HELLOARROW
A Navigation System for Smooth Rendezvous using Compass Interface

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Abstract: In the days before cellphones, we have to wait at a fixed point for the partner till he or she comes. But now it does not matter where we spend a time till he or she comes, thanks for cellphones. Moreover we can leave a friend who is late, because cellphones helps their catching us up. Therefore it saves our frustration for waiting the partner and decreases a messy search for landmarks. But a new problem comes up. It is bothersome that looking for the partner, who is in unknown position, using only by cellphone. In this research, we propose and prototype a dynamic navigation system which leads directly from a movable user's point to another movable user's point using HelloArrow, the intuitive compass interface for comfortable smooth meeting.

1 INTRODUCTION

Cellphones have been indispensable for our rendezvous today. Thanks for them, we do not have to wait a partner at a fixed point. We can spend a time wherever we want till he or she comes or depart little earlier without waiting. Therefore it saves our frustration for waiting and decreases a messy search for landmarks (Hirano, 2004). However, it is tough to find a partner by cellphone call. In this paper we explain HelloArrow, a navigation system for smooth rendezvous.

2 HELLOARROW

In this chapter, we explain the dynamic navigation system and the compass interface that are the characteristic of this system, with comparing our system with existing system.

2.1 The Dynamic Navigation

Most of existing systems lead users toward a fixed point(Soga and Kakumoto, 2008). We call them the indirectly navigation system. On the other hand, our system leads users toward each users. We call this the dynamic navigation system. It is possible to move without depending on landmarks with this system. Moreover, it is not necessary to make a database of point.

2.2 The Compass Interface

Most of existing system uses a map (Machi Pittan). However it is difficult to read a map while looking for a rendezvous partner and landmarks, and telling a partner his or her own point. Especially in an unfamiliar place, it is tough to figure out the current position, direction and distance. Therefore we propose the interface consists of the compass which always points a rendezvous partner.

3 PROTOTYPING

We explain the prototyping of HelloArrow in the chapter.

3.1 Device

We use Nexus One which is a smartphone powered by Google Android. We developed the system on the Android SDK2.1 with JAVA1.6 and PHP5.2.

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3.2 System Architecture

Each users have a smartphone for this system. Each device gets the location and orientation. Then they exchange data through the data server. After getting the both own data and partner's data, the system computes the distance and angle for the target. Finally, it shows the compass interface on the display.

3.3 User Interface

Figure 1 shows the interface of this system. There is the compass on the center of the display and there is the numerical value of distance above the compass. In addition while the device is turning in a correct direction, the device vibrates.

Figure 1: User Interface

4 EXPERIMENT

In this chapter, we explain about the two experiments that we have done. We focused on the compass interface in the Experiment 1. Then we focused on the dynamic navigation in the Experiment 2.

4.1 Experiment 1: About Compass Interface

Experiment Objective and Experimental Outline: The goal of the Experiment 1 is figuring out the effectiveness of the compass interface. In the first part of the experiment, experimenter led examinee by cellphone call, as the current rendezvous style. Then in the latter part of the experiment experimenter led him or her with our system HelloArrow, the style we propose. After that we compared both result. In addition we have done preliminary experiments and questionary investigation to figure out locality and a sense of direction of examinees. Details of each experiment are described as follows.

Experimental Period: 12/5/2009 (Tue.) - 12/22/2009 (Fri.) (All days fine)

Experimental Area: The Shonaidai station, Fujisawa-shi, Kanagawa, Japan

Examinee: 20-years-old from 23 twenty-four university students (male:12 female:12)

Details:
(1) Experiment 1: The goal of the Experiment 1 is figuring out the effectiveness of the compass interface. In the first part of Experiment 1, the experimenter led examinee by cellphone call, as the current rendezvous style. While navigating examine we show examinee only landmarks. If we were asked the way, we tell him or her only landmarks to the target. For the sake of expedience, after telling how the experimenter walked behind the examinee to do various measurements and the action observations. In the latter part of Experiment 1 the experimenter led examinee with HelloArrow, as the style we propose.

