named books, as Figure 8.1 shows. So he clicks the books under The University of Waikato. In the next screenshot, Figure 8.3 appears on his screen. Tom sees that a list of books related to this sight is ready for selection. These books are displayed

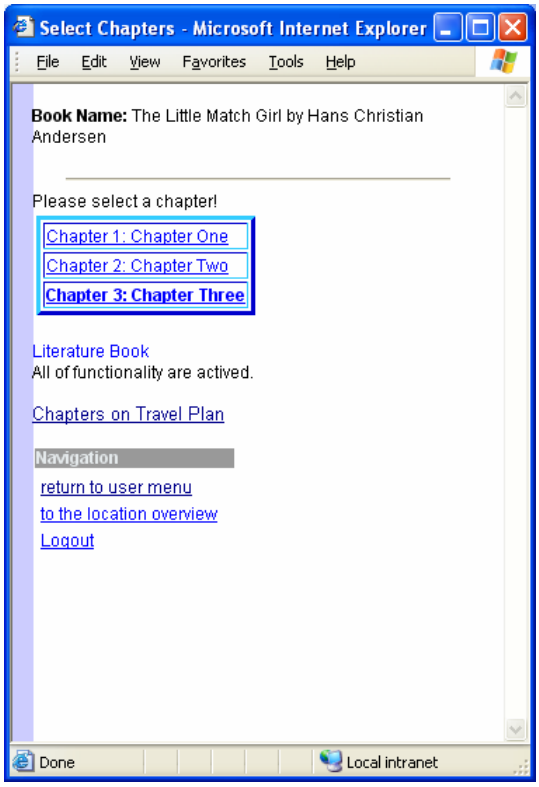


Figure 8.5. Select chapter section

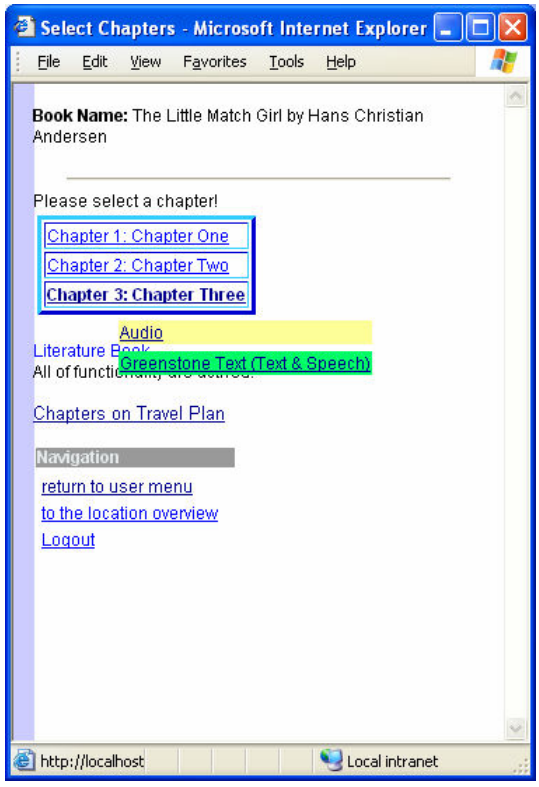


Figure 8.6. Select chapter section with playing model

as Title, Author, Publisher, and Published year. The various word colours display the book type. When Tom selects a book that is a reference book, the system goes to the screenshot as in Figure 8.4. On this page there is only chapter one for computer science papers. When he clicks the hyperlink the system plays an Audio Book about this year's papers. Tom goes back to his web browser to the "Select Books" section and selects a literature book named "The Little Match Girl", and the screen turns to the screenshot shown in Figure 8.5. Tom finds a bold chapter name, which indicates the current chapter. When he clicks it a popup window appears to allow him to select an option between audio and Greenstone text including Text-to-Speech. When Tom clicks the audio the system turns to the playing control page as shown in Figure 8.7. He hears the Audio Books for chapter three of "The Little Match Girl" being played. Also he sees a hyperlink

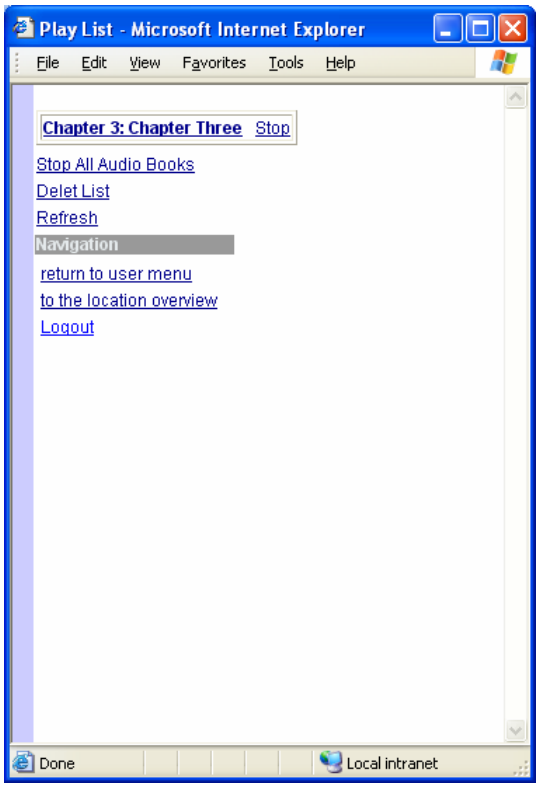


Figure 8.7. Playing list with one audio added

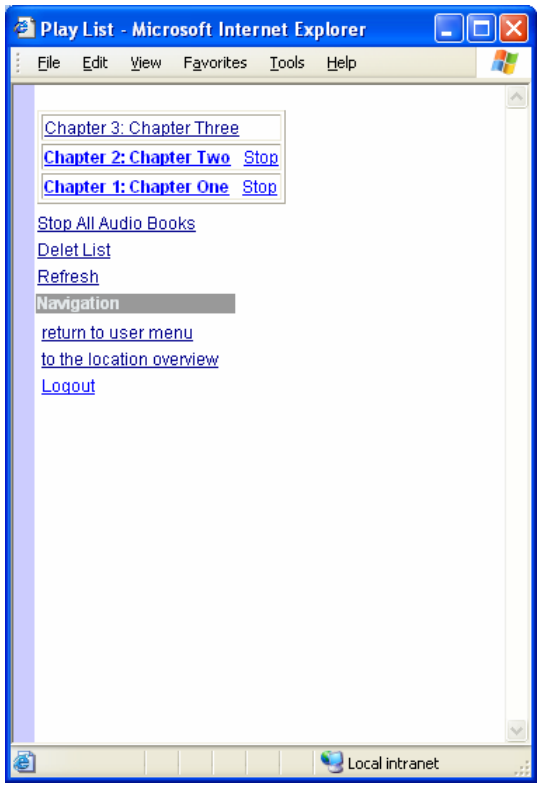


Figure 8.8. Playing list with one stopped and two in the queue

named “stop” following the chapter name. But he wants to listen to this book from the beginning, so he backs his browser to the “Select Chapter” section and selects chapters one and two, as in Figure 8.6. Figure 8.8 shows the chapters have been added into a playing list. Tom clicks a stop hyperlink to the audio for this chapter to be stopped and the chapter name goes back to the normal font. When Tom clicks the name again the chapter title goes back into bold and the audio is on the playing list again. He then stops playing with the Audio Icon and Audio Books Service, and keeps walking on the campus with the playing Audio Books.

