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An improved method to extract landmarks information for the purpose of using maps and route

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Abstract: When we want to go somewhere, we usually prepare maps, route and route descriptions. In that situation, we need these data to understand easy the map data and route descriptions, to contain appropriate information to reach to destinations from starting points, such as landmarks information and action points,, and not to contain ambiguous information. In this paper, we investigate difference between human route descriptions and those made automatically by Google Maps API in order to obtain the guidelines for good route descriptions.

Keywords: Automatic map construction, Landmark information, Route description.

1 INTRODUCTION

When we go somewhere, we usually proceed two tasks simultaneously. One is, as everyone knows, that we follow the dedicated route description or the map someone else made, and most of us think that we are just following them, but it is not the case. Actually, we reconstruct our own route description adding conspicuous landmarks in order to remember the route. In this sense, the navigation is an action to reach the destination by constructing and using our own route description [1]. The spatial knowledge acquired this way is called a cognitive map by Tolman [2]. From this viewpoint, the trouble with a given route description is caused by mismatches between it and what we expect to be included as landmarks. It is thus necessary to make the gap smaller in order to make a good, sufficient route description.

The aim of our study is to devise a better mechanism to improve route descriptions written by humans and to make route descriptions automatically from the relevant maps. For this purpose, an intense investigation is necessary to compare route descriptions written by humans and those automatically made with online maps. As a first approximation, we employ maps provided by Google Maps API, which we consider to have room to improve. With this investigation, the purpose of this paper is to make clear the guidelines for good route descriptions that is easy for us to understand.

The organization of this paper is as follows: Section 2 defines some important terms. Then section 3 describes our system that automatically generates a route description based on the information provided by Google Maps API and added some extra landmarks from our database of landmarks. Section 4 explains our evaluative experiment and discusses the result. Section 5 is the conclusion.

2 ACTION POINT AND LANDMARK IN ROUTE DESCRIPTIONS

Wherever we go, the route to the destination is not just straightforward. We have to cross a road or a river, turn right or left at a certain point, and so on. In other words, we are repeatedly forced to do actions at certain points, or *action points*. So it is quite important to recognize where the correct action point is for a certain action. Sometimes they are obvious enough to recognize it, but in many cases they are not so obvious and we need some extra key spots with which the action point is easily recognized and remembered. It is often difficult to distinguish between obvious action points and extra key spots for action points because they can be used interchangeably in different route descriptions. So Let us call obvious action points and extra key spots for action points *landmarks*.

Different types of spots can be landmarks. Some are natural and others are artifacts; some are small such as bulletin boards while others are big such as large buildings and rivers. As Lynch pointed out, even when an action point has its internal structure like buildings, it has little to do with its role of a landmark [3]. Whether a landmark is an action point or a key spot between action points that makes the next action point easier to detect, it should be conspicuous enough. Though different people have different preferences and viewpoints, and thus different people may regard different spots as their own landmarks, it is generally considered that there are still many potential landmarks that most people commonly regard as landmarks.

3 OUR ROUTING SYSTEM

In order to construct a more easily accessible navigation system, the current method to make a route description based on maps seems to have problems in adding and selecting the appropriate landmark information, though at the same time the mere addition of extra landmark information may not work. In order to the validity of landmark addition to route descriptions automatically made based on maps, we constructed an experimental routing system. The procedure is as follows:

1. Input of the source and the destination by a human

2. The system obtains the exact location of the source and destination using the prepared database.
3. The system obtains the route with necessary information and its route description from Google Maps API.
4. The system revises the obtained route description and the corresponding map by adding appropriate extra landmarks in the prepared landmark list.
5. The system shows the revised map and route description to the user.

We prepared tree different databases in advance for this sytem, which are described in 3.1.

3.1 Construction of Databases

The system we made has three databases: landmark's list, the list of the source locations like train stations, and the list of the destination locations that consists of restaurants' this time. All sources and destinations are located, for an experimental reason, in a small area, downtowns in Osaka, Japan. All databases are implemented with MySQL.

