GIS TOOL FOR TEACHING CHINESE DIASPORA

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A Thesis
Presented to the
Faculty of
San Diego State University

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In Partial Fulfillment
of the Requirements for the Degree
Master of Science
in
Computer Science

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by
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GIS Tool for Teaching Chinese Diaspora

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DEDICATION

I would like to dedicate my thesis to my family and all my dear friends for their motivation, support and love.
Chinese Emigration (also known as the “Chinese Diaspora”) first occurred thousands of years ago, and thus the Chinese population spread all over the world. The mass emigration that happened was mainly the result of wars and starvation in mainland China, as well as political corruption and civil unrest.

Motivation for this thesis is to develop an interactive GIS tool to help students to learn about where the Chinese have migrated by utilizing modern computer technology. This software is developed keeping in mind both teachers and students, so that both are benefited. This software displays some points on the world map, which are pre-loaded, or can be read from Comma Separated Values (CSV) files. The non-location attribute information about the countries where Chinese migration is significant. These countries have been grouped into regions. Students can click on the respective country with the help of a hotlink tool to see brief information about the country, overseas Chinese population, year of data, percentage of local Chinese population, percentage of global overseas Chinese population. A wiki link is provided if the student wants to know more information about the Chinese emigrants in that country.

This software is made with the help of Map Objects Java Objects (MOJO) provided by Environmental Systems Research Institute (ESRI) and Google sites to create help pages about the tool. The formal name of MOJO is Map Objects, Java Edition.
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I would like to convey my heartfelt thanks to Dr. Carl Eckberg for his continuous support and encouragement towards my thesis work. It was a great learning experience and a pleasure working under his guidance. Further, I would like to extend my thanks to other faculty members in my committee, Prof. William Root and Prof. Kathryn Edgerton-Tarpley. I thank you all for being on my committee and believing me in my thesis idea and the ensuing efforts.

This is an opportunity to thank my family for showering unconditional love and care as always. Last but not least, I would like to thank my friends who have helped me through thick and thin during the course of my project.
CHAPTER 1

INTRODUCTION

Geographic Information Science (GIS) is a system designed to capture, store, manipulate, analyze, manage and combine all types of geographically referenced data and maps to display graphics where users can visualize the data and use it. A GIS can be thought of as a system – it digitally creates and “manipulates” spatial areas that may be jurisdictional, or application-oriented, for which a specific GIS is developed. Since the invention of Google maps, the use of maps has been drastically increased. Hence the maps for representing data have been considerably improved.

With the help of GIS, users can store, display, manipulate, analyze and link data locations on maps. The GIS tool stores the feature data related to maps in an ESRI shape file format. Each layer of an application represents one specific type of data e.g. countries, states, cities, counties, capitals, rivers, lakes, roads etc. Users can edit these layers individually or in combination. Each layer is displayed on a map. Attribute data is also available for each layer and the combination gives users a wealth of total information. There are many layers provided by Environmental Systems Research Institute (ESRI). Academic usage of GIS encourages students with critical thinking, promotes global awareness, strengthens and extends technology skills, introduces students to real world technology applications, instills students with a sense of place, and creates in them a sense of community. Best of all, using GIS is fun, challenging, and motivating for students and teachers alike [1].

This GIS Tool is developed using Map Objects Java Objects (MOJO) which is distributed by ESRI. ESRI is one of the top leaders in the field of GIS. MOJO, a java based Map API, allows developers to build custom map applications using the open standard Java programming language. Software developers can leverage the basic map functionality to meet the requirements to satisfy the end user needs. Map Objects is a suite of java based developer components for creating client or server side mapping and GIS application [2].

My thesis is all about teaching the Chinese emigration across the world, which is developed using GIS software, making it easy for teachers to teach and simultaneously
making it interesting for students to learn more about Chinese emigration in an interactive way. In this thesis, a webpage is created for each country which has a strong Chinese population. These web pages can be easily modified to add more information. For this, two shape files are used namely world and country. Each shape file has a dbf file associated with it which consists of specific attribute data related to the type of shape file.

