

論文の内容の要旨

論文題目 Collaborative Mobile Map Collaging for Local Knowledge Sharing
(地域知共有のための協調的モバイル地図コラージング)

氏 名 司 若辰

Local knowledge is unique to a given culture and society. The sharing of local knowledge contributes to the development of local community activities. Local people have played important roles in sharing their knowledge to drive regional activation, such as through tourism planning, creation of local recycling-oriented societies, and local bus services management. There are problems with local people's participation in local knowledge sharing. First, local information in such media as books, signboards, and web sites is not widely known, noticed, or sought by people with little background knowledge, thus affecting the efficient spread and use of local knowledge. Second, there is a lack of communication and cooperation among different local communities, preventing the wide sharing of local knowledge.

As important tools for spatial communications, maps play key roles in local storytelling, such as local navigation, introducing local information, and inspiring people to visit local areas. Nowadays, web mapping and mobile mapping are popular and widely used for the advantages of convenient access through the internet and powerful location-based services; however, they are not detailed in local areas and lack local information and knowledge, such as culture, history, and nature for storytelling. Currently, a trend of story mapping is emerging that provides mashup maps. Combined from multiple sources, they integrate multiple media types – such as text, photos, movies, sounds, and webs with location data – which are useful for creating spatial storytelling. Such story mapping services have deficiencies in local knowledge sharing due to the limitation of web mapping as base maps to represent local storytelling, in addition to the difficulty of using digital technology for geography and archeology researchers and non-professional local people who are not skilled in GIS (Geographic Information Science). Conversely, local analogue maps, such as illustrated maps and map signboards, are still popularly used for such purposes as local travelling, walking tours, and environmental education. Many local communities have created and published paper-based analogue maps for activities such as walking tours and lifelong education. Analogue maps are considered to have better local area content for both users and creators; however, most of the local communities have been used to analogue maps and overlooked digital technology, which is capable of enhancing current local knowledge sharing through the better presentation of mobile and authoring environments. Such new environments enable local people to more easily and efficiently experience spatial storytelling, in addition to having creative opportunities to contribute to local map creation and location-based storytelling application development, using mashup content compiled from paper-based local knowledge materials, including analogue maps, photos, and text.

This thesis proposes a new framework of map collaging for local people to participate in local knowledge sharing through the mashup of various georeferenced local analogue maps, created by different local communities with photos, text, and audio to convey local knowledge of different topics, eras, and areas. The framework dynamically combines and organizes the relations among different local maps, in addition to automatically managing the map switch and information narration for local area navigating and location-based spatial learning for tourism and life-long learning. It also provides easy functions for producing map-collaging content, involving the cooperation of local communities and the participation of local people to share their knowledge, thereby enriching collective local knowledge for promoting local development.

The thesis makes three principal contributions to realizing the framework of map collaging: (1) proposing methods for accurate positioning on and overlaying of analogue maps with distortions, (2) constructing models for visual and cognitive continuity management of presenting and switching multiple maps for local storytelling, and (3) implementing easy software

tools to enable people to make map collaging content for sharing their knowledge.

Accurate positioning and map overlaying are the foundations of the mobile environment application of map collaging. Therefore, the thesis first introduces the methods for accurate positioning and map overlaying in Chapters 2 and 3.

Chapter 2 introduces polyline-based georeferencing, which uses polylines as spatial references to connect analogue map images with the base mobile mapping. Algorithms to calculate positions, directions and map overlaying based on polyline georeferences are proposed. Experiments and simulations prove that the new method realizes accurate and robust positioning along the polylines for georeferencing, and reasonable map overlaying on the focus point (e.g., the user's position).

Chapter 3 explains semi-georeferencing for building connections among local analogue maps, which supports position transferring and map overlaying among the local analogue maps. Semi-georeferencing enables positioning on old maps, on which it is difficult to find spatial objects corresponding to the base maps for georeferencing, through other georeferenced maps. It also contributes to improving positioning and map overlaying accuracy.

Local analogue maps have different map presentations, scales, and alignments, which are not designed for combined use; consequently, discontinuities are caused in map cognition with simple overlaying of the local analogue maps.

Chapter 4 explains a research study on new models to manage continuities among multiple maps for storytelling, with easy-to-follow map presentation and smooth map switching. Spatial triggers are applied to cue local stories on different maps with spatial trajectories, with which proper maps will be presented and related information displayed or narrated automatically according to users' positions and trajectories. A model of using various factors for user-friendly map collaging presentation and smooth map switching is proposed. Experiments with web questionnaires and users' operations on map collaging are conducted, through which factor-value combination for managing map collaging continuity is determined.

Chapter 5 explains the software architecture and the implementation of the experimental application MapCollaging. Data structure, user interfaces, and interaction methods are designed for map collaging browsing and editing. For browsing multiple maps, it provides such functions as map switching, map transparency, and visibility controlling. For the editing component, basic functions are provided for adding polyline-based georeferences, placing POI (Point of Interest) icons on maps, setting spatial triggers, etc. Moreover, guidance functions of computer-aided map georeferencing are developed, such as enhancing the base maps with user trajectory, presenting hints to assist finding corresponding polylines, automatic polyline bundling, and a sequential guiding function. User experiments demonstrate feasibility of the application for users to browse and edit map collaging content.

Chapter 6 introduces fieldwork experiments for map collaging. With the cooperation of local communities, the map collaging content and walking tour application KashiwaWalk are made for Kashiwa City, and experimental map collaging content is made by the Shiroy City local people. The fieldwork indicates the feasibility of local storytelling through map collaging and local people's participation in map collaging content making.

Chapter 7 draws conclusions on the contributions of the thesis, and considers future research opportunities. This research proposed a computer-based framework for local knowledge sharing through mapping services with multiple local maps. It achieves learning and experiencing local knowledge in the real world, and supports local people's participation in sharing personal knowledge with others through the system. In the future, improvement will be made to the framework of map collaging to facilitate wide use of the framework for local knowledge sharing to activate and promote development of local areas.