Novel Route Depiction Method Based on Light Information for Map Applications

Namgyu Kang(✉) and Kana Takahashi

Department of Information Architecture, Future University Hakodate, Hakodate, Japan
{kang, bl0ll0l7}@fun.ac.jp

Abstract. In recent times, the number of users who use map apps on their smartphones has rapidly increased. When a pedestrian travels to a destination, he/she uses a nearby landmark for finding the route. However, in almost all map apps, routes are depicted considering daytime conditions. This implies that when a pedestrian uses such map apps at nighttime, he/she would need more information to determine whether a route is safe, such as the route's luminance level. Therefore, to address this need, we propose a new route depiction method based on light information. Furthermore, we verify the effectiveness of the proposed method through evaluation experiments involving 25 women participants. Experimental results show that the proposed method affects a user's choice of route; moreover, the proposed method is not only easy to understand and use but is also highly rated in *Kansei* aspects such as fun, interesting, and safety assistance.

Keywords: Map application · Light information · Depiction · *Kansei* value

1 Introduction

In recent times, map applications (apps) have become some of the most used apps in smart phones. A map app helps a user conveniently search and find his/her way to a destination [1]. When a user searches for a location using a map app, along with the route, visual information about landmarks, such as point of interaction, buildings, and signboards, is provided, which is immensely helpful in navigation. However, the availability of such visual information can change depending on weather conditions or the time of day. For example, visual information about landmarks in some map apps is typically described considering daytime conditions; therefore, when a user uses such a map app at nighttime, the availability of the visual information may be different as compared to that during daytime. Further, many users prefer a safe route at nighttime rather than the shortest path recommendation of typical map apps. For instance, Nakazawa reported that a user selects a route based on the availability of streetlights and number of open stores along the path [2]. According to Boyce's research team, how safe a person feels on a particular road varies depending on the illuminance level of the road [3]. Some recent studies have focused on the relationship between the luminance level of roads at night and the occurrence frequency of crime [4, 5]. In other words, a person's perception of safety, which typically depends on the luminance level of the route, is an important factor when selecting a route at night. However, there are

C. Stephanidis (Ed.): HCII 2015 Posters, Part II, CCIS 529, pp. 551–557, 2015.
DOI: 10.1007/978-3-319-21383-5_92

not many map apps that account for this need for safety when suggesting a route. Thus, to address this need, in this study, a new route depiction method that considers road luminance information is proposed. Further, we verify the effectiveness of the proposed method through evaluation experiments.

2 Proposed Method

In this section, first, we review some related works. Next, we survey the current situation of streetlights in Hakodate city. Then, based on the current situation of Hakodate streetlights and insights from previous work, we develop the underlying concept for the proposed method. Then, the proposed route depiction method, developed based on the concept and insights from previous work, is described.

2.1 Related Works

Google Maps is the most used map app in the world. Google Maps shows not only the shortest route to a destination but also information about real time traffic as well information about nearby destinations such as restaurants and shops (Left of Fig. 1). Yahoo! Maps shows not only the shortest route to a destination but also information about railroads and underground shopping arcades (Middle of Fig. 1).

However, the information in these two apps is provided considering daytime conditions. In contrast, the information of the NGY Night Street Advisor app is based on light information (luminance intensity). In this app, the illuminance level of a road is expressed by different colors. Red in this app indicates a bright road, and green indicates a dark road (Right of Fig. 1).

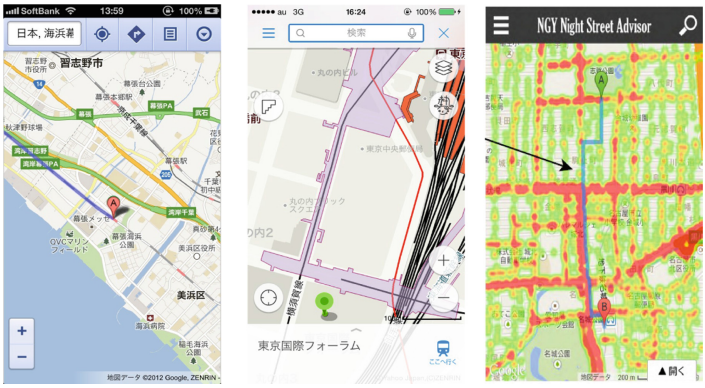

Fig. 1. Google maps, Yahoo! maps, and NGY night street advisor

2.2 Current Situation of Street Lamps in Hakodate City

Hakodate city was selected as the target city for the proposed method because of Hakodate's famous night view. Hakodate's night view is one of the most beautiful night views in the world similar to that of Hong Kong and Napoli.

