

Myglobe: A Navigation Service Based on Cognitive Maps

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ABSTRACT

Myglobe is a user generated navigation service that enables users to share each cognitive map with one another. Cognitive map is a personalized map, shape of which is emphasized according to user's preference and activity in the city. It facilitates users to look back on their own city and have a new understanding by using an application in smart phones and physically interacting with a globe shaped device. In this paper, we present *Myglobe* service for users to achieve a new city experience with cognitive maps.

Author Keywords

Cognitive Map, Interaction Design, Locative Media

ACM Classification Keywords

H5.m Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

Design, Human Factors

INTRODUCTION

Myglobe is a navigation service that allows us to share our cognitive maps. In the area of Cognitive Science, "cognitive map" is used as a term when humans understand the image of an environment. In *Myglobe*, cognitive map is a map reflecting the user's individual experiences and the view of the city. Kevin Lynch [4] identifies elements which people use to form cognitive representation of cities; landmarks, paths, districts, nodes and edges. This map reflects our own activities and shows our subjective view of the city by emphasizing landmarks, paths, and districts frequently used. Users can bring up their own city in *Myglobe* by actually walking in the city, sharing their own maps with each other, and utilizing them as a navigation to discover unknown places.

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Present map services such as Google maps and Google Earth, provide mash-up tools which allow us to create our own favorite place on the map easily. With current map services, we can use hand held GPS devices to make our own travel route and navigate to a destination place. In addition to putting markers on maps, *Myglobe* enables us to change the shape of the map itself. In contrast to current digital maps, *Myglobe* also allows us not only view through laptop and mobile device but also to browse by *Myglobe* device, spherical tangible device. It can also be used as a communication tool to share the life history with your friends or strangers.

RELATED WORKS

"Automatic Generation of Tourist Maps" [3] is a prior work about maps emphasizing landmarks and streets. The size accords to their scores evaluated by semantic information from websites. In contrast, *Myglobe* emphasizes important areas of user's subjective cognitions according to the user's own activity history. "CityFlocks" [2] is a prior work about social navigation application for mobile device. This application facilitates indirect navigation by utilizing average ratings and comments from local residents. "User-Adaptive Maps for Location-Based Services for Tourism" [7] suggests personalized maps based on user preference and GPS. "Goal and Path Prediction based on User's Moving Path Data" [6] is a method to predict a user's goal and a path to the goal by analyzing the user's past moving paths. *Myglobe* predicts user's highly impressed paths by analyzing the user's past moving paths. "Sphere: A Multi-Touch Interactive Spherical Display" [1] is a prior work about an interactive spherical display prototype. This allows users to operate interface by multi-touch interaction, while *Myglobe* allows users to operate the map by rotating the sphere itself.

MYGLOBE

Myglobe service consists of three parts; the engine for generating the cognitive map from user's location data histories, an application that works in smart phones, such as iPhone, and a hardware device for displaying the map (Figure.1). *Myglobe* engine converts location information stored in the server into data that generates user's cognitive maps. *Myglobe* application is utilized for "location-logging", navigation by other user's cognitive maps and sharing it

with others. *Myglobe* hardware, a sphere shaped device, is used as the cognitive map viewer for reviewing their life histories noticing their favorites, and discovering unknown places outside their cognitions.

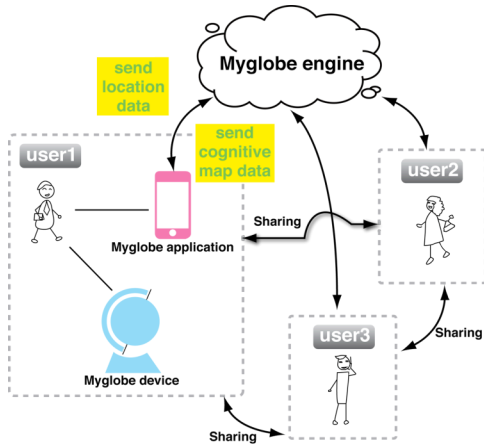


Figure 1. System

Myglobe engine

Myglobe engine calculates position and size of islands, roads and landmarks in cognitive maps from user's location data accumulated in database. User's location data is taken from the latitude and longitude recorded every fifteen seconds. *Myglobe* engine sends the calculated data to *Myglobe* application, which renders cognitive maps. Areas the user goes around are shaped as if they were islands, which spread as the user visits many places. Paths the user moved in past are rendered as lines, which becomes wider as the user visits more. Buildings the users often visit or stay are expressed as landmarks, the size of which depends on the duration of their stay and the frequency of the visit.