For the test data, the audios and books in text are not related to the tested sight. But this does not affect anything of this evaluation, because the relations between them are input manually into the database. This test can still be performed even though the content of audios and books in text is not related to the tested sight logically in the real world. The books will be displayed to the user if there is any single chapter related to the selected sight. The chapter related to that sight will be displayed in bold. As to the control panel, only a few of the many things a normal media player has were implemented, as this project does not concentrate on media player and playing control.

Now Tom discovers that his route is from the Education Library to the Department of Computer Science via general places of Waikato University. He wants his Audio Books to play the same sequence of the visiting place. That is so he can listen to the chapter about his current location, and also the Audio Books is able to change to the next chapter related to his next location on the route. To solve this problem, Tom navigates his system to the “Select Chapter” section again. There is a hyperlink named “Chapters on Travel Plan” which can bring users to the “order chapters by route” section, as Figure 8.8 shows. The sight names on route with related chapters are shown on the screen, as in Figure 8.9.

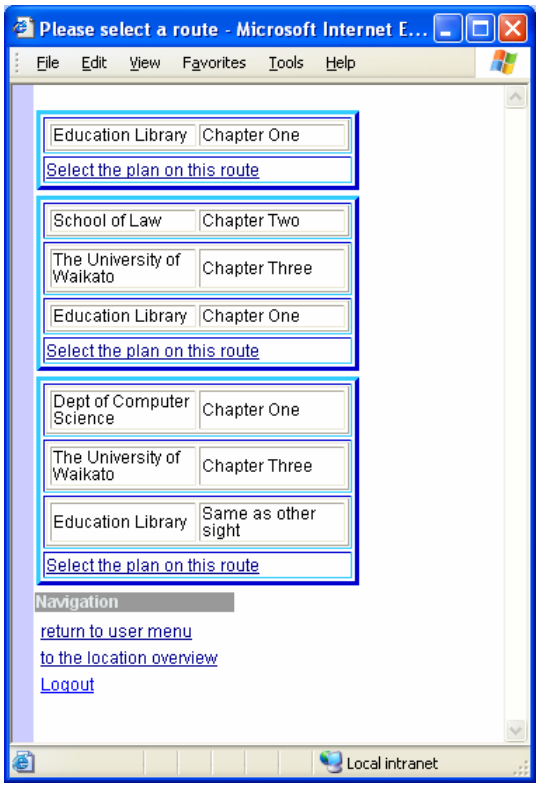


Figure 8.9. Select route for chapter section

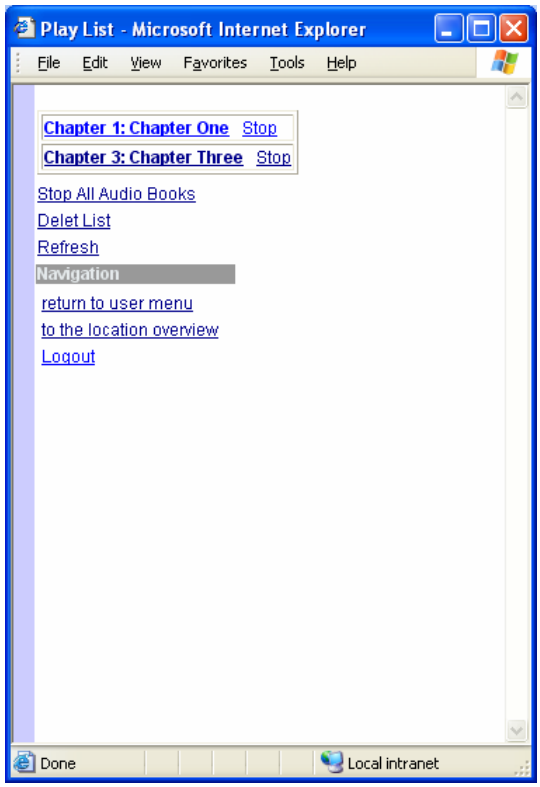


Figure 8.10. Audio added by travel route

Tom selects the route he is currently using to add the chapters into the now-playing list automatically. Figure 8.10 shows the two chapters have been added into the now-playing list when there are three sights on the route, because the system detects there is a chapter related to two of those sights. After this, Tom can enjoy his trip with the Audio Books playing. He still can hear the Audio Icon when he is listening to the Audio Books, so he can still use it and Audio Books at same time.

The previously saved route information that related to Tom, will be load from the database and compare this with the chapters. Any chapters related to the sight on the route will be listed in groups like in the descriptions above. The Audio Books will not affect anything of the Audio Icon. So the Audio Icon can still work as

usually when Tom is listening to the Audio Books.

But there is another problem for Tom, which is that he cannot differentiate which sight is directed by the current directed audio. This is because he has no acknowledgement about the sight around him, so he cannot work out what kind of sight this audio is directing him to. So he turns on the Text-to-Speech assistance program. The Text-to-Speech is built on the Java Web Start so Tom can see it downloaded when he uses it the first time. The system told him in speech "Text-to-Speech start", and then speech of the sight name is displayed on the notification of the main page, as Figure 8.1 shows. Now Tom can hear the system tell him the nearby sight name in speech, which can help him to know what the Audio Icon is guiding him to.

The audio does not support the related sight because there was not enough audio data, but this does not affect the test. Yet even when enough data is provided, it is still difficult to find an accurate audio for every sight. People usually have different ideals for the same audio. Because Tom does not know anything about the coming sight he cannot guess what sight the audio is directed to. For the developer it is still difficult to decide the relation for those sights. For example, which audio can present the Library? The situation is that the audio can only give Tom a general idea about the up coming sight and Tom needs to read his screen to know what the audio means. It is a good idea to add speech of sight names into audio to give users quick and accurate direction. In this project Text-to-Speech is used instead the speech of sight names.