The shape files are used to display the world map with borders of countries on the tool. The data is all about the countries that have Chinese population. The countries are divided into specific regions like Africa, Americas, Asia, Europe, and Oceania. The data is initially represented in comma separated value files (i.e CSV files). So both shape files and CSV files acts as the input or data files to the tool. The web pages, which are linked through CSV files, contain information about the Chinese population in their respective country. One advantage of CSV file, which is Excel modifiable, is that anyone can, for example, expand the set of countries explored for emigration.
CHAPTER 2

SOFTWARE TECHNOLOGY

This chapter focuses on the software technology used to accomplish the task. As suggested by Dr. Carl Eckberg, Environmental Systems Research Institute’s (ESRI) ArcGIS Software and Java SDK (Standard Development Kit) are used to implement the Tool. GIS here stands for Geographic Information System. Java SDK is used since the Java language is one of the best technologies available in the current software industry. Java is robust and it is widely taught, with dozens of readily available texts. Java technology’s versatility, efficiency, platform portability and security make it the ideal technology [3]. As Java is free software, anyone can easily download it and use it. This tool can run on any hardware platform and operating systems as it is developed using Java which is platform independent. The Graphical User Interface (GUI) of this tool is built using java’s Abstract Windowing Toolkit (AWT) along with Java Swing. AWT is a general interface between Java and a native windowing system, and has many events and layout managers [4]. Java swing is a set of class libraries that support building GUIs and graphics functionality for applications [5]. Swing can set a native look and feel for the user interface. Our GIS is mainly built using Map Objects Java Edition. Map Objects Java Edition is a set of pure java components that can be used for creating GIS-enabled applications [1]. Some of the important things that we are going to discuss about Map Objects Java Edition are cited at [1]. There are two groups of components that can be used for developing GIS components. One is client-side components and the other is server side components. Client side is used for mapping user interfaces and applications and server side is used for integration with internet and enterprise applications. Map Objects essentially consists of a number of JAR files containing UI java beans (extensions to java swing) and an API of mapping components. Client side is the one that is used for this software. The following are some of the core features available through Java Edition.

- Displaying maps with dynamic, real time geographic data.
- Allowing users to navigate and zoom through maps layers.
• Performing queries on spatial information.
• Performing geometric operations.
• Labeling and customizing map interfaces.

Map Objects API’s and Java Language is too broad a topic to be covered in a single writing and are beyond the scope of this thesis. The next section will discuss aspects of these technologies in detail.

2.1 JAVA PROGRAMMING LANGUAGE

Object-Oriented: Java is object-oriented because Java code is organized in modular object-oriented units called classes. Programming in Java is centered on creating objects, from classes, manipulating objects, and making objects work together. The process of creating an object is called instantiation; any class could be instantiated from within the code as needed by the application, thus supporting extensibility [6].

Multithreaded and Dynamic: Java supports multithreading, meaning it is capable of performing various tasks from a program. In cases of network programming multithreading is a necessity because the program may need to interact with other resources [6]. Since map displays consume time, threading is important for GIS.

Internationalization: Java has the capability of supporting internationalization, the software built using Java could have support for multiple languages, and the same software could become available for a whole different set of users without the need of creating one from scratch [6].

2.2 MAP OBJECTS JAVA OBJECTS (MOJO)

MOJO is the core Java Application Programming Interface (API) used for building GIS application. MOJO is a developer’s tool kit; it includes a set of JAR files containing pure Java components that can be used to develop a usable stand-alone GIS application or to add maps or map functionality to other applications [7]. Since it is written in Java, an application using MOJO can be cross platform. Java classes and components are easily integrated with classes supplied by ESRI in MOJO. The wide acceptance of Map Objects results in multiple forums which are available on the internet which can provide guidance and help. Dr. Carl Eckberg also teaches a class at San Diego State University which covers Map Objects in
depth and has published a comprehensive guide on Map Objects [8]. For implementation of this tool Map Objects Java Objects version 2.1 was used.

