Table Mediator: Digital Storytelling System based on Information Retrieval and Tabletop

Hyun Sang Cho*, Gwan Jang**, Soung Soo Park**, and Minsoo Hahn***

Abstract We proposed "Table Mediator" which is a tabletop system for digital storytelling that uses web-retrieved information for the students' educational field trip. Students can perform their storytelling for their virtual pre-field trip to build up a sequential path as a story with web-retrieved documents, satellite images, geographical information, and group discussion. The proposed system was designed to lessen the limitation of individual interaction such as restricted viewpoint and biased inclination by group digital storytelling. Local interactions also have the limitation such as insufficient information and knowledge and the system supplied the rich live information such as subjective critiques or recently discovered history, or new updates for building a story that makes users arrange their own idea as a consistent story to lessen the limitation of the local interactions. The system can be used for various applications such as travel, education and other collaborative works with group interaction.

Keyword : Storytelling, Tabletop, Google Earth, Education, Collaborative, Groupware

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1. Introduction

For the past several decades, the Computer Supported Collaborative Work (CSCW) has been one of the major fields in computer science to study the computer-supported promotion of effective social interaction. Recently, tabletop systems which utilize the traditional table metaphor as a tool for small group interactions and which promotes collaborative works have been proposed as one of new groupware research fields [3][4]. Most of recent tabletop models consist of tabletop surface as a display and input devices including conventional desktop input devices such as the mouse and the keyboard and tools of new input modalities such as the Tangible User Interface (TUI), and user's context detection devices such as gesture recognition, voice recognition, and others.

In the meanwhile, the Internet-connected system supplies plentiful resources for collaborative works. However, the great amount of information has lead users to miss the comprehensive understanding due to a lot of scattered information for a certain topic. The combination of multi-type information from internet can makes the fragmentary issues as a whole for solving the problem. Some applications such as "yourstreet" that shows location related news on Google map [8] supplies such the combinations of multi-type information but it still lacks the coherence among subtopics. We thought the problem could be overcome by making a consistent story of the information because the story is a sequence of events with some particular contexts [1], a narration of a chain of events told or written in prose or verse, and one possible mechanism to transmit knowledge [2]. We noticed that the stories hold a key to unlock the vital knowledge [2] and the web information can provide user the rich live information such as subjective critiques, recently discovered histories, or new updates.

In this paper, we propose "Table mediator", a tabletop system for the storytelling, which presents geographical information with satellite images from Google earth and web-retrieved documents. The system presents a tool of small group collaborative task for interactive storytelling with the interesting virtual experience. For the purpose, the system gathers documents set from commercial web retrieval engines, accumulates, and presents the documents for interactive storytelling. We adopted fieldtrip for students as a first phase application and the result of the group storytelling is used as a guide map for actual fieldtrip to enhance the comprehension for the visiting site. In this paper, we selected the fieldtrips of traditional palaces in Seoul, a capital of Korea, as a scenario.

The organization of this paper is as follows. After this introduction, we described a working scenario and the design of the system. Next, we described actual implementation with related issues. Finally, we described conclusion and future work.

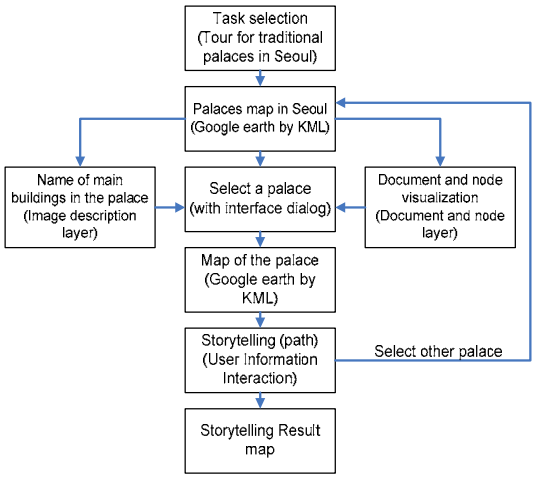

Figure 1 System working flow diagram

2. Scenario Design

Figure 1 shows the flow diagram of a educational fieldtrip working scenario for traditional palaces in Seoul. At the beginning of an operation session, users select a task file (*.tak) to start a given task. An instructor (coordinator) who designs the trip prepares the task file (*.tak), KML files (*.kml) which are Google offered XML type markup language to drive Google earth server, and location description files (*.loc). A task file includes a list of subtasks as couples of a KML and a location description file that describes a geographical area for visiting. Users execute Google earth client by selection of subtasks to get a satellite image for an area specified by the KML file. Each KML file has a corresponding location information description file,