Now Tom finds a chair and has a rest for a moment. After listening to the Audio Books he wants to see it in writing. So he navigates his system to the "Select Chapter" section as in Figure 8.5 and 8.6. He selects the second option, "Greenstone Text", for this chapter. This activates the new TIP/Greenstone

Service described in earlier chapters. Thus when he clicks the hyperlink to the Audio Books Service it will turn to the Select collection section to allow him to select the collection he wants to search the book for, as Figure 8.11 shows. When he selects the TIP-Audio Service test collection the new TIP/Greenstone Service shows the possible chapters searched by the chapter name selected by Tom at the "Select a Document" section, as in Figure 8.12. He picks up the first chapter name in the list to see the content of the chapter from the Digital Library. As Figure 8.13. shows, the new TIP/Greenstone Service has provided the text to Tom. All of the TIP/Greenstone Service functionality is active here, as described in Section 2.6. Tom finds there are more than the three hyperlinks of the early version of TIP/Greenstone Service. He uses these hyperlinks to play the text on this page by Text-to-Speech, add them into the now-playing-list of Text-to-Speech, or clean the now-playing-list. When the Audio Books in text is being speech, the speech of the

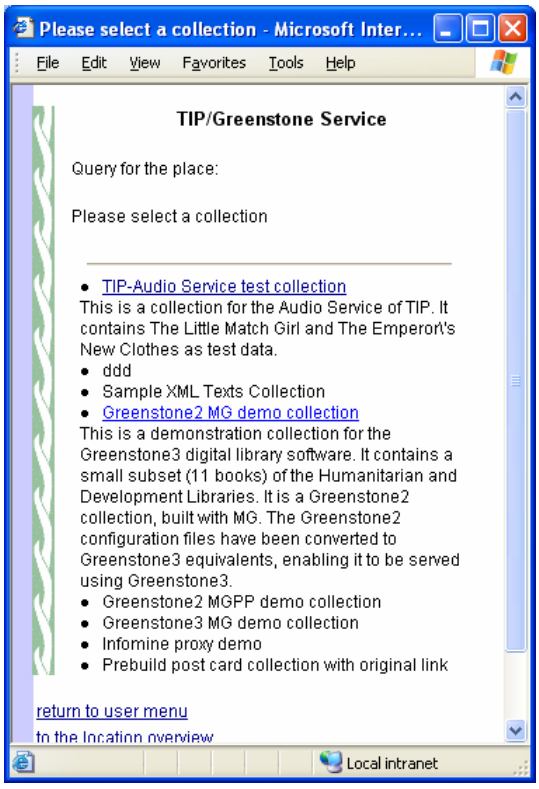


Figure 8.11. Select collection section

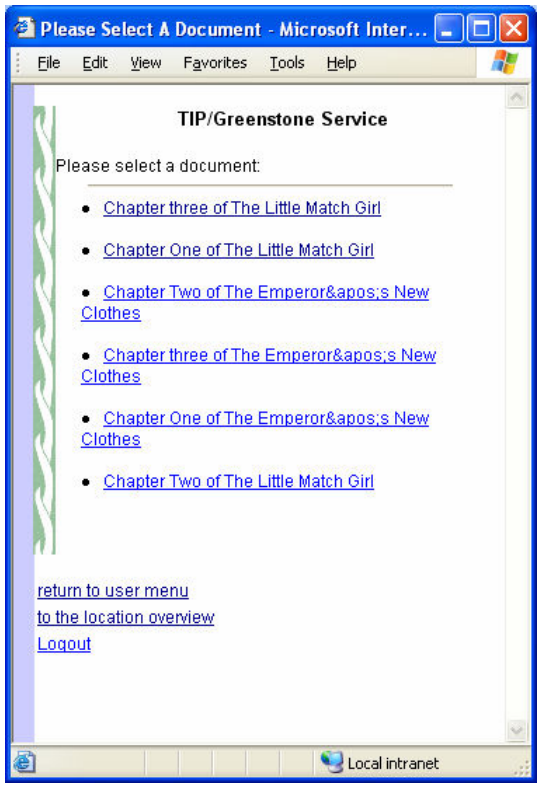


Figure 8.12. Select a document section

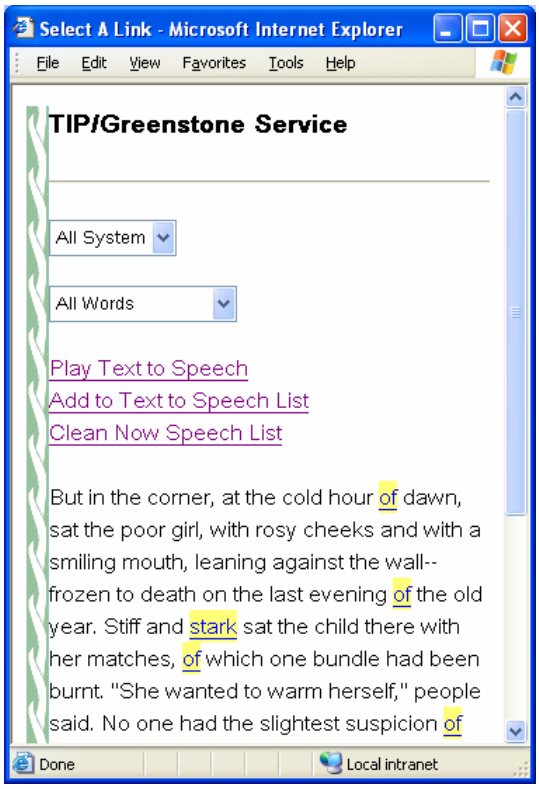


Figure 8.13 Display a documents

sight name will be stopped until the now-playing-list of Text-to-Speech is cleaned up. During this process Tom can still hear the Audio Icon and Audio Books. Through the help of the new TIP/Greenstone Service he is able to listen to the Text-to-Speech when reading the Text.

This part describes the situation in which Tom uses the new TIP/Greenstone Service. The previous version uses the place name as a query to search documents but this new service uses the chapter name as query to search documents, with the index based on the chapter level. The selected text will be sent to Text-to-Speech so Tom can hear the speech of text books that have the same content as Audio Books. The speech of close by sight names will automatically stop, because Tom can hear nothing from the overlap of speech. Also Tom can listen to Audio Books

in audio and read the text as the other usage of this system.

Tom completes his trip in Waikato University, just as if he had had a real tourist guide. He never misses any sight close by, because the Audio Icon can notify him and the Text-to-Speech for the sight name can help him to know what exactly the sight is. The audio allows him to listen to some Audio Books when he is watching the sight. So this new service provides an environment for Tom to allow him to use the Recommendation Service, the Travel Plan Service, and the TIP/Greenstone Service, by interaction with the Audio Icon and Audio Books Service.

8.1.3 Analysis and Summary

What has been implemented is the qualitative evaluation in the last section by the data setting and a user scenario. The functionality of each component has been evaluated separately in the user scenario. This summary is use to describe the effectiveness of the Audio Icon, Audio Books and Text from Greenstone. The analysis will based on the functional requirement in Chapter 4 and the design in Chapter 6.