Key features as cited from the Map Objects Java Objects brochure include [7], [9]:

- Access to ESRI’s ArcIMS Web Services, as well as building map applications for distribution over the internet, applications can be deployed over the Web (as applets or using Java Web Start) and a significant amount of tools are available for both functional requirements and UI development.
- Ability to combine multiple data sources together.
- Display real-time geographic data.
- Interface that supports exporting maps to image files such as jpeg etc.
- Major GIS capabilities such as labeling map features, displaying thematic map layers, performing geometric processing, zooming and panning map layers, measuring distances, querying spatial data and creating layouts etc.
- Capability to create, add and remove shape files [10], [11].
CHAPTER 3

THE REQUIREMENTS

This tool is developed for the use of the department of history at San Diego State University. It will be mainly used for teaching Chinese Diaspora in the world by Prof. Kathryn Edgerton-Tarpley, Associate Professor of Late Imperial and Modern Chinese History at San Diego State University. This tool is developed according to Kathryn Edgerton-Tarpley’s needs. Software development guidance is given by my thesis chair, Dr. Carl Eckberg from the San Diego State University, Computer Science Department.

The requirements gathered have been further classified into:

- Data Requirements
- Platform Requirements
- Functional Requirements
- Graphical User Interface (GUI) Requirements

3.1 DATA REQUIREMENTS

Data requirements cover the points about the data which need to be represented through the software, the way the data is represented which is covered in more detail in the student specific and functional requirements [12].

The data requirements for this tool were gathered from Prof. Kathryn Edgerton-Tarpley from Department of History at San Diego State University.

Below is the list of data items that shall be covered

- Country Name
- Year of Data
- Overseas Chinese Population
- Local Chinese population percentage
- Percentage of global overseas Chinese population.
- Web Link.
3.2 Platform Requirements

The development language, operating system and the IDE (Integrated Development Environment) that should be used along-with GIS solution that should be implemented to develop the software were gathered from Dr. Carl Eckberg.

The software shall be developed using

- JAVA as Programming Language.
- MOJO as the GIS API.
- Windows as Operating System.

The Software is essentially designed to be platform independent, hence various approaches were kept open while designing, the JVM (Java Virtual Machine) approach could be used to run the software on different platforms or even the EXE can be used to run it directly from the machine code. Windows XP was chosen as a suitable operating system with the existing setup at Department of History for which it is primarily intent for. Eclipse is chosen as a satisfactory IDE.

3.3 Functional Requirements

The functional requirements were gathered from Prof. Kathryn Edgerton-Tarpley and Dr. Carl Eckberg.

Functional requirements scope the extent of the software in terms of the tools that shall be provided in the software, the behavior of the tools to perform different actions, and any other GUI requirements which may leverage the capabilities of the software.

The function requirements for my thesis are:

- The tool when it is launched should come up with a default map of the world.
- The software shall provide tools to zoom in and zoom out and it should be capable of adding more layers e.g. countries, states, counties, rivers etc.
- The tool should provide any interesting and informational images, videos, html links, books etc in the information displayed that are related to the Chinese Emigration.
- The tool should also provide information about the Chinese Population, year of data, overseas Chinese population, percentage of local Chinese population and percentage of global overseas Chinese population in each country.
- Provide links to data related to the Chinese Emigration that are available on the internet, like Wikipedia and other informational sites.
3.4 GRAPHICAN USER INTERFACE (GUI) REQUIREMENTS

The student specific requirements arise by keeping students of the History Department in mind. The student centric approach was followed under the guidance of Professor Kathryn Edgerton-Tarpley from San Diego State University as follows:

- The GIS tool should be easy to use and easy to configure.
- The intended audience for this tool is students of the History Department at San Diego State University. Most of them don’t have much experience using software tools. So it should be easy to learn and easy to find help within the tool. A dedicated help link is provided which covers all major areas of use in the software. Also it gives a brief introduction of the tool’s behavior.
- The language used to describe the summary and important facts of each Country should be simple and informative for students.
- The summary should not be more than 2-4 sentences, easy to understand, and the text should be neat, bold, clear and in simple English.
- A dedicated Help Link will help the students to explore all the software capabilities to aid them in learning more on how to use it efficiently.
CHAPTER 4

DEVELOPMENT

This tool is developed using Eclipse IDE. This tool is developed using Java; hence it is a platform independent. Eclipse is a open source software which is available at [13]. Eclipse is a powerful GUI builder which supports simplified Swing Application Framework and beans building. It provides an easy way for compiling and running the Java Programs, in the case of a MapObject based Java project, the JAR files accompanied as a set of compiled classes are added to the resource folder and it integrates them into the project leveraging all the available classes. The next thing is to read the CSV files using the XY button which is developed to load the CSV files and plot them on the map using the longitude and latitude values provided in the file.