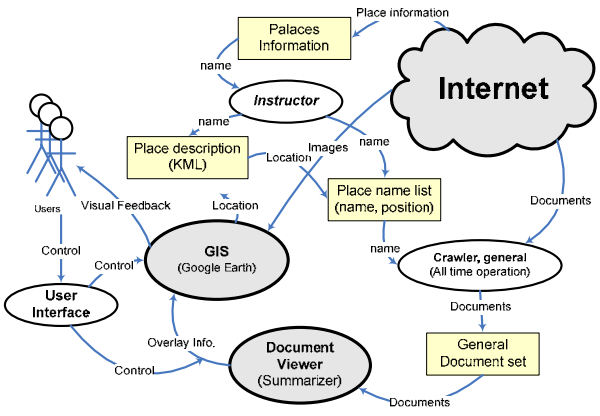

Figure 2 Overall concept of system configuration

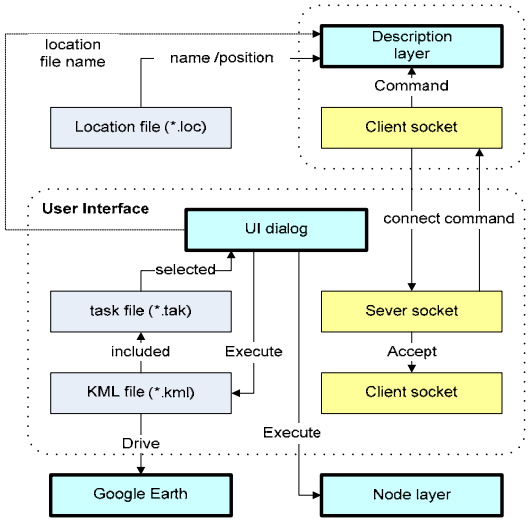

Figure 3 Software structure and communication links

which has loc file extension. The location description file (*.loc) describes the name of buildings within the selected location and the names are used to form a query for a retrieval request. When user selects one of the subtask items that are actually KML files, Google earth client shows a satellite image of the area. Two overlapped transparent layers present the information such as a name of buildings and documents that are related to a selected building for the storytelling. The two transparent layers are a description and a node layer: the description layer shows name of buildings and other predefined information and the node layer shows the information for the interaction and storytelling progress.

For the cultural universality of the system, we designed the system directly interact with the satellite image itself. An instructor can easily change the contents of the trip by changing the language to describe the location description file (*.loc) to generate a query when the users uses the system in the different geometric location and culture. Users can generate the queries to get web-retrieved pieces of a story not from the direct keyboard typing but from the selection of a location by placing a marker. For example, if a user selects Koungbokgoong palace, a term 'Koungbokgoong', the name of an individual building, and user contexts such as a name of current season and a temperature degree composes a query. We used a general "GET" method to send web-retrieval engine vendor specified query sentences through http channel for getting web-retrieved documents. In this version, we used web search engine ranked documents instead of using our own ranking process for reducing implementation overload. Figure 2 shows the overall concept of Table mediator system. We have a plan to use Lucene [5] and SVM [6] for the classification and the ranking process for

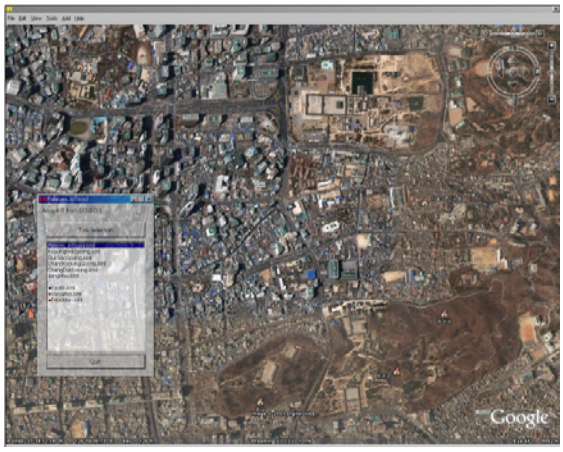

Figure 4 Satellite image from Google Earth and a half-transparent interface dialog box

more sophisticated context information processing at the next phase.