The first matter to be discussed in this section is the evaluation of the Audio Icon Service. In the user scenario Tom can receive audio notification from the Audio Icon Service when he comes into the region where can receive near by sight from recommendation component. This means users can receive audio notification when they are near enough to their interested sight. Tom compared the sight with the sight appeared in recommendation Service; the sight displayed in the two component are completely same. So it can be seen that the functionality of the chosen sight based on users' interest is working well. The audio cannot accurately

tell Tom what the sight is but it can give tom a general idea about the sight. So the functional requirement that the source can be disguised is being implemented successfully. Tom can set up his user parameter and that can control the system effectively, including the ant overlap function. Also, the audios can be stopped when Tom wants this happen. So the general requirement in the Section 4.3 is implemented. Overall this paragraph has shown the functionality of the Audio Icon Service can provide the service effectively.

Secondly, the evaluation show the Audio Books Service is still fulfilling the functional requirements in Chapter 4 and the designs in Chapter 6. Tom can get a notice when any Audio Books are available. The listed Audio Books has at least one chapter related to the signaled sight. The literature and reference book has been separated. The Travel Plan Service can add Audio Books chapters to now-playing list. Audio Control Panel allows Tom to control the now-playing list. So the Audio Books Service has an effective functionality.

Thirdly, the Greenstone function and Text-to-Speech is working effectively in this evaluation. The speech of sight name can synchronize with the Audio Icon as an assistance function of the Audio Icon. The TIP/Greenstone Service can search Audio Books in text based on chapter and send the text to Text-to-Speech component. So Tom can access the text of the Audio Books. Text-to-Speech allows Tom to hear some books that are not saved as audio. This can also reduce the expensive data storage of audios. So it is confirmed that the Greenstone functions and Text-to-Speech is the other effective component of this project.

All the functionality that has been tested in the user scenario fits the functional requirement and the design purpose. Only the Audio Icon cannot describe the sight accurately but the Text-to-Speech function has replaced this defect. The functionality of this prototype has full implemented the aim of this project, and

has much improved the effectiveness of the TIP system.

8.2 Quantitative Evaluation

This chapter will conduct the quantitative evaluation on the implementation of Audio Icon and Audio Books Service Component. This evaluation concentrates on the performance of the audio server–client system (the Audio Server component in Section 7.2.8). Its methodologies and parameters, which may affect the performance, will first be identified. Then the hypothesis based on the effect of the parameters will be described. Following this is a consideration of the creation of the data for the experiment, and its execution. The result will be analyzed and discussed at the end.

8.2.1 Methodology

This project receives sight information from the Recommendation component and processes those audios to sends them to client. The first part of the performance depends on the Recommendation component of TIP system. The performance of new TIP/Greenstone Service interacts with Greenstone Digital Library in the most situations. Therefore this evaluation will concentrate on the audio server-client pair.

The subject to be tested is the response time. That means the time from the audio server receiving notice to the client starting to play the audio, which will be calculated as the response time. It exclude the time when the system load the file form hard drive, as that happen only once when the first user active the system.

Here we don't separate up the Audio Icon and Audio Books because they are tread as the same in the processing of mixing and send to client.

This subject is important to this project because the design purpose is a real time notification. The notification must happen quickly otherwise it will become useless. The audio data must go through the network to arrive users' mobile device, and the delay of network is not expectable and therefore this evaluation does not include anything about possible time delay of network. So we have to make sure the response time of the audio server-client pair is short enough to fit the needs of the users.

8.2.2 Parameters

The response time depend on the number of playing audio and the number of loaded audio. The main parameters for the audio sever-client pair are user ID, audio ID, and audio files name. The audio files will be loaded when the system start. The command which is used to direct to play the audios will be added when it is needed. The command include which audio plays for which user, so the user ID and audio ID will be sent in one command. The number of commands sent to the audio server indicates how many audio is playing. The number of playing audio and the number of loaded audio was chosen as the parameter of this experiment.

8.2.3 Hypothesis

A hypothesis is now being examined before the performance the experiment in

reality. Two parameters have been identified in the last section to consider in this hypothesis.

Firstly, the number of playing audios may significantly affect the performance. In the process the system mixes the audio, and the program need to sum the audio data from different audio files one by one based on bit level. So more audio should slow down the mixing speed. The other reason for this parameter is that the audio information, which is used to divide the audio play or stop, is stored as a data structure in memory. So the long list will slow down the speed of search. All of the process will be completed in RAM of the computer so it will be very fast. A small number of audio should not effect the performance significantly.

Secondly, the number of loaded audio may also affect the performance. All of available audio will be loaded when system start, and when it does the mix it need to go through all of the audio detail and search it in the data structure that was described in the last section. The number of audio decides the times of search, so a larger number of loaded audio will run for a longer time. Another matter is that the number of loaded audio causes a memory problem. The design purpose of loading all audio is to try to save the loading time. But the memory problem while should not effect the performance as much as the file loading. The memory problem should cause response time increase to be very slow.

Both of the increasing of the two parameters should result in the response time increase slowly. There should not be significant different between a small number of changes on the two parameters.

8.2.4 Data Setting

The main data for this experiment include a group of user ID, audio ID and audio files. The number of pairs containing user ID and audio ID in the data structure decide the speed that the mixer search for audio information to decide whether an audio is to be mixed in to the final audio stream. If the multi user is used to do the test the system will process those users one by one, so it is the same as one user's processing. Therefore it was decided to use one user ID as the first parameter.

The number of audios for one user decides the number of audio to be mixed, and thus it is important for the test result. We use the numbers 1 to 100 the audio ID which is separate in to an average of ten groups.

The audio files are the audios used in the qualitative evaluation but they are extended to five hundreds files whose frame length is 4 bit and simple rate is 4000Hz. Each of them will be give a unique audio ID when they are load in to the system. The total size for all of the files is 43.6MB.

This experiment run on the platform which is a windows based desktop computer with Intel Pentium 4 CPU, with the speed at 1.80GHz and 521MB of RAM.

8.2.5 Executing of Experiment

Some evaluation code was added into the original programming to run the experiment. These parameters are loaded automatically and response time is recorded automatically. The code used to play audio has been jumped over as test the time of audio playing is not tested; that depend on the length of audio. The

server and the client are set on same computer, and therefore the network delay can be ignored. The package send between server and client content 32k bit data that may play audio for about two second audio when the simple rate is 4000Hz.

In this experiment we generate as sequence of audio ID programming and they are paired with user ID and added into the data structure to simulate the process the Audio Icon and Audio Books Service did.