The XY button can read the data from the CSV file and then convert the data into a layer of points and show them on the map. The XY button provisions to choose the CSV file using the file browser. The data read from the CSV file is stored in a data structure to use the information later in the tool. The longitudes and latitudes that are read from the CSV file are converted into points and are stored in base points array.

The points on the map are represented using triangle shape with red color. All the CSV files will be loaded when the software shows the main screen. By default only Americas and Asia are enabled, all the CSV files loaded can be toggled any time by selecting the Checkbox. The name of the layer is same as the CSV file name as it is easy to maintain the names consistent with the file names.

Figure 4.1 is the first window that will be shown when the user first starts the tool. The users have been categorized into two roles namely Professor and Student. The role can be assigned to the user at the time of account creation which can only be done by professors.

Figure 4.2 shows the screen that will be shown when the user login with professor role. Figure 4.3 shows the screen when the user login with student role. Professor will have the ability to create the login account for the intended users and also he has authority to delete a particular user if the user is no more required.
Figure 4.1. Login screen.

Figure 4.2. Chinese diaspora initial screen when logged in as professor.

In its current forms, all layers are loaded automatically into the map, but the XY option is available if a student or professor wants to create additional CSV files, for didactic reasons, or as a student assignment.

Whenever a user is logged in to the tool, the World Map along with different regions of Chinese Diaspora details will be presented. Only Asia, Americas will be enabled by default and user can toggle other regions to see the Chinese Diaspora details in other regions.

Figure 4.4 shows the Account Creation screen when user logged in as a Professor. He can enter the required username and password and also select a role which is suitable for the particular user.
Figure 4.3. Chinese diaspora initial screen when logged in as student.

Figure 4.4. Add user screen.
CHAPTER 5

MAPOBJECTS TOOLBARS

MapObjects Java Edition provides multiple beans which can be used to add basic capabilities to the tool. Toolbars are some of these beans, which can provide commonly used functions such as zoom in, zoom out, zoom to full extent etc. In this chapter the toolbars listed in Table 5.1 are explained along with the code on how the toolbars are being integrated to this tool. All the three toolbars are shown in Figure 5.1 [14].

Table 5.1. Legend of MapObjects Toolbars

<table>
<thead>
<tr>
<th>Toolbar Name</th>
<th>Class Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoom Pan Tool Bar</td>
<td>com.esri.mo2.ui.tb.ZoomPanToolBar</td>
</tr>
<tr>
<td>Selection Tool Bar</td>
<td>com.esri.mo2.ui.tb.SelectionToolBar</td>
</tr>
<tr>
<td>Project Tool Bar</td>
<td>com.esri.mo2.ui.tb.ProjectToolBar</td>
</tr>
</tbody>
</table>

5.1 COM.ESRI.MO2.UI.TB.PROJECTTOOLBAR

This toolbar provides variety of tools to the user to save the project, open the project, save current shown map to a file and print the selected layer. All the tools are discussed below, and are create from this project.

5.1.1 Open Project

When users click on the button shown in Figure 5.2, file browser is opened to select any existing project from the local computer which is shown in Figure 5.3.
5.1.2 Save Project

When a user clicks on the button shown in Figure 5.4, the tool opens up the file save screen which is shown in Figure 5.5 where user can enter the file name and select the path to store the file.

5.1.3 Save Map Image to File

When a user clicks on the button shown in Figure 5.6, the user will be presented with the file save screen shown in Figure 5.7 where the user can enter the file name which allows user to select the image type to store.

5.1.4 Print Layer

When a user clicks on the button shown in Figure 5.8, the user will be presented with the print screen shown in Figure 5.9 which allows the user to select the desired printer and select any other print options.

