STRAVIGATION: A Vibrotactile Mobile Navigation for Exploration-Like Sightseeing

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Abstract. Exploration-like sightseeing is wandering around an unfamiliar place, and is a way of seeing sights and enjoying novel experiences that are not mentioned in guidebooks. However, the fear of getting lost prevents tourists from engaging in exploration-like sightseeing. Current navigation devices are capable of providing effective routes to specific places, which is not compatible for this mode of sightseeing. This is because tourists tend to focus on the recommended route displayed on the device and follow it faithfully. This prevents tourists from seeing surrounding sights. Here, we propose a new navigation method called stravigation. Stravigation is a vibrotactile mobile navigation for the tourist to be able to enjoy exploration-like sightseeing. We describe its basic concept and the results of evaluation experiments. These results show that stravigation is capable of guiding tourists to specific places correctly without the need to watch navigation devices. Furthermore, the results also show that stravigation enhances the sense of delight while wandering.

Keywords: Navigation, Exploration, Vibrotactile, Mobile Device, Sightseeing.

1 Introduction

Wandering about an unfamiliar place, which is similar to exploration, is one of the ways to enjoy sightseeing. For instance, Venice is famous for its complex network of alleyways and many bridges across canals. Many tourists have found themselves lost while walking its islands, and have become irritated when unable to reach their destination easily. However, while wandering around the city, tourists often discover something new. Wandering and exploring unknown places often lead tourists to novel experiences that are not mentioned in guidebooks. Such unique experiences underscore the enjoyment in sightseeing. In this research, we call this mode of sightseeing "exploration-like sightseeing". Although wandering itself is sometimes enjoyable for tourists, they do not want to find themselves in situations where they are unable to return, for example, to their hotel. Current navigation devices are able to display appropriate and precise route information to guide tourists to their destination; these devices comfort the mind and enable the tourist to freely enjoy the walk. However, such devices are incompatible with exploration-like sightseeing. Displaying a precise route implicitly forces tourists to stay on a specific track, requiring that they maintain their focus on the displayed route. The enjoyment of sightseeing therefore diminishes.

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Using visual displays to provide navigation-related information interrupts the enjoyment of wandering because it would still require the user to watch the display. To solve the problem, we propose a new vibrotactile mobile navigation called "stravigation". The basic concept of stravigation has two components. The first is reducing the amount of information. Too much information can annoy tourists and impede seeing the surrounding sights. Thus, only distance and direction to a specific place are provided by stravigation. This represents the minimum amount of information needed to prevent tourists from getting lost. The second is making use of vibrotactile sensation. Stravigation provides distance and direction by using vibrotactile signals enabling tourists to free their attention from their navigation devices.

2 Related Works

Much research related to vibrotactile navigation has been done. That research can be grouped into two methods: turn-by-turn or relative position-based. The turn-by-turn method indicates the correct direction every time the user reaches a specific waypoint or an intersection [1,2]. These systems are able to provide precise route information. However, vibrotactile signals at every intersection could annoy tourists. The relative position-based method only indicates spatial relationships, such as direction and distance, between current location and destination [3-5]. This method does not provide precise route information. However, users are able to understand these spatial relationships, enabling them to choose between routes to a destination freely, engaging in what we term exploration-like sightseeing. Most systems based on this method are able to provide direction to the destination by having the user scan the surroundings with the device. A vibrotactile signal is generated only when the device points towards the destination. Stravigation is based on the same concept as this relative position-based method. However, previous systems do not have sufficient capability for navigation, and some are unable to provide distance information. This is not only essential for estimating time of arrival, but also directly affects reliability of such systems. The transition of such information, based on the tourist's walking, is the basis for them knowing whether the system is working. In addition, the accuracy of directional information of these previous systems is almost ±30 [deg], which is far from being satisfactory. Stravigation is capable of providing distance information as well as providing directional information with an accuracy of ±5 [deg].