According to the streetlight layout drawing of Hakodate (Fig. 2), there are two types of lamps, lamps intended to illuminate a road and lamps intended to prevent crime. Further, the operation hours of these lamps are different depending on seasons. Therefore, many tourists who visit Hakodate determine the operation hours of the lamps in order to enjoy the beautiful night view.

Fig. 2. Example of street lamp information in Hakodate

2.3 Concept for the Proposed Method

From previous studies, the concept "Grasping route and feeling safe, though it is night!" was extracted. In particular, women are the main target users for the proposed method. There are various light sources in our daily life such as natural sunlight, street lamp light, light from signboards, light from a store, and light from a car. In this study, we focus on changing sunlight intensity and light from street lamps.

The concept of the proposed method is to enable users to view the available light information for a route as well as indicate the presence or absence of landmarks.

2.4 Proposed Route Depiction Method

The proposed method for map apps of iPhone and other smart phone was developed based on the aforementioned concept (Fig. 3). The street lamp information was depicted on the map based on the streetlight layout of Hakodate. The proposed method has the following four functions:

1. Turn on and off the streetlight: A user is able to light and douse the streetlights on the map using the top left button on the screen. This function helps a user imagine the luminance conditions of a street at night. Figure 3 shows an example of the different background luminance levels of the map app. When user turns on and off the light, the lamps on the screen will fade-in and fade-out.
2. Adjusting the brightness level of sunlight: A user is able to change the background color to reflect the changing sunlight intensity using the white lever on the bottom of the screen.
3. Turn on and off landmark information: A user can view and hide landmarks on the map. If the background is too dark, it may become difficult for a user to read the information on the map, and therefore, hard to find the route to a destination owing to the blur on the screen. In such cases, a user can view the landmarks clearly on the map using the function. This function helps user to perceive night conditions while also being able to select the exact route to a destination on the map.
4. Zoom in and out: A user is able to zoom in and out of the map using this function (Fig. 4).

Fig. 3. Proposed route depiction method based on light information

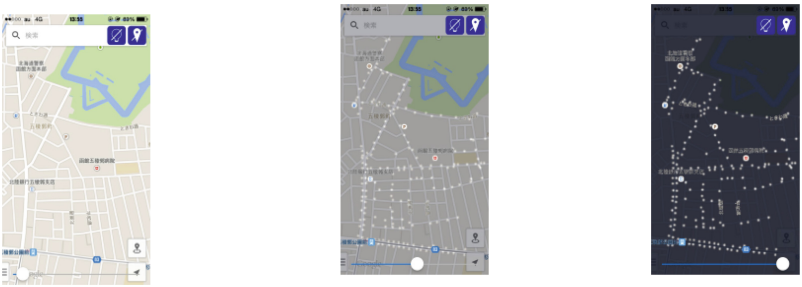

Fig. 4. Examples of streetlight information for changing sunlight intensities

3 Evaluation Experiment

3.1 Experimental Method

The *Kansei* evaluation experiment to verify the effectiveness of the proposed method was conducted with 25 participants at Future University Hakodate of Japan. All of the participants were young female students. First, the participants used both versions: the standard Google Maps version that only considers daytime conditions (existing version), and the Google Maps version implementing the proposed method (the light information version) for 10 min. Next, the following three features were evaluated: (1) fade-in and fade-out streetlights, (2) changing brightness level of sunlight, and (3) viewing and hiding landmarks on the map. Each feature was evaluated on a scale of 1 to 6 from the following eight *Kansei* aspects: (1) interesting, (2) fun, (3) easy to understand, (4) safety assistance, (5) user-friendly, (6) likability, (7) novelty, and (8) easy to perceive night conditions. Lastly, they selected a route from the specified start-point to a destination using the existing version and the light information version.

3.2 Results of the Experiment

Fade-in and Fade-Out Streetlights Feature. This feature was highly rated in the "novelty," "easy to understand," "fun," "safety assistance," "likability," and "easy to perceive night conditions" aspects. Figure 5 illustrates the evaluation result. These results imply that many users can easily understand the feature, fading in and out streetlights, and it helps them perceive night conditions. This feature helps assist a person to perceive the level of safety while also being fun and novel.