The lines below are used to initialize the ProjectToolbar and set the current shown map to the Project toolbar and add the toolbar to the panel, and then the panel is added to the content pane of the JFrame, which displays the toolbar.
ProjectToolBar mProjectToolBar = new ProjectToolBar ();
mProjectToolBar.setMap (mMap);
mPanelOne.add (mProjectToolBar);
getContentPane ().add (mPanelTwo, "South");
5.2 COM.ESRI.MO2.UI.TB.ZOOMPANTOOLBAR

This toolbar provides a variety of options to the user to perform on the map. It allows users to find Previous Extent, Next Extent, Zoom to Active Layer, Zoom In, Zoom Out, Zoom To Full Extent, Pan, Pan One Direction and Identify. These buttons are discussed individually in the section below.

5.2.1 Previous Extent

When user clicks on the button shown in Figure 5.10, it takes the user to the previous state of the map.

5.2.2 Next Extent

When the user clicks on the button shown in Figure 5.11, it takes the user to the next state of the map. User can imagine the Previous Extent and Next Extent buttons are like breadcrumb (back and forward) buttons in the file browser.
5.2.3 Zoom to Active Layer

When a user clicks on the button shown in Figure 5.12, it zooms to the active layer selected on the table of contents show on the left side of the map.

5.2.4 Zoom to Full Extent

When user clicks on the button shown in Figure 5.13, the whole map is shown, in case if the user had zoomed into the map and cannot determine where exactly he is, and wants to see the whole map again.

5.2.5 Zoom In

When the user clicks on the button shown in Figure 5.14, it zooms into the map. Cursor will also be changed to the zoom in icon. If the user wants to get back the original arrow icon, then the user can click on the arrow button.
5.2.6 Zoom Out

When the user clicks on the button shown in Figure 5.15, it zooms out of the map. Cursor will also be changed to the zoom out icon. If the user wants to get back the original arrow icon, then the user can click on the arrow button

![Figure 5.15. Zoom out.](image)

5.2.7 Pan

When the user clicks on the button shown in Figure 5.16, then the user can drag the map in any direction he wishes and view it. This tool is similar to move page if the page is out of the screen.

![Figure 5.16. Pan.](image)

5.2.8 Pan One Direction

When the user clicks on the button shown in Figure 5.17, it provides four options. User can select any direction in which he is intends to move.

![Figure 5.17. Pan one direction.](image)

5.2.9 Identify

When the user click on the button shown in Figure 5.18, the cursor will change to the identify icon. User can click on anywhere on the map to find more information about that
particular location which will highlight that particular location and a pop up window is presented with more information, which is shown in Figure 5.19.

The lines below are used to initialize the ZoomPanToolbar and set the current shown map to the ZoomPan toolbar and add the toolbar to the panel; then the panel is added to the content pane of JFrame which displays the toolbar.

```java
ZoomPanToolBar mZoomPanToolBar = new ZoomPanToolBar();
mZoomPanToolBar.setMap (mMap);
mPidPanelOne.add (mZoomPanToolBar);
getContentPane ().add (mPidPanelTwo, "South");
```

5.3 COM.ESRI.MO2.ULTB.SELECTIONTOOLBAR

Feature selection based on attribute or spatial queries are performed by this set of toolbar controls which are discussed below:
5.3.1 Find

Find tool is used to text search on any layer. To use this tool, select a layer from the TOC on the left side and then click on the icon that is shown in Figure 5.20. When user clicks on this button it will open a window where user can enter the text in the Value field and click on find. It searches the whole layer and displays any matches found. The entered value to search is case sensitive. Figure 5.21 shows the screen shot of find. Figure 5.22 shows the resulting screen of the find tool.

Figure 5.20. Find.

Figure 5.21. Screen shot of using find tool.

Figure 5.22. Result of find tool.
5.3.2 Query Builder

Query Builder helps users to create SQL kind of queries and select certain features on the map. The icon for this is as shown in Figure 5.23. Click on this icon and you will see query builder as shown in Figure 5.24. Now you can build a query by selecting the fields or you can write your own query and click on execute. It will display the values returned in the query builder and also selects those areas on the map. The demonstration of this is shown in Figure 5.25. By convention, related features are colored yellow, as in Figure 5.25.