3. System Implementation

Figure 3 shows the software structure and communication links among processes of the system. The system consists of a web contents processing unit for information including satellite image and text from the web, a user interaction unit for query and story generation, and hardware systems to support the overall operations.

3.1 Web contents: Information Retrieval and Geographic Information

Figure 4 shows a screenshot of initial screen that consists of Google earth client for real satellite images and two transparent layers (description and node layer) for information display and interactions. A half-transparent interface dialog box accesses and drives predefined KML files and location description files when user select a task file. KML file drive Google earth to show a satellite image of an area where was predefined by the KML file. The interface dialog is an always-top displayed dialog window for a user's location selection and sends the user selection information to the transparent layers through two TCP channels and direct execution of the KML file. The description layer shows pre-defined information about each palace, which was described in a location description file. On the node layer, user makes a query for web retrieval. Every documents related to the location are retrieved from World Wide Web. We used four popular web-retrieval engines in Korea to get related web page lists. Each query is combination of geometrical and temporal contexts such as a location name, a name of season, a name of month, and a status of weather. We did not use APIs provided from service provider because some APIs

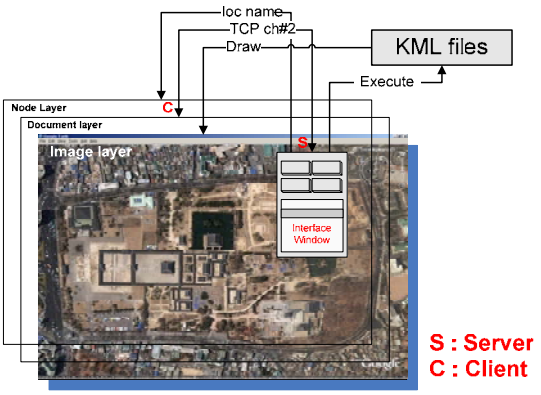

Figure 5 Display layer structure

returns a XML file as a result could not satisfy our requirements such as a response data type, a coverage, etc. Therefore, we directly crawled each search engine results as in HTML files. We restricted the length of each document to less than 300 characters for the limited display area of Table mediator. Each text document is converted to a post-it like sheet as a bmp file and displayed on the node layer. Figure 5 shows the connection schematic.

3.2 User Interaction

The two transparent layers are fully transparent that differs from interface dialog box. The layers and the interface dialog box are always shown on the top of a satellite image layer. The user interactions for a storytelling are performed on the node layer. Each building of a selected palace has a node bar, which represents the number of documents as color intensity. Thus, user can easily recognize which building has more documents by looking at the color intensity. The visualization module gets the documents from commercial web retrieval engines. Figure 6 shows an example of the intermediate progress of a storytelling. Then the users can see the detailed contents of the documents by a mouse click or a placing an AR marker attached on a TUI object. We used a webcam placed over a tabletop display and ARToolkit [7] to get a position and an orientation of the marker. For an exact pointing to select a building, a marker size should be as small as possible but a web camera and ARToolkit could not detect the small size marker. The optimal size of a marker is 4×4 cm^2. The light condition is also one of important condition to detect a marker. The optimal light condition of the system is dark for clearer image on the top of the table but it also causes recognition problem. We used a LED equipped cubic as a backlight device of a marker and got a prominent result. Next, a calibration process is needed to get correct position of the marker on a screen at the beginning because small movement of any part on the path of the light form a

Figure 6 Storytelling process on a satellite image of a Koungbokgoong palace

projector easily change the size and the position of an image on the table. The calibration process is done by placing four calibration markers on the four corners of an actual region of a screen. The system gets the positions of four calibration markers and uses the position for a calculation of the actual positions of markers on the tabletop. Like the calibration markers, each marker has a unique function for a specific operation. For selection of a building to get web-retrieved documents set, it needs a location-pointing marker. The documents pop up on the screen when user selects a building and the user can bind a selected document as an event of storytelling by a marker for the selection. Then users select a document for making connection a storytelling path from a previous selected story to a current selected story. When user selects a next document as a next event of the story by same method, a line is generated to connect the two documents as a piece of storytelling sequence. In addition, it needs a marker to pull or a maker to rotate a document sheet. At the end of storytelling, users can check the result of their storytelling by an auto-play of story along a path of the story.