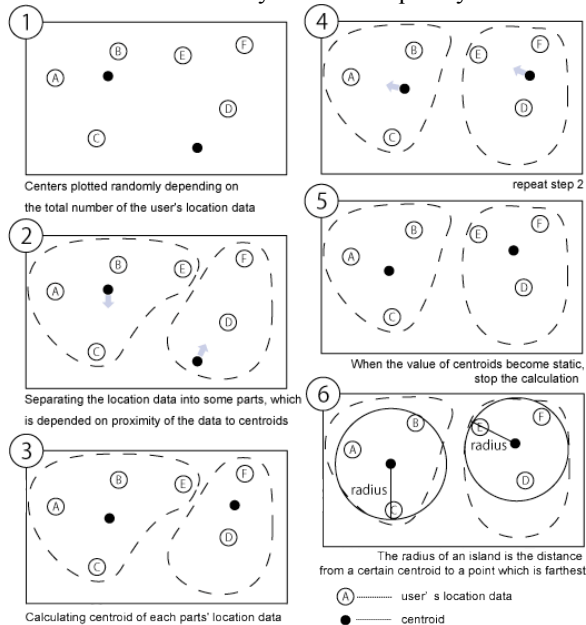


Figure 2. How to calculate island's location and size

First, we describe how to calculate the island's size and location drawn in the cognitive map (Figure.2). The island's coordinates (latitude and longitude) are decided by finding centers of the user location data, which employs the k-means algorithm. For deciding the center of islands, *Myglobe* engine decides the number of centers which should be found depending on the total number of the user's location data. The engine assigns a value to centroids based on coordinates and separates the location data into some parts, which is depended on proximity. It separates every user's location data into the number of parts of the centroids, and repeats this again. After repeating these steps a number of times, the value of centroids become static, which means it is the end of calculation. This becomes the center of an island. From user's location data which is separated around the centroid. Some little islands are drawn on the basis of island's location and radius which is calculated in this way, or some big islands are drawn by a little island lap over a little island.

Second, we describe how the engine calculates the coordinates and size of roads drawn in cognitive maps. *Myglobe* engine calculates duration of stay and number of time visiting, which are the cumulative times user stays or passes in a certain point. Duration of stay is registered when the coordinates are continuous over a given length of time, which is set as five minutes for current prototype. The number of times visiting is stored and counted in the database when passing a certain point. The engine calculates the duration of stay and number of times visiting by analyzing position tracking histories which *Myglobe* application attains and stores in database. If points successive in distance have more than a certain number of times and also a similarity in the frequency, the engine renders roads by connecting the points and drawing lines. Widths of the roads are decided according to the average of numbers of times the user visited of the points. By using this algorithm, routes the users have walked very often are indicated broadly and those the users have walked only once are quite narrow (Figure.3).



Figure 3. Rendering of roads, red line are roads

Landmarks in cognitive maps are generated in location coordinates where duration of staying is longer than the given length of time. The sizes of each landmark are

proportional to duration of staying and the frequency of visiting. Landmarks where the duration of stay is longer and the number of times visiting is more are expressed larger than actual size. The types of landmarks are predicted by requesting web API of database registered buildings and tags users put on. Fundamentally, the types of buildings are decided by requesting the coordinates of locations to be created landmark to web API of database registered types of store information, such as restaurants, cafes or bars. If type of landmark is not registered in web API, user himself can register the type of the landmark by tagging the location. Islands, roads and landmarks are rendered in cognitive maps by sending data created by *Myglobe* engine to *Myglobe* application.

Myglobe application

Myglobe application (Figure.4) installable in smart phones, such as iPhones, has four functions; location logging, viewing cognitive maps in current location, sharing the maps with friends, and tagging. *Myglobe* application gets the exact position data (longitude and latitude) at fixed intervals by utilizing the GPS inside the phones and sends the data to the server through wi-fi and 3G networks. It also shows other users' cognitive maps in their current locations. Users can take a look at their friend's or any stranger's cognitive map and use as a navigation guide to find out a new favorite places. User's favorite places or the streets frequently used are shown as large icons and white lines. The green island is the territory of the user. When the user selects other's cognitive map shown under his/her map, the other's favorite place can be added to the user's cognitive map.



Figure 4. Myglobe application interface

The “Friends list” function allows users to make friends by searching friends within *Myglobe* users or inviting non-users to the service. . In order to register friends, there is a need to send a request to the friend, and when accepted s/he is automatically added in the friends list. Users can not look only at the friend's cognitive maps in current location but also cognitive maps in other places. For example, you can take a look at a friend's Kyoto vacation cognitive map

when finding him/her in Shibuya. Users can also tag buildings on the cognitive map. By tagging buildings, users can take note the buildings. If the building is not registered in database, users can decide what kind of icon the building may look like by putting tags on it. *Myglobe* give users control of your private information by three limitation settings of displaying user's cognitive maps; allowing anyone to access the maps, allowing only friends to access, allowing only the user himself/herself to access. Users can set these settings per each place. By these settings, users can keep some areas private and recommend places they want to.