Figure 5.23. Query Builder.

Figure 5.24. Query Builder dialog window.

Figure 5.25. Illustration of using Query Builder.
5.3.3 Select Features

The icon to use this tool is as shown in Figure 5.26. To use this tool click on that icon and it will give four options rectangle, circle, polygon and line as shown in Figure 5.27. Select any one of them. Now click on any area of the map which you want to select and it will turn into yellow bordered showing that you selected that area as shown in Figure 5.28. You can select multiple areas by using the shift key.

![Figure 5.26. Select features icon.](image1)

![Figure 5.27. Options of select features icon.](image2)

![Figure 5.28. Select features tool options.](image3)

5.3.4 Clear All Selections

The icon for this tool is as shown in Figure 5.29. This tool is used to erase any features selected using the Select Features tool. If you had any selections using the Select Features tool. Now to erase the selection made in Figure 5.28, you simply click on this icon and the map will return to normal.
5.3.5 Buffer

To enable this feature you need to select a layer on the left side and select any area on the map with the help of Select Features Icon shown in Figure 5.26. When the feature is enabled the icon will be seen as shown in Figure 5.30 otherwise it will be grayed out. This tool is used to buffer (expand) the selected area along with the units selected in the buffer window. When you click on this, a window will be opened called Buffer as shown in Figure 5.31. Give the Buffer distance and select the buffer units and then click on apply. You will see that the selected area is buffered. The demonstration is as shown in Figure 5.32.

5.3.6 Attributes Icon

This tool is used to get the attributes for the selected areas made on selected layers. To enable this feature you need to select a layer on the left side and select any area on the map with the help of Select Features Icon shown in Figure 5.26. When the feature is enabled the icon will be seen as shown in Figure 5.33, otherwise it will be grayed. When you successfully made some selection as shown in Figure 5.34, you will get the attributes
Figure 5.32. Illustration of applying buffer.

Figure 5.33. Attributes icon.

Figure 5.34. Result of attributes icon.
window when clicked on this icon as you see in Figure 5.34. This tool gets all the data at the same time.

The lines below are used to initialize the ProjectToolbar and set the current shown map to the Project toolbar and add the toolbar to the panel, then the panel is added to the content pane of the JFrame which displays the toolbar.

```java
SelectionToolBar mSelectionToolBar = new SelectionToolBar ();
mSelectionToolBar.setMap (mMap);
mPanelOne.add (mSelectionToolBar);
getContentPane ().add (mPanelTwo, "South");
```
CHAPTER 6

CUSTOM ADDED FUNCTIONALITIES

Along-with the standard toolbars, additional toolbars and also menu bars have been implemented to facilitate the usability of the GIS tool. Code is shown on how this can be achieved but this can be done using drag and drop also from the Eclipse IDE Swing Controls.

6.1 CUSTOM TOOLS TOOLBAR

The tools shown in Figure 6.1 are discussed below.

![Custom toolbar](image)

**Figure 6.1. Custom toolbar.**

6.1.1 Add Layer

Geographic data is added to the map in the form of a layer. The data can be anything related to map like roads, cities, lakes, schools, rivers etc. One of the file formats to represent this data is a shape file. The screen shot of the Add Layer button is as shown in Figure 6.2.

![Add layer icon](image)

**Figure 6.2. Add layer icon.**

So when you click on this button you will get a dialog window asking to select a shape file as shown in Figure 6.3. Figure 6.4 shows the screen shot after adding the cities shapefile to the word map.

6.1.2 Pointer Button

The Pointer button gets the cursor back to normal i.e. arrow. For example when you click on the zoom in or pan button your cursor will be changed to respective tool icons and
Figure 6.3. Add layer dialog window.

Figure 6.4. Screen shot after adding cities shape file to the map.
after using them if you want to return normal cursor icon just click on this button. The screen shot of the arrow button is as shown in Figure 6.5.