3 System Summary

When providing directional information, stravigation indicates the angular deviation between the device's axial direction and the direction to the destination. This means that specific vibration occurs according to the angular deviation (Figure 1 Left). If the angular deviation is greater than ±30[deg] [6], the device does not provide any vibrational feedback. If the angular deviation is between ±15[deg] and ±30[deg], the device vibrates with a low frequency; an intermediate frequency is generated when the

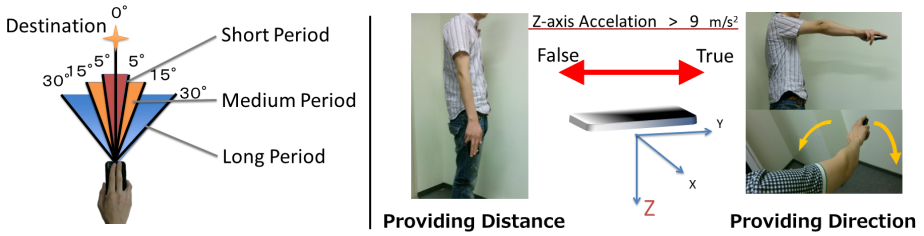

Fig. 1. Left: The angular deviation and vibration period, Right: Switching information by using device orientation

angular deviation angle is between ±5[deg] and ±15[deg]. If the angular deviation is less than ±5[deg], a rapid frequency vibration is generated. The same principle provides the distance information; specific vibrations are generated according to distance.

Distance and directional information is provided through the same vibrotactile signal. Some sort of practical means is required for users to identify easily which information is provided. To solve this problem, we make use of the orientation of the device. By using a 3-dimensional accelerometer, we can determine whether the surface of the device is parallel to the ground (Figure 1 Right). The users are able to switch information modes by gesturing. If its surface is parallel to the ground, the device switches to the direction-providing mode in which the user swings the device left and right to find the direction; otherwise the device switches to the distance-providing mode.

4 Evaluation Experiments

4.1 Navigation Capability

We performed an experiment to confirm the practicality of stravigation. Subjects were asked to walk towards a specific place, which was 400 [m] away from their starting position, using stravigation. They were not informed where the place was. The tracked routes and times taken are shown in Figure 2 Left. The result shows that stravigation has sufficient capability to guide users to a specific place.

4.2 User Test

User tests were performed to confirm that stravigation is able to put users in an exploratory-like mood while walking. We compared stravigation with a conventional map-based visual navigation system (Google Maps). The participants were asked to answer a questionnaire after using these two navigation methods. The number of participants was 4. All participants use both stravigation and Google Maps two times each. The results are shown in Figure 2 Right. The result for Q2 indicates that our system received better scores than navigation using maps. This means that stravigation does not

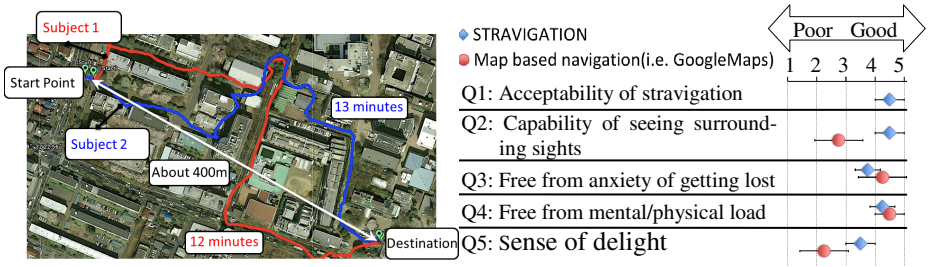

Fig. 2. Left: Time taken and tracked route walked by subjects, Right:Questionnaire responses

hinder tourists from seeing the surrounding sights. At the same time, the result for Q5 indicates that using stravigation is more exciting than using conventional systems. As a result, tourists should be able to enjoy wandering without losing their way.

5 Conclusion

In this research, we propose a new navigation method, stravigation, for tourists to enjoy exploration-like sightseeing. The experimental results show that stravigation has higher accuracy in providing directional information. Also, stravigation had sufficient capability as a navigation aid and reliability to enable tourists to enjoy exploration-like sightseeing. In the future, we will deliver stravigation via the web to conduct larger-scale user tests.

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