3.3 Hardware system

The hardware consists of a projection-type display system and a marker based pointing system. The display system is a movable 1 m cubic box with four wheels at the each corner of the bottom side. The top side of Table mediator is a strengthening grinding glass. The size of the glass is 1 m square and we choose the size by the reach of an adult to opposite side. For suitable user interaction, the tabletop system needed enough screen size on the top display surface and we had to get long focal distance (approximately 4~5 m) within the inside of 1 m cubic. As shown in figure 7, it was impossible to get the sufficient distance directly. Therefore, we used two mirrors and one wide angles lens to get the distance and the result is figure 8.

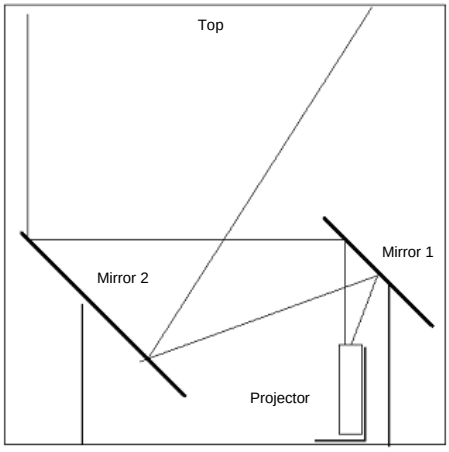

Figure 7 Projection path in Table mediator

Table mediator may be equipped with two cameras to detect the upper side and the bottom side of markers. In this case, the users can recognize only the upper side but the computer can recognize the bottom side as well as the upper side. This function can be used in some interesting applications like game. We tested three types of marker detection methods. The first type was with a bottom side equipped web camera that detected the makers, which faced to the surface of a grinding glass. Since there was no obstacle between a camera and markers, the markers were not disturbed by hands. However, a very bright light spot from reflected light of projector disturbed to detect markers around the spot. Second type was with an IR filtered camera. We equipped an IR lamp over the tabletop and a bottom-equipped webcam with an IR filter received the IR light through a marker. The blight spot issue of type 1 could be eliminated but it caused difficulty to adjust the optimal intensity for the marker detection. Third type was a topside detection method, which detected upside of markers. This type was good for bright environment but an image on the tabletop was severely disturbed by the environment. For solving the problems, we made a LED backlight cubic type marker. The cubic type marker has several advantages: First, it is possible to avoid the hand-generated camera disturbance because a user can handle the cube by grip bottom of cube side. Second, using the LED as a backlight, it can make dim environment to make user see an image on the tabletop clearly.

Over the top of the tabletop, a 6 inches LCD, named Private Reflection Display (PRD) is equipped to serve the private information that only shared within the members around the system by the law of reflection. The direction of the LCD display is down side and users can see the image by reflective material such as mirror, surface of tea, or glass at the appropriate position to satisfy the law of refection [9].

Figure 8 Actual implementation of the Table mediator

3. Conclusion and Future work

This paper presents Table mediator, a new tabletop system that supplies a place for the digital storytelling with geographical information and social knowledge. The system gets satellite images from Google earth server and web-retrieved documents of user-selected location from commercial web retrieval engines. Users assigned one or more web-retrieved documents for related buildings in the location as selectable events for performing a story for a virtual educational fieldtrip. Users choose location-based web-retrieved documents as events of their own story with discussion amongst members around the table. The documents have various contents including continuously updated objective information and subjective opinions and we expect they can help the tabletop users to lessen the limitations of local area small group interaction that are insufficient information, restricted knowledge, and biased inclination.

We got positive response from several small user groups for the preliminary experiment. They showed great interest to navigate the satellite image and building a story from web-retrieved documents. We are going to evaluate the performance of Table mediator as an educational instrument by the traditional educational evaluation method by cooperation with teachers on service. At same time, we are developing and testing new rotational document display types and several document-handling methods for the next phase experiment.

Next, we will develop a module for summarization of actual fieldtrip. After actual fieldtrip, the system automatically classifies and positions the photos from GPS equipped digital cameras on the map to complete the fieldtrip with user annotations. Finally, the results will be uploaded to the web for sharing with other groups. We expect this system will be an effective educational tool and a new type digital

storytelling-authoring tool for other collaborative group work applications including touring club work and digital photo album for a family.

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