![Pointer button](image)

**Figure 6.5.**
Pointer button.

### 6.1.3 Distance Measure Button

The distance button is as shown in Figure 6.6. This button helps us to measure the distance between two points on the map. The distance is given in both miles and kilometers at the bottom of the map. Suppose you want to measure the distance between USA and India. Simply click on this button then press on USA then drag it until India and then release it. The screen shot demonstrating this is as shown in Figure 6.7.

![Distance measure button](image)

**Figure 6.6.** Distance measure button.

### 6.1.4 XY Button

The XY button is used to read the information from a CSV (Comma Separate Value) file and then it adds a layer on to the map as points. The CSV file contains longitude, latitude and any other information values separated by commas. The icon of the XY feature tool is as shown in Figure 6.8. Figure 6.9 shows the file dialog that opens when you click on this button. Select a CSV file and then click on ok. The screen shot of the map after adding the CSV file is as shown in Figure 6.10.

### 6.1.5 Hot Link Button

The hotlink tool is used to click on the points displayed on the map to get the information about that point on the map. The icon for the hotlink is as shown in Figure 6.11. When you click on this icon the cursor will change to the hotlink symbol that
Figure 6.7. Demonstrating the distance measure between two points.

Figure 6.8. XY layer button.

Figure 6.9. File dialog for XY button.
looks like a bolt. Now click on any one of the points to get the information window. If the information window does not pop up when you click on the point try to zoom in and then click on the point. The sample information window is as shown in Figure 6.12 when clicked on a star for country USA.

6.2 USER TOOLS TOOLBAR

This toolbar is implemented to create users, delete users, logout and exit options. All these tools are discussed below with screenshots of each tool.

6.2.1 Add User

When the user clicks on the icon shown in Figure 6.13, the add user window dialog shows up which is shown in Figure 6.14.
6.2.2 Delete User

This tool is used to delete the users which are created using Add User tool. The icon of delete user is shown in Figure 6.15 and the delete user window dialog is shown in Figure 6.16.
6.2.3 Logout Button

The tool is used to logout of the application. The logout icon is shown in Figure 6.17.

6.2.4 Exit Button

This tool is used to exit the application. The Exit icon is shown in Figure 6.18.

6.3 MENUBAR

The Menu bar has four menus File, Theme, Layer Control, Display and Help. I will discuss each of these, their sub parts, functionality and how to use them. File, Theme and Layer Control, Display drop down options are shown in Figures 6.19, 6.20 and 6.21, 6.22 and 6.23, respectively.
6.3.1 Add Layer

Add layer menu item is similar to the Add Layer button discussed in Section 6.1.1.

6.3.2 Remove Layer

Remove layer simply removes a layer from the map. The icon for remove layer is shown in Figure 6.24. If you want to remove the cities layer that we have added previously this is shown in Figure 6.4. Select the cities layer on the table of contents i.e. on the left side of the map, then go to file menu and then click remove layer. Now the cities layer is removed from the map.
6.3.3 Legend Editor

Using the editor we can change the color of the layers and we can add labels to the map. We can customize the font, size, orientation and color of the labels displayed on the map. The icon for the legend editor is as shown in Figure 6.25. To use this feature, first you need to select a layer on the table of contents. Now I want to change the color of the country layer on the map. As I selected that layer I will go to file menu and then click on the legend editor. Now it opens legend editor dialog window that is shown in Figure 6.26. Go to color and then click on the drop down then click on custom. It shows a color palette window as shown in Figure 6.27. Now select some red color and then click on apply. It now changes the color of the country layer to red as shown in Figure 6.28.

![Legend Editor](image)

Figure 6.25. Legend Editor.

Figure 6.26. Legend Editor window.

6.3.4 Attribute Table

An attribute table contains data about the layer that will be in the form of rows and columns. This attribute table is stored in the format of .dbf files. These files come along with shape files. The size of these depends upon the information they want to provide along with that layer. To see the attribute table, select a layer on the table of contents and then go to the theme menu and click on the open attribute table option that is shown in Figure 6.29.

Here we have selected Asia layer and clicked on the open attribute table. The attribute table that we got is shown in Figure 6.30.
Figure 6.27. Color chooser.

Figure 6.28. Map after changing the color using Legend Editor.