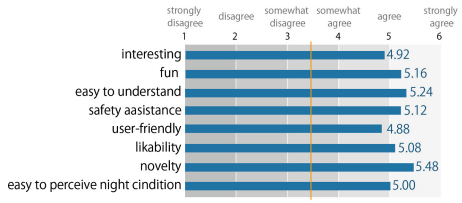

Fig. 5. Evaluation result of 'fade in and out streetlights' feature

Changing Brightness Level of Sunlight Feature. This feature was rated highly from the "novelty" aspect. Furthermore, other aspects such as "easy to understand," "likability," "interesting," and "fun" were also highly rated. Figure 6 illustrates the evaluation results. These results imply that the changing brightness level of sunlight feature is novel while also being fun, interesting, and likable.

Viewing and Hiding Landmarks Feature. This feature was rated highly in the "safety assistance" and "easy to understand" aspects. These results show that landmarks help users understand a street so that they can select an exact route. This process helps user to feel safer. However, this feature is not very helpful in "perceiving night

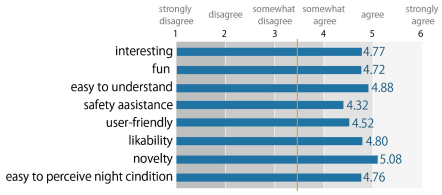

Fig. 6. Evaluation result of 'changing brightness level of sunlight' feature

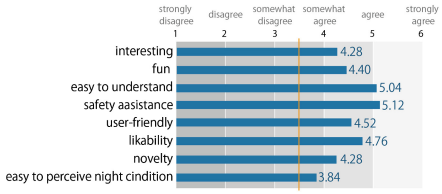

Fig. 7. Evaluation result of 'viewing and hiding landmarks' feature

conditions". In addition, almost all existing map apps have implemented this landmark function.

Selecting a Route Using Either Map Version. In the existing version, many participants selected the shortest and most convenient route. In the proposed method version, they selected a route depending on the concentration of streetlights; all participants selected a route different from the first route in the existing version. The result implies that preferred route to destination differs depending on daytime or night. Figure 7 shows the example of results selected by most users for each map version. Each route was selected by 28 % participants (7/25 person) (Fig. 8).

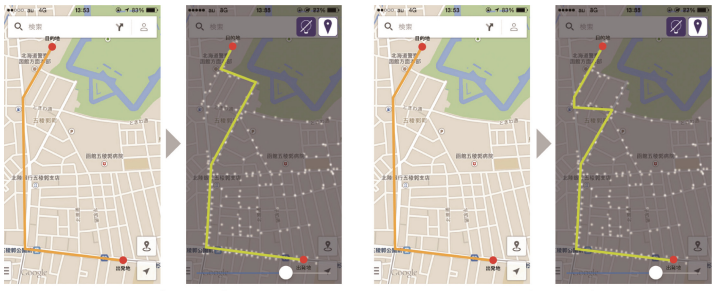

Fig. 8. Example of the results of selecting a route

4 Conclusion

The proposed method was highly rated in the aspects of "fun," "interesting," and "safety assistance." Moreover, almost all of the participants stated that the proposed method was easy to understand and use. The results of the experiment implied that users can search for a route to a destination without any stress for operating with *Kansei* value such as "fun" and "interesting." In addition, users can perceive the night conditions for a street, which helps users feel safer. From the evaluations experiment for route selection, it was confirmed that most users selected routes differently depending on whether it was daytime or nighttime. This result indicated that light information affects a user's route choice. From the experiment, it is evident that the proposed method is not only easy to understand but also is highly rated in terms of *Kansei* aspects such as fun, interesting, and safety assistance.

References

1. Google Maps, 29 May 2014. https://www.google.co.jp/intl/ja/maps/about/explore/mobile/
2. Nakazawa, K., Kita, N., Takagi, K., Inoue, T., Shigeno, H., Okada, K.: A dynamic map based on landmark's visibility. Inf. Process. Soc. Jpn **49**(1), 233–241 (2008)
3. Boyce, P.R., Eklund, N.H., Hamilton, B.J., Bruno, L.D.: Perceptions of safety at night in different lighting conditions. Light. Res. Technol. **32**, 72–91 (2000)
4. Mitsui, T., Mori, K., Namikawa, K.: Effects of retroreflective materials on recognition of pedestrian accidents at night. Int. Assoc. Traffic Saf. Sci. **33**(1), 88–97 (2008)
5. Kobayashi, S., Abe, T., Yoshizaki, K.: The Pedestrians avoidance behaviors toward a stranger on the nighttime streets. Archit. Inst. Jpn **556**, 69–75 (2002)