3.1.1 *The list of destination locations*

The list of destination locations is constructed as follows. First, we chose 1,200 restaurants in the targeted area from *Tabelog*, a famous online restaurant guide site with customer reviews. Second, we extracted the following information of each restaurants:

- Name
- Address
- Route description
- URL of the page of the restaurant in *Tabelog*

Third, the addresses above are modified in order to make them compatible to Google Maps API, using the following regular expression:

/(大阪府|京都府|北海道|東京都|[一-龥]+[県]){1}([一-龥あ-ヶ]+[市区郡町村]){1}([一-龥あ-ヶー]+([0-9]+(\-|－|丁目|丁))*([0-9]+(\-|－|番地|番))*([0-9]*[号]*))/

Fourth, we made queries to Google Geocoder API to obtain the exact location consisting of the latitude and longitude.

The prepared list of destination locations thus has eight fields shown in Table 1.

Table 1 Fields in the database of destination locations

field	description
id	unique id of the record
link	URL
name	the name of the restaurant
full_address	the address obtained from *Tabelog*
short_address	the address modified
lat	the latitude
lng	the longitude
description	the textual description of the restaurant

Lastly, we manually checked the information obtained and corrected errors and wrong data.

3.1.2 *The lists of the sources and landmarks*

As for the lists of the sources and landmarks, we first analyzed the route descriptions given by *Tabelog*, and manually selected the sources and landmarks frequently used in them. Then we obtained *name*, *lat*, and *lng* in the same way above, and the relevant map.

Red markers are landmarks and their information are appended to the route description in the right window. There are two *Green markers*, A is an original point, and B is a destination.
Blue line is a route calculated by our system.

Fig. 1. A screen shot of our system.

3.2 Method

Google Maps API provides maps and routes. The route is available in 3 types of travel modes, which is bicycling, driving, walking. Our purpose is to provide a better navigation for walkers and we chose walking, and add two types of modification to them.

3.2.1 Add Landmark Information

First, we insert pins on the map which means landmark. Landmark's information used for this method are registered in advance in the landmark's list described in section 3.2. The distance between a landmark and an action point is calculated, and if it is within 20m, then the landmark is inserted.

3.2.2 Clarify Directions

Route descriptions obtained from Google Maps API often lack the exact direction to be chosen at action points: e.g., to go straight or to turn left or right when crossing a road. So we manually added the exact direction for these cases.

4 EXPERIMENTS

We conducted two experiments to evaluate the accuracy and usability of the route that Google Maps API provides, and the usefulness of our system.

In the first experiment, in order to confirm that human route descriptions contain enough of information to arrive destinations from stating points and route on the map created by Google Maps API accord or not with human route descriptions, we compared them.

Next, we call it experiment 2, we compare the route's descriptions created by Google Maps API and the human route descriptions and discussed whether are according points and whether are difference in order to reveal what attributes are important for route descriptions to guide readers to destinations correctly.

4.1 Experimental data

We used the data of restaurants extracted from the web site "*tabelog*". Each restaurant data consists of maps, addresses of shops, route descriptions, starting points and destinations information. It turned out that many restaurants used the route description given by Google Maps API, and we extracted 41 data that contain route descriptions that are different from the corresponding route description obtained by Google Maps API and are seemingly described by a human with more than 60 characters.

4.2 Experiment 1: Comparison of route and route de scriptions

In Experiment 1, we compared route descriptions by Google Maps API and by humans.

We assume two standard criteria of accordance with constructed routes and route descriptions as follows.

(1) *All actions on the action points of routes are consistent with human route descriptions.*

(2) *All landmarks are actually found from each action-point if the route descriptions contain some landmark information.*

We used Google Street View to confirm whether the criterion (2) is fulfilled or not.

As a result of this experiment 1, the correct route was constructed with 27 data and 14 wrong routes are created with the other data. There are three main reasons for wrong routes.