(2) Preliminary Experiments for Locality: Every examinee draws a map, range of 300m around *the Shonandai station*, by surprise before starting the main experiment to figure out his or her locality. We count the number of road, landmark and mistake on the map examinee had drawn in a 4 minute. We considered that the examinee had sense of locality with a good grade.

(3) Sub Experiments for Sense of Direction: We did sub experiments between the first part of experiment and the latter part of experiment to figure out him or her sense of direction. First we showed examinee a white map of *Shonandai*(1/1500) and tell him or her to point the current position on the map. Then we showed him or her the display of HelloArrow of which compass interface points the point and tells him or her to point the point on the map. We measured time and correction. We considered that the examinee had sense of direction with a good grade.

(4) Questionary Investigation: We did questionary investigation after the experiments to figure out how they felt about both navigation. The question was prepared for each item and answers were collected by five stage evaluation of *"Do not think very so"* (1) to *"Think very so"* (5).

4.2 Result of the Experiment 1

In the navigation experiment of experiment 1, all of the 24 examinee succeeded in the navigation by the cellphone and the navigation by HelloArrow.In the item of *"Were you able to walk a natural speed?"*,

examinees who had answered as *"Thought very so"* and *"Think so"* was 7% more abundant in the navigation by HelloArrow. Then examinees who had answered as *"Did not think very so"* and *"Do not think so"* was 6% more abundant in the navigation by cellphone call.

Moreover, in the item of *"Did it become uneasy in the direction on the way?"*, examinees who had answered as *"Did not think so"* and *"Do not think very so"* exceeded 58% and the majorities by in the navigation by HelloArrow. On the other hand, it was 46% in the navigation by the cellphone call.

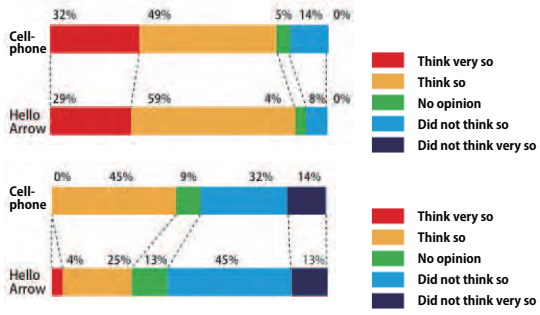

Figure 2: Were you able to walk a natural speed? (Top) Did it become uneasy in the direction on the way? (Bottom).

4.3 Discussions of the Experiment 1

All 24 people succeed in walking, and we found that the compass interface has potential. Though the navigation by the cellphone call tends to be a little superior in the walking rate and the item of *"Were you able to walk a natural speed?"* and *"Did it become uneasy the direction?"*, there are no significant differences. The result of t-test (significance level 5%) were 0.17, 0.4 and 0.3. Therefore we compared the result of the navigation by cellphone with the result of the navigation by HelloArrow, in all result we had got, with grouping sex, locality and sense of direction.

4.3.1 Comparison on Gender

At first, we calculated average value by Gender. It has been understood that male's walking rates were faster in the navigation both by cellphone call and HelloArrow. Female felt more uneasiness in the navigation by the cellphone call compared with male. In addition, among female examinees, the average of the answer to five stage of *"Did it become uneasy the direction?"* was 3.71 by cellphone and 2.86 by HelloArrow, *"Were you able to walk a natural speed?"* was 3.7 by cellphone and 3.86 by HelloArrow. Navigation by HelloArrow was more popular among the woman.

4.3.2 Comparison on Locality

Then we focused on a locality. We classified examinees into higher group and lower group by using the score of the preliminary experiment. Then we compared the navigation by cellphone call and by HelloArrow. However there are no significant differences in t-test (significance level 5%). Therefore it has been understood that locality does not influence walking.

According to the record of conversation in the navigation by cellphone call, averages of the frequency with the question are 2.8 times of the man, and 4.3 times of female from the examinee side. And averages of the number of landmarks, that appeared in the conversation besides the experimenter prepared, were 1.2 (males) and 2.1 (females). In the experiment, the experimenter was perfect for the experimental area and lead examinees accurately. If both users in a rendezvous do not have a locality, they can not lead them each other and it may be smooth that using HelloArrow.