Myglobe device

Myglobe device is a terrestrial globe device that allows users to take a look at cognitive maps created by the engine, and look back on their activity in the city. The design of the device focuses on metaphor of a traditional globe, for it is used to look at their image of the city in everyday life, like interior globes. *Myglobe* consists of five sections; a laptop that connects to *Myglobe* engine through the internet, built-in projector in the base of the device, spherical acrylic displaying the cognitive map, axis section that has built-in sensor which allows the displayed cognitive map to change as it turns, and an arm section for zooming cognitive map (Figure.5). *Myglobe* device downloads cognitive map data that is calculated by *Myglobe* engine when *Myglobe* device starts up. The laptop visualizes user's cognitive map by using downloaded data. By projecting the cognitive map to a spherical acrylic through fish-eye lens, the map can be shown as if it were a globe.

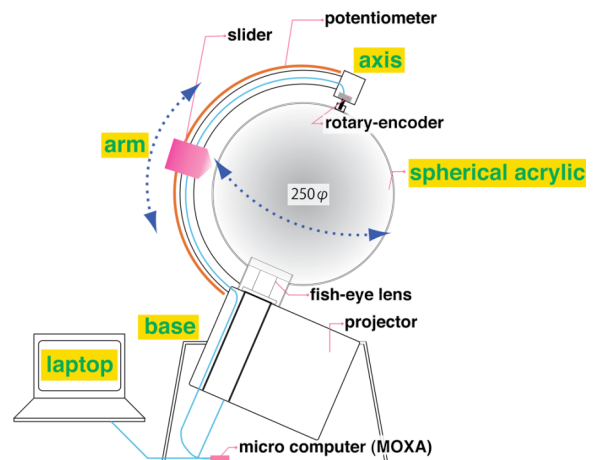


Figure 5. Device layout

Rotary-encoder installed in axis determines whether the user rotates right-handed or left-handed, and how many degrees of an angle the user rotates. By rotating sphere along latitude, user can rotate projected cognitive maps. When user moves the slider and potentiometer, installed along the arm, the movement along latitude is sensed and the area pointed by slider can be zoomed in and out. By using a combination of rotating sphere and moving slider, *Myglobe* device allows users to operate cognitive map.

These functions in *Myglobe* device are implemented by xtel, a development environment provided by CREST, JST. There are three modules that comprise xtel: 1) "MOXA," the hardware board for connecting with sensor and actuator; 2) "Talktic," the virtual machine compiler library for the development of applications on MOXA; and 3) "EntityCollaborator," an environment for developing network applications that make use of "Session Initiation Protocol" (SIP). *Myglobe* utilizes "MOXA" in order to send data sensed by rotary-encoder and potentiometer to PC.

USER EXPERIENCE

Myglobe can give users two main experiences through the cognitive map. One is the experience when walking in the city with *Myglobe* application in smart phone. The other is the experience of looking back at their life histories with friends by interacting with *Myglobe* device at home.

Experience in the city

Users go out to city having *Myglobe* application running in iPhone, which stores his/her activity record. By generating their favorite landmarks or roads with *Myglobe* application, users can express their own world and individualities. Moreover, users can customize the favorites as if they brought the city up. For example, places you have never been to will be expressed as a sea, but when you begin to go to the area frequently, islands and buildings and streets will be created. Users can view other user's cognitive maps around the current area and get to know their favorite places and routes to the places. For example, in Shibuya station, you can view his/her friend's cognitive map and go to his/her favorite clothing shop in Shibuya. Users can provide their cognitive maps to each other to navigate their recommended places.

Experience at home

Users can display *Myglobe* device (Figure.6) in the room as an interior, which allows users to enjoy their image of the city in everyday life. Users can recall on the day by touching and rotating the sphere-shaped device as if turning a globe and take a look at the places they have visited. Moreover, users may feel more familiarity with places they go around by touching them on the globe physically. In contrast to looking at 2 dimensional maps, users can look the cognitive map without certain purposes in the spherical device, which facilitates the user to discover unknown places by chance. For example, when a commuter is taking a browse at his cognitive map at home, he can notice that there is a sea between his office and home. To know more about what is in the area, he can zoom in the sea by moving the slider, and find out a lot of nice bars under the sea, which is an area that he usually does not go. He may want to take a stopover at the area of the sea tomorrow. *Myglobe* provides users with experiences in which they explore unknown place in the city by looking the globe, in the same way explorers in the "Age of Discovery" sail to the "New World".

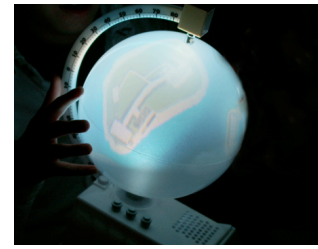


Figure 6. *Myglobe* device

CONCLUSION / FUTURE WORKS

Myglobe realizes user generated navigation service by sharing each user's own cognitive maps. *Myglobe* service provide users three experiences; creating their cognitive map by walking, looking at friend's or stranger's view of the city, and looking back their life history in the city by an interactive device. We will enhance the quality of *Myglobe* service by analyzing user's other activities in the city, such as taking pictures, and upgrading the algorithm into *Myglobe* engine.

ACKNOWLEDGEMENT

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