The system generate add ten audios to the data structure to play each time. When the audios are added the system starts timing. When the system receives one thousand mixed data it will stop the timing. The average response time for one data package will be calculated. Then the system will load another ten audio ID into the audio server and repeat the test again. The audios added in the previous test will be still in the audio server and join in the next test. The respond time will be recorded with the number of audios.

The audios in this paragraph are loaded audio, which is different from audio to play. The experiment described above will be repeated five times. The loaded audio are start from one hundred, and another one hundred audios are attached for each test; the last test has five hundreds audio loaded.

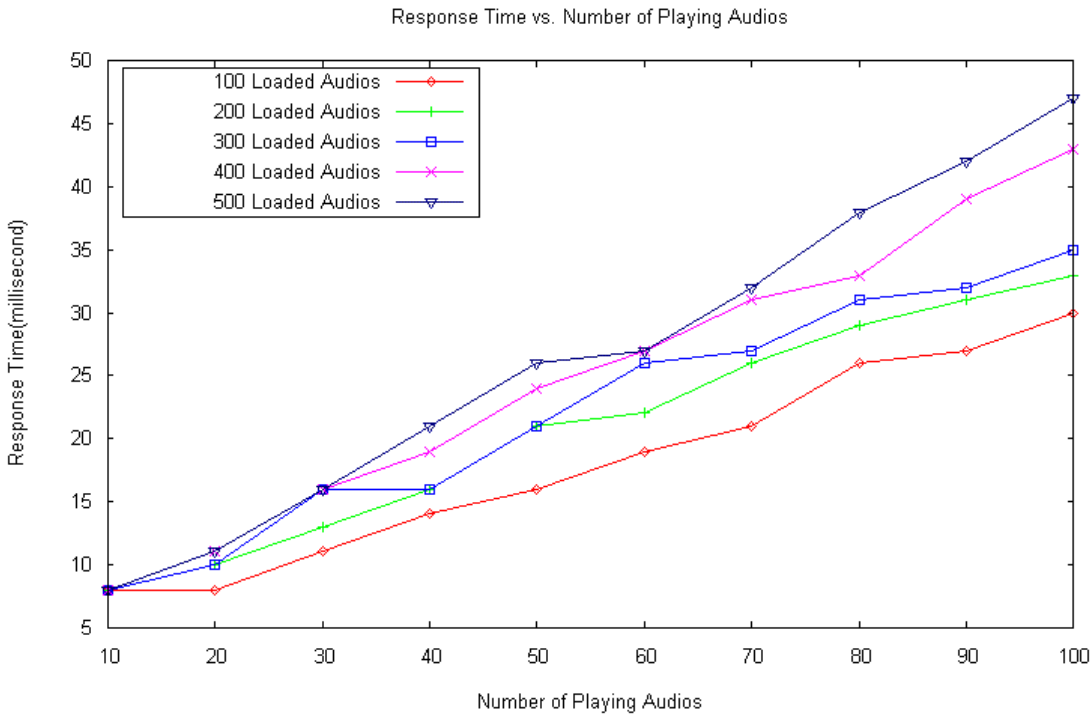


Figure 8.14. Response Time vs. Number of Playing Audios

The data from the experiment has been draw into the graphic as the Figure 8.14 by Gnu plot. Each of the lines that have different points is presenting each test with a number of loaded audio. The X is presenting the number of current playing audio. The Y is the response time in milliseconds. So this figure shows that the result of this experiment is that the increase of audio cause the response time to increase.

8.2.6 Discussing and Analysis

This section will discuss and analysis the test result. The Figure 8.14 shows the response time increases when the numbers of audios and all of the five lines have similar shapes; this situation happened at all of the lines. It is easy to see the parameters described in an earlier section are a real effect the response time.

The figure confirmed that the number of playing audios may significantly affect the performance. From the slope of all of the lines, it can be seen that response time always increase whenever the number of playing audio is being added. The entire slope is nearly linear but there are some twists and turns on those lines, because the response time is based on milliseconds so it is difficult to get some very precision results.

This figure also confirmed that the number of loaded audio may also affect the performance. The lines for more loaded audio get more response time when they process same number of playing audio. This becomes clearer when it get larger number of playing audio. It may be noted that the lines between ten audios and twenty audios are really close each other; this mean the response time is not changed much when there is a small number of playing audio.

The increasing of response time does not slow down the speed of the performance. It is easy to see the response time only increase five times when the number of playing audio increase by ten times. However, the response time is on millisecond for each data package which can provide a two second audio. That illustrate that the server has a more than adequate capability to provide the audio data to clients for the Audio Icon and Audio Books Service.

Chapter 9

Conclusion

What has been accomplished in this project will be summarized in this chapter. The aim of the project and its achievements will be reviewed and described and then future works will be outlined.

9.1 Summary

The goal of this project was identified in Chapter 1 as improving the current Audio Icon and Audio Books Service to give users notification and the facility to select and play Audio Books, involving the TIP/Greenstone Service into the Audio Books Service.

9.1.1 Problem Identify

The problem was discovered form the current Audio Icon and Audio Books Service.

A) Missing Direction Problem

The current Audio Icon Service can only notify user when the system displays the information of this sight that user may have already seen them from the screen; therefore, the audio cannot provide direction in most situations.

B) Chapter Sequence Problem

The current Audio Books Service can only provide users with Audio Books when the current sight matches the beginning of the book. The Audio Books will be missing if the current sight related to another chapter.

C) No Text Display Problem

The Audio Books Service can only provide some detail of the books, such as title and author. In some case users need the text for the books; therefore there is a need to provide this functionality.

D) Free Eyes Required

This is to help users to use the TIP/Greenstone Service to read some lengthy books when they are touring. It is important to involve a Text-to-Speech into the TIP/Greenstone Service.

9.1.2 Functional Requirement

Through the problems and the background in Chapter 2, the functional requirement has been worked out and described in Chapter 4.

A) Audio Icon Service

To solve the missing direction problem this requirement has been chosen. The Audio Icon Service is necessary to give users audio notification when they get close to the sight. Users should know some general ideal about the close sight from the audio notification. Therefore the audio content, which is a related sound to the sight, is chosen as the Audio Icon.

B) Audio Books Service

Audio Books are required to be played to users via audio. The system need to choose any book that has any chapter related to this sight. The literature and reference books need to be identified. The system needs to notify users when the books are ready to play.

C) Books via Digital Library

The system should bring users to the TIP/Greenstone Service and provide the current books chapters in text. The books need to be read to users by Text-to-Speech when the audio for this book is not available, or users want to use Text-to-Speech. Users should be allowed switch between audio form file and audio form Text-to-Speech.

D) General Requirement

The general requirement includes Anti Overlap, Interactions and Recommendation based notification. Anti Overlap is used to anti the audio play at same time. Interaction allows users set up some user parameter. Recommendation based notification keeps the notification about a sight send to users as same as the sight provided by the recommendation service.