(i) Discrepancy between the shortest route and the com prehensible route

Route descriptions are supposedly used by a person who is going to the palce for the first time, and thus the most important feature of the route descprtion is comprehensibility. However, Google Maps API has a tendency to provide the shortest route, which is sometimes different from a comprehensible route. Eight of 14 route descriptions have different route between the two.

(ii) Multilayer type

If the starting point is above the subway station, Google Maps API would misunderstand that user is in the station. This type of error is shown only 1 of 14 data.

(iii) Double-sided type

Each destination, which is supposedly a building or a part of a building, is considerably large in size compared to a human, and there is no guarantee that the exact location of the *entrance* to the restaurant is obtained from Google Maps API. It might seem to be trivial, but it is not. Many restaurants face more than one street, and the choice of the correct street among them affects the decision of the total route.

4.3 Experiment 2: Comparison of modified route desc riptions and human route descriptions

In this section, we compare human route descriptions with route descriptions obtained from Googe Maps API and modified by our proposed method. And we will show differences between these two types of route descriptions.

We investigated whether modified route descriptions accorded with human route descriptions at three points:

(1) whether all the same action points are contained
(2) whether the direction to chosse at each action point is described or not
(3) whether all the landmarks inserted are the same or not

Table.1 shows results of experiment 2. Experimental data is 27 data that accorded with their route descriptions and human route description in experiment 1.

Table 1. Results of experiment 2

Rate of landmark	Rates of action point	
	GMA⊃H	GMA⊂H
93.2%	60.3%	49.4%

In table 1, the rate of landmark shows the rate of the cases in which the same landmarks are used in both route descriptions. The rates of action point shows the rate of the cases in which the action points used in the route description obtained from one are used in the other. Average of action points of H was 3.4 times in one description, and average of action points of GMA was 5.5 times in them, so GMA is more redundant.

First, some of the landmarks were not contained in the route descriptions obtained from Google Maps API. The landmark information is found in only 1 data. Our proposed method considered landmarks information beside routes and it did not consider about landmarks in front of the routes. We will improve our method to search not only beside areas but also forward areas of routes.

Second, the proposed method cannot add streets and/or rivers as landmarks. Because these are inherently lines, not points, though they can be regarded as a point to be crossed in a route. In other words, if we add the information of relevant roads or rivers as landmarks, we need another method to specify the exact point that is to be regarded as a landmark in each case. 20 out of 27 wrong data contain this type of error, and we are devising some improvements else where.

Thirdly, 10 descriptions have a sentence like "*turn the left at the* <u>*n-th*</u> *corner*". The proposed method do not count the number of corners or signals from a particular action point, because it is a relative information to be computed separately.

Many description contained descriptions like "*cross over the ~ river*". Generally, names of rivers are more famous than bridges. Therefore there is not any description of "*cross over on ~ bridge*". Therefore sometimes we cannot obtain which road or bridge to be crossed. We suppose that action-points before rivers are important factors for correct information and we have to describe these information more clearly.

The proposed methods added information about walking time from the previous action point to the current one to route descriptions constructed by Google Maps API's. Human descriptors tend not to write these information, but it often concern people particularly in the case that two action points are rather remote.

Moreover, we also found the descriptions that show directions with compass points. However, we do not always have some devices to know directions like a compass. Because of it, we suppose that we should show direction by words "*right*" and "*left*" in route descriptions.

As the result shows, the rate in which the same landmarks are used in both description is rather high. Though we manually made the landmark list this time, but if the list can be constructed automatically, then we can apply our method to any locations, which is to be pursued else where. The result also shows the tendency that human descriptions contain fewer action points than descriptions obtained from Google Maps API, and the appropriate number of action points for human walkers should be investigated.

5 CONCLUSION

In this paper, we proposed a method to modify the maps, routes, and route descriptions obtained from Google Maps API, and discuss differences between map data by Google Maps API and human route descriptions. We obtained the results that they are often different, particularly in the usage of landmarks, and we proposed a method to add extra landmarks to route descriptions obtained from Google Maps API. The result is not still satisfactory and more refinements are needed, but the result indicates that this kind of improvements are necessary for a more comprehensible route description to be automatically constrcuted.

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