Figure 6.29. Attribute table.
Figure 6.30. Attribute table for layer Asia.

Note that the Identify tool shows, on effect, a row of the attribute table. Thus we can see all the data at once to compare, using the attribute table.

6.3.5 Create Layer from Selection

Using this option you can create a new layer from the selections made on the map using the select features functionality which is in Figure 5.26. Make selections as explained in Section 5.3.2 and as shown in Figure 6.31. The icon for this option is as shown in Figure 5.28.

Figure 6.31. Create layer from selection.

After selecting some areas on the map using the shift key and select features tool click on create layer from selection. It will show a prompt to click on and do it. It adds automatically a new layer to the map. We made some selections and created a layer on the map that you can see in Figure 6.32. You can change the name of the layer using the legend editor, which we discussed about earlier.

6.3.6 Promote or Demote Selected Layer

Using these options that are present under the menu layer control as shown in Figure 6.33 we can change the order of layers displayed on the map. Now if I want to move
the layer America to bottom of the TOC (Table of Contents), simply select that layer and click on “demote layer” until its position is changed to the last one in the table of contents as shown in Figure 6.34. Now if you observe you cannot see some of the red stars as they are hidden below the other layers. Now if you want to move the Americas layer to the top so that you can see all the red stars, use the promote layer option in the same way as demote layer.

6.3.7 About Us

About us is used to tell about the developer. The About Us window is shown in Figure 6.35.

6.3.8 Contact Us

Contact Us window provides contact details about the developer in case the user wants to contact the developer when there is an issue with the software. The contact us window is shown in Figure 6.36.
Figure 6.34. Moved layer Asia all the way to bottom.

Figure 6.35. About us.  

Figure 6.36. Contact us.
CHAPTER 7

CONCLUSION

This thesis is about building a teaching aid tool for the Chinese Diaspora for the department of history. Dr. Carl Eckberg and Prof. Kathryn Edgerton-Tarpley played very important roles in shaping up this software. The whole point of building the software is to satisfy the customers ultimately. All the software requirements were not given at one time. Requirements were given or changed every time there was a review about the software which is planned to be interactive. So a lot of time has been spent upon building the software until the customers are satisfied with the project.

As the Chinese Diaspora is so vast and the topic is about the whole world, there was lot of data to be collected about so many countries. It took a very long time for the collection of data and preparing the data. As the requirements were changing, it took a lot more time to collect the data. First it took time to know which countries have Chinese Immigrants. After preparing the list of countries that contains Chinese Immigrants then data about each country has been collected. The data collection included start of the Chinese Population in that country, year of data, percentage of Chinese population, percentage of Global population etc.

Coming to the challenges faced on the technical side, first as I was not proficient in Java and it took some time to get started with the development. As one of the requirements was easy installation of the software, Eclipse was used. Eclipse was completely new to me and it took time to configure the map objects in Eclipse. Then making the hotlink cursor work properly and opening the html links in any available internet browser on any type of machine were some of the challenges faced in development of the software.

A lot of things were learned from the thesis, for example hands on experience with Java, Eclipse, and Map Objects that are helpful for my career in this competitive world. Also gained experience working on the ArcGIS Desktop application, one of the challenging and interesting environments.
CHAPTER 8

FUTURE ENHANCEMENTS

This GIS tool is built using Map Objects Java and Java Swing, so adding additional features or modifying the features can be comfortably done with this software. Most of the code contains java classes and these classes can be reused or extended easily. It is also easy to write new classes using Java. Some of the ideas that can be considered for future enhancements are:

1. This software is developed only for Chinese Diaspora, but it can be extended to be generic to teach any world history like the Japanese Diaspora, the American Diaspora, the French Colonial Republic, etc. It is only that collection of data and preparation of CSV files matters.
2. Ability to let the user easily gives coordinate and other information and then add automatically adding that as a point on the map.
3. Coloring the countries map area in different colors for each category.
4. Adding additional CSV files for country capitals, major rivers or ports, key battles, etc.
5. Adding self-test quizzes.
6. Adding dynamic map based games.
7. Making the application multilingual.
BIBLIOGRAPHY