E) Text-to-Speech Assistance

This requirement can help users to know the specific name of the nearby sight. It can tell users the name of the close-by sight to avoid any misunderstanding of audio.

To address the above this aspect is processed in three phases: design, implementation and evaluation.

9.2 Design

Based on the background knowledge of Chapter 2 and the study of related work in Chapter 5, the design has been work out in Chapter 6. This design is based on the requirement in Chapter 4 and as an aim to solute the problem identified in Chapter 1.

The design of Audio Icon has been described in the successive screen figures that describe four main kinds of situations when users walk though an area. Those stages describe the user setting the audio as play one by one or play them together. When users are close to those sights and then walk away from them, the system will turn the Audio Icon on and off. Also the Audio Icon will be turn off when users have interactions with it.

Figure 6.2 which is the figures of successive screens, describe what happens after users accept the offer to have interaction with Audio Books, without the notification for available books. That is because the notification about books available will be sent and displayed with the Audio Icon together. This figure of successive screen covers the process of users' interaction with the Audio Books Service. It shows that the users may select any chapter to add into the now-playing list, choose chapters by Travel Planning Service, or access the TIP/Greenstone Service.

9.3 Implementation

The implementation is described in Chapter 7, and includes the architecture, implementation structure and the implemented classes.

This architecture is different to other component of TIP, because it is connected with multi service of TIP. This tends to connect more TIP service together by programming. The architecture focused on the introduction of the component on both the server and client side. Also the relation between those components is introduced in that section.

The implementation structure is also different with other component. It not only uses the Java struct that is used in normal TIP component but also the Java application. And there are interactions between the Java struct and Java application.

The implementation is described by class diagram and the class sequence diagram. The main focus is how the system selects, mixes and sends audio data to clients.

9.4 Evaluation

The qualitative evaluation is described by a user scenario that has reference to the implemented Audio Icon and Audio Books Service via the Digital Library. The functionality of the Audio Icon, Audio Books and new TIP/Greenstone has been described by this usage scenario. The result shows that all of the functionality has covered the functionality requirement in Chapter 4.

The quantitative evaluation is used to test the response time. The response time was that calculated between the audio server receiving the command and the client side program taking action. This response time is increased when the playing audio and loaded audio increased. The response time will be in approximate 50 milliseconds for each package when the system has one hundred

playing audio and has five hundred audio loaded. Each package contents two second audio. So this system has a great capability to run with many users and audios.

9.5 Lesson Learned from this Project

This project has analysed the existing system, include TIP location Service, Current TIP/Greenstone Service and Current Audio Icon and Audio Books Service. The requirements of new system have been identified. The figures of successive screen have been created to describe the functionality of the system. The usage scenario for the new system has been described based on the successive screen. The design of the Audio Icon and Audio Books Service will be used for the implementation of the system. The project has been implemented as the functionality required. The new TIP/Greenstone Service has been developed. The qualitative evaluation and the quantitative evaluation confirm that the system is working well and has solved the problem described in Chapter 1.

The problems in Chapter 1 and functionality in Chapter 2 are described in Table 9.1 and Table 9.2. The problems marked with a + have been solved. The problem marked with +– have been partially solved.

Descriptions	**Solved**
Missing direction problem	+
Chapter sequence problem	+
No text display problem	+
Free eyes required	+

Table 9.1. The problem identified in Chapter 1

Descriptions	Solved
Basic Audio Icon service	+
Source can be distinguished	+-
Books via audio	+
Books playing control	+
Chapter based	+
Books via Digital Library	+
Anti Overlap	+
Signalled place based on users' interest	+
Text-to-Speech assistance	+

Table 9.2. The functional requirement in Chapter 4

9.6 Future Study

First, reference to Table 9.2, the requirement that the source can be distinguished, has only been part solved, so this needs future study. In this project the users experience was not considered; if they have more experience about using this service they are able to distinguish the source of audio well.

Second, the system requires more activity than JSP struct can do. So it is good to implement the whole system on Java application. The system can renew the information on its interface easily without refreshing; the automatic refresh was used in this project.

Finally, the clients may do the audio mix. This project restores audio and does the audio mix on server side; the purpose is to lighten the process on client side. But if users have an ability mobile device, restoring and mixing the audio should be considered on client side.

References

HOTELMARKETING.COM. Available at http://www.hotelmarketing.com/index.php/content/article/060616_hotelscom_now_available_on_mobile_phones/ and http://www.hotels.com Accessed on 23/06/06 5: 18 p.m.

MSN. Available at http://mobile.msn.com/ Accessed on 23/06/06 5: 18 p.m.

Hinze, A., Malik, P. and Malik, R. (2006). Interaction Design for a Mobile Context-Aware System using Discrete Event Modelling. In Proc. Twenty-Ninth Australasian Computer Science Conference (ACSC 2006), Hobart Australia. CRPIT, 48. Estivill-Castro, V. and Dobbie, G., Eds., ACS. 257-266

Hinze, A. and Buchanan, G. (2006). The Challenge of Creating Cooperating Mobile Services: Experiences and Lessons Learned. In Proc. Twenty-Ninth Australasian Computer Science Conference (ACSC 2006), Hobart Australia. CRPIT, 48. Estivill-Castro, V. and Dobbie, G., Eds., ACS. 207-215.

Hinze, A., and Voisard, A.: Location and Time-based Information Delivery in Tourism. Advances in Spatial and Temporal Databases, 8th International Symposium, LNCS 2750, Santorini Island, Greece, 2003

Saijai Junmanee: Design, Implementation and Evaluation of Advanced Recommendation Models in the Mobile Tourist Information System TIP. Masters Thesis (COMP594C) 2005

Xin Gao: Design and Implementation of Greenstone Service in a Mobile Tourist Information System. Dissertation (COMP591C) 2005

Katherine J.Don, David Bainbridge, and Lan H.Witten: The design of Greenstone3: An agent based dynamic Digital Library. Initial design document of Greenstone3, Dec 2002. Online: http://www.greenstone.org/greenstone3.html

A. Hinze and A. Voisard: Combining Even Notification Services and Location-based Services in Tourism. Technical Report Number tr-b-03-06, Freie Universität Berlin, 2003.