4.3.3 Comparison on Sense of Direction

Lastly, we focused on a sense of direction. We classified examinees into higher group and lower group by using the score of the sub experiment. Then compare the them as preceding clause. As a result, it has been understood that the higher group leaves a good record and a popular value either in the navigation by cellphone and HelloArrow.

4.4 The Experiment 2: About the Dynamic Navigation System

Experiment Objective and Experimental Outline: The goal of the Experiment 2 is figuring out the effectiveness of the dynamic navigation system. We have done experiments in 14 differently-structured towns. In each town, two examinee had a rendezvous using HelloArrow. While examinee tried to find a rendezvous partner, we record their walking speed, route, behavior, frequency and length in which screen is seen. In addition we have done interview and questionary investigation after each experiment.

Experimental Period: 6/28/2010(Fri.) 9.00 - 20:00 (It rained from afternoon to the evening)

Experimental Area: We took place experiments in 14 differently-structured towns in Tokyo. All experimental areas are 500m range.

Examinee: It has been understood that a locality does not influence the navigation by HelloArrow and ex-

aminees who are in higher group of a sense of direction or male examinees tend to leave higher score both in the navigation by cellphone and HelloArrow. Therefore we picked up two female examinees in the lower group of a sense of direction.

4.5 Result of the Experiment 2

In the navigation experiment of Experiment 2, examinee succeeded their rendezvous in all of the 14 areas.

4.6 Discussion on Second Experiment

4.6.1 About the Upskilling

We classified the results into the first half places and the latter half places in order of the experiment. Then we compare them with t-test (significance level 5%). It has been understood that the ratio in which screen was seen at walking time decrease 35.5% to16% (0.03 of significant difference) and time to put screen on seeing once decrease 2.94 seconds to 1.75 seconds (0.008 of significant difference) And, we got comments: *"To take shortest route it is better to keep walking straight till the angle of the compass indicates 90.", "The best way is to see compass first then see the value number to the target."* We could see examinees gripped the knack of the system, and the appearance in which it was skilled.

4.6.2 About the Length in which Screen is Seen

Then we focused on the length in which screen is seen. We classified the results of the second experiment into the times felt uneasy and the times felt easy by using the questionary investigation.

The average of the halt frequency has increased from 0.4 times to 1.6 times. And the average of the frequency of turning back increased from 0.1 times to 1.1 times. Then the average of the frequency in which the screen is seen has increased from 17.7 to 24.6 times. However, it has been understood that the time spent to see the screen once is both 2.7 seconds and it doesn't change. Ratio in which screen was seen while walking is 34% examinee A and 18% examinee B. However time to put screen once on seeing was 2.5 seconds examinee A and 2.3 seconds examinee B. This shows that the examinees is instantaneously obtaining information from the HelloArrow in any case. Using HelloArrow, we do not have to consider the route as a map.

5 CONCLUSIONS

In this research, we propose and prototype a dynamic Navigation System called HelloArrow for smooth rendezvous using compass Interface. It is bothersome to have a rendezvous with partner only by cellphone call. Therefore, we propose HelloArrow which has two characteristic way. The first is the dynamic navigation system that leads users toward a rendezvous partner directly. The second is the compass interface that consists of the compass which always point a rendezvous partner. As the result of two experiment, we conclude that HelloArrow is effective for our rendezvous.

By the Experiment 1, we found two facts about HelloArrow. The first one is that HelloArrow is superior in terms of a sense of ease than current style especially for female or examinees who does not have sense of direction very much. the one second is that HelloArrow does not need locality. By the Experiment 2, we found three facts about HelloArrow. The first one is that is possible to lead users in differently-structured towns. The second one is that examinee gain skills to find a rendezvous partner. The last one is that examinees understand information on the screen instantaneously that they can walk smoothly.

We are now developing system for rendezvous with three or more people with improving algorithm and user interface. And we also contended with the way not to make unease users where GPS is insensitive. Now, we would like to release HelloArrow as an Android application to get many feedbacks to improve the system.

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