Hinze, A., and Voisard, A.: Location and Time-based Information Delivery in Tourism. Advances in Spatial and Temporal Databases, 8th International Symposium, LNCS 2750, Santorini Island, Greece, 2003

Katherine J.Don, David Bainbridge, and Lan H.Witten: The design of Greenstone3: An agent based dynamic Digital Library. Initial design document of Greenstone3, Dec 2002. Online: http://www.greenstone.org/greenstone3.html

Katherine Don, George Buchanan and Ian H.Witten: Greenstone3: A modular Digital Library. User and developer manual. Work in progress. (Last updated 9/11/05) Online: http://www.greenstone.org/greenstone3.html

Witten, I. H., Bainbridge, D., Paynter, G. W., Boddie, S. J. (2002) G. Marchionini and W. Hersh (eds): Greenstone plugin architecture. Proc Second ACM/IEEE Joint Conference on Digital Libraries (JCDL'02), Portland, Oregon, 285-286. ACM Press, New York.

Tim: Audio Icon and Audio Books Service for TIP. Honors project (COMP420) 2005

Klante, P., Krosche, J., & Boll, S. (2004). A Multimodal Location-A ware Mobile Tourist Information System. Computers Helping People with Special Needs: 9th International Conference, ICCHP 2004 Paris, France, July 7-9, 2004 Proceedings. pp. 287 – 294.

Hatala, M., Kalantari, L., Wakkary, R., & Newby, K. (2004). Ontology and rule based retrieval of sound objects in augmented audio reality system for museum visitors. Proceedings of the 2004 ACM symposium on Applied computing, Nicosia, Cyprus: Information access and retrieval (IAR) pp. 1045 – 1050

Bellotti F., Berta, R., Gloria, A. & Margarone, M. (2005). Implementing Tour Guide for Travelers. Human Factors and Ergonomics in Manufacturing, Wiley Periodicals, Inc., A Wiley Company. pp. 461 – 476

Cheverst, K., Davies, N., Mitchell, K., & Friday, A. (2000) Experiences of developing and deploying a context-aware tourist guide: the GUIDE project. International Conference on Mobile Computing and Networking. Proceedings of the 6th annual international conference on Mobile computing and networking. Boston, Massachusetts, United States. pp. 20 - 31.

Benjamin, B. (1995) Audio augmented reality: a prototype automated tour guide. Conference on Human Factors in Computing Systems. Denver, Colorado, United States. pp. 210 - 211.

Aoki, P. M. Grinter, R. E., Hurst, A., Szymanski, M. H., Thornton, J. D., & Woodruff, A. (2000). Sotto Voce: Exploring the Interplay of Conversation and Mobile Audio Spaces. Association for Computing Machinery Inc, USA. pp. 431-438

Warren, N., Jones, M., Jones, S., & Bainbridge, D. (2005) Navigation via continuously adapted music. Conference on Human Factors in Computing Systems, CHI '05 extended abstracts on Human factors in computing systems. Portland, OR, USA. pp. 1849 – 1852.

Holland， S., Morse, D. R., & Gedenryd, H. (2002) Spatial Audio Navigation with a Minimal Attention Interface. Personal and Ubiquitous Computing (pp. 253 – 259). Computing Department, The Open University, Walton Hall, Milton Keynes, UK. London: Springer.

Abowd, G., Atkesen, C., Hong, J., Long, S., Kooper, R., & Pinkerton, M.: Cyberguide: A mobile context-aware tour guide. In ACM Wireless Networks, 3(13), pages 421 – 433, 1997.

Poslad, S., Laamanen, H., Malaka, R., Nick, A., & Zipf, A.: CRUMPET: Creation of User-Friendly Mobile Services Personalized for Tourism. In proceedings of 3G2001 Mobile Communication Technologies, pages 28-32, 2001.

Huang, X: Development of a map service. Masters Thesis (COMP594C) 2006

Appendix A

A User Survey

A.1. Introduction

This survey was conducted with a paper based questionnaire, which will be introduced specifically in this section.

This application includes all relevant information necessary for evaluation against the SCMS and University ethics regulations. The Bill of Rights has applied to this user survey, together with a Research Consent Form that is used to explain the purpose of the experiment and the questionnaire. The survey itself has approved by SCMS Ethics Committee.

The participants were selected randomly on the Waikato University campus. Twenty participants have been involved in this survey that was require the processing without identify them. All of them completed the questionnaire under the explanation of the experiment policy and the question meaning. The explanation was based on the actual survey without having any effect on the participants' idea. All participants answered the questionnaire well, including the short answer question at the end. For some questions the participants could select more than one answer or not give an answer. The researcher also chatted with the participants to get a better understanding of their reason for those answers.

A.2. Tourist General Information

This part of survey is used to collect general information about the tourism activity of the participants. It contained five questions as shown in the Table A.1 to A.5. The aim was to find out what people normally do in real travel and figure out how the activity could be converted into the service of TIP.

Table A.1. shows that people normally travel one to three times, so it is necessary to make some software to help them. Table A.2. and Table A.3. show that currently nobody uses an electronic guide because they are not generally available. If they were available they would become 5/29 in all of the type of tourism guide. Because most participants had never used it they do not know how good it is. Form Table A.4. and Table A.5. it can be seen that most people like to travel with a guide person and most of them want the guide person to notify them of some new sight nearby on their tourism route. Therefore, an electronic guide is a viable alternative that could be developed in place of the real guide in person.

Times	Number of people selected
None	4
1 – 3 times	16
4 – 6 times	0

Table A.1. The number of times participants go travel each year

Type of tourist guide	Number of people selected
Guide book	9
Internet guide	9
Guide person	10
Electronic guide	0

Table A.2. Type of tourist guide

Type of tourist guide	Number of people selected
Guide book	8
Internet guide	8
Guide person	8
Electronic guide	5

Table A.3. Type of tourist guide they would use if available

Grade	Never	1	2	3	4	5	Always
Number of people selected	1	1	3	6	4	4	1

Table A.4. The grade indicating how much tourists like travel with a guide person.

Grade	Never	1	2	3	4	5	Always
Number of people selected	0	0	1	2	4	10	3

Table A.5. The grade indicating how tourists like a guide person to notify them about the sight around them on their tourism route.

A.3. Possible Interaction with Audio Icon

This part gave users a hypothesis that they are using the Audio Icon Service. Table A.6. and A.7. show that most participants like a device to notify them and like to move over to a new sight after that. This confirms that the Audio Icon may have effect in the real word when it is developed. Table A.8. shows that nearly 2/5 people like to stop the notification when they know the sight, so the stop Audio Icon functional need to be added into the Audio Icon Service. Table A.9. shows that people have a very different ideas regarding the reminder time, and therefore a parameter is needed to set up the reminder time for the next time to play the audio. Table A.10. and A.11. show that, as to the type of sight, there is significant difference between tourists relating to whether they like to hear about them or not, and therefore the audio notification should depend on the user's interests. Table A.12. also shows a similar number of people selecting each option, which mean tourist will take different action when they receive notification. So the system needs to list all the notified sight for user to select and see the specific information of the sight they want.

Grade	Hate	1	2	3	4	5	Like
Number of people selected	0	0	1	4	3	9	3

Table A.6. The grading is about how much or how little tourists like device to notify them that some new sight is getting closer to them when they are on their tourism route.

Grade	Unlike	1	2	3	4	5	Like
Number of people selected	0	0	1	7	8	3	1

Table A.7. The grading is of how much tourists appreciate it when a device notifies them another sight is available when they currently enjoy a sight.

State	Yes	No
Number of people selected	8	12

Table A.8. This shows whether they want to stop being told more than once that some sight is coming closer to them, when they already know that.

Reminder Time	Number of people selected
5 seconds	1
10 seconds	2
15 seconds	7
Others	One off, three times, 60 sec(3 selects), 30 sec, depend on type of message

Table A.9. The reminder time the participants like to be reminded under the situation of Table A.8.

The type of sight	Number of people selected
Famous Building	7
Museum	8
Shops	6
Station for transport	10
Others	1. All according to pre-programmed 2. Natural signals such as water falls

Table A.10. The type of sight they like the audio to notify for.

The type of sight	Number of people selected
Famous Building	4
Museum	3
Shops	8
Station for transport	3
Others	Beach and landscape

Table A.11. The type of sight they do **NOT** like the audio to notify for.

Actions	Number of people selected
Look at all of them	6
Only look at the most interested sound.	6
Look at the most interested sound first, and then others.	8

Table A.12. The action they take when they hear more than one Audio Icon.

A.4. General Usage of Books in Travel

This part of the survey is to try to find out how people use guide books in their travel. Table A.13., Table A.14. and Table A.15. show that more people selected the higher score in those tables. What this means is that tourist normally use guide books and enjoy using them. So the electronic books and Digital Library is involved into this project. Table A.16. shows that nearly a half of the participants often make a sequence for book chapters to read based on their tourism location. So the chapter based Audio Books is needed for this system. Table A.17. shows that most tourist like to have text of the book when they listen to Audio Books. So the books in text from Digital Library is suitable for this project. Table A.18.,

Table A.19. and Table A.21. show that the people who use Audio Books for none travel purpose are more than those who use Audio Books for travel. From the chatting with participants it is clear the reason is that audio guide books are not available or not effected in the real truism environments. Table A.20. shows that there are still half of participants who wish to use the audio guide books. So the audio guide books do need to be developed.

Grade	Never	1	2	3	4	5	Always
Number of people selected	2	1	3	5	4	4	1

Table A.13. The grading of how often they tend to travel with guide books.

Grade	Never	1	2	3	4	5	Always
Number of people selected	0	0	3	3	4	6	3

Table A.14. The grading their tending to read a guide book about their current location.

Grade	Never	1	2	3	4	5	Always
Number of people selected	0	1	5	5	3	6	0

Table A.15. The grading of whether they enjoy reading a guide book about their current location.

Grade	Never	1	2	3	4	5	Always
Number of people selected	1	2	5	3	8	0	1

Table A.16. The grading of how much they like to read a book in a sequence, when there are different chapters based on different locations.

Grade	Never	1	2	3	4	5	Always
Number of people selected	0	1	3	3	5	5	3

Table A.17. The grading that indicate how much or how little they like to have the book read in audio and have the text available on device for reference.

Grade	Never	1	2	3	4	5	Always
Number of people selected	3	5	2	3	5	2	0

Table A.18. This grading is of their preferences on generally using Audio Books rather than travel.

Grade	Never	1	2	3	4	5	Always
Number of people selected	4	11	0	1	0	2	0

Table A.19. The grading on how much they like to use Audio Books as their tourist guide.

Grade	Never	1	2	3	4	5	Always
Number of people selected	1	3	4	4	4	3	1

Table A.20. The grading of how often they expect to use an audio guide books.

Grade	Never	1	2	3	4	5	Always
Number of people selected	5	10	0	1	2	2	0

Table A.21. The grading is of how much they had been playing Audio Books or audio guides about their current travel location when they look around on their travel route.

A.5. How People Use Audio Books

This part is to try to figure out what people like to use Audio Books for. Table A.22., Table A.23. and Table A.24 show that large part of participants like to use Audio Books for tourist; the content, which people hate to hear, is only advertisement. Table A.25. shows that a small part of participants like to listen to the Audio Books and read the text at the same time. Table A.26. shows that people like to listen to Audio Books a little more than they read them; only one

participants answered both and one of them answered depend on the situation. So we decide to consider the interactions between playing Audio Books and show the related text at the last stage of the designing.

Purpose	Number of people selected
Tourist guide	12
Entertainment	6
Education	6
To free eyes	6

Table A.22. The purpose that participants like to Audio Books for.

Purpose	Number of people selected
Tourist guide	10
Introduction of travel location	12
History	7
Story	6
Other	Entrance fees to tourist locations and cost of special tours

Table A.23. The contents participants like to hear in an Audio Books.

Purpose	Number of people selected
Tourist guide	2
Introduction of travel location	0
History	2
Story	9
Other	Advertisements

Table A.24. The content participants does **NOT** like to hear in Audio Books.

Grade	Never	1	2	3	4	5	Always
Number of people selected	1	6	5	3	3	1	1

Table A.25. The grading to show often the participants like to read an electronic book and at the same time listen to sound recordings of somebody reading it.

Model	Number of people selected
Read	8
Listen	10
Other	1. Both, 2. different situation

Table A.26. The model to show participants preference to just read the book or to just listen.

A.6. Audio Books about Museum

This part is used to figure out whether people like to use Audio Books as a tourism guide in museum. The Table A.27. shows that most participants do not use audio guide in museum. The short answer questions in the survey have given the reason.

Grade	Never	1	2	3	4	5	Always
Number of people selected	1	4	5	4	4	2	0

Table A.27. The grading of participant use of Audio Books in museums.

Many participants gave different ideas for the audio guide use in a museum. In fact the same person sometimes had more than one ideal, so the total number of people is more than the number of participants.

The reason people do not use the audio guide in museum has been separated to

two parts.

Half of the participants answered that they are not available or not effect. Two answered that some of the audio, when is not based on the interest, is dislike. Three participants like to have a mobile device to use instead of the stationary device. Some body does not use it because it cost high. Others all answered that they did not use it because it is not available.

Six of the participants dislike it because they dislike Audio Books anyway or dislike Audio Books to be used in museum. Some of their dislike is of the uses of the senses of listening, and a language problem.

Seven participants answered that they do like it because it is helpful for travel and the Audio Books are able to replace the guide person.

A.7. Conclusions

This survey has been processed under the rules of user surveys. All the data was collected from the original answers of the participants and from chatting with them. An overview of this survey confirmed that tourist use Audio Icon and Audio Books in most travel situation. This survey also provides the ideas for developing practical functionality for the Audio Icon and Audio Books Service via Digital Library.