DEVELOPMENT OF AN INDOOR MOBILE NAVIGATON SYSTEM BASED ON ITEMS WITH POSITION

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ABSTRACT: In this paper we present an indoor mobile navigation system that assists users in shopping in a commercial complex. First, we arranged three-dimensional geospatial information database for buildings and shops. We associated not only shops but also items with the geospatial coordinate with this database. Secondly, we developed an item search system that can be used for searching items and menus in the commercial complex. Finally, we developed an indoor mobile navigation system that can provide a route from the user's current location with Wi-Fi positioning system to the shops which sell the items user selected on the floor maps of the building. Then, we conducted a verification experiment for this system. The result of it was that this system is useful and affects users' buying behavior. With this system, users can compare and reach the items they want easily without going around the various shops in the commercial complex.

1. INTRODUCTION

When we buy items, we have bought them at real shops in shopping areas. Today, we often buy at internet shopping sites with PC or mobile phone. As for merits of buying at real shops, we can see and touch real items and can get them there and then. However, it is difficult to find items we want from large amount of items because we can't search them like internet shopping sites. Then, when we buy items at large shopping malls, we have to check floor maps and go to shops and find items in the shops. There have been studies on support of customers by agent system (Tonomura et al, 2007). However, they assumed buying in one large shop, and they didn't provide navigation and routing assistance.

2. OBJECTIVES

In this study, first, we associate item information with position information. Second, we develop item search system like an internet shopping sites to search items from large amount of items of a number of shops in shopping malls. Third, we develop an indoor navigation system which guides customers to the items with position information. Finally, we conduct verification experiments for this system with examinees.

3. INDOOR NAVIGATION APPLICATION "MonoDoco" BASED ON POSITION OF ITEMS

3.1 System overview

To navigate customers to shops based on position of items, we developed an indoor navigation system "MonoDoco". This system can be divided into two sides. One is server side which provides geographical information and floor maps. The other is client side which navigates user to items. Figure 1 shows overview of this system.

3.2 Server Application

3.2.1 Spatial reference database

Spatial reference database handles the floor maps data and network data. We created floor maps of SVG formats with coordinate data and network data based on administrative map of a building with tools for spatial reference database.

3.2.2 Geographical Information Database

Geographical information database handles building data, shop data, event data and item data. A tool for geographical information database can read the SVG maps and display them (Figure 2). When we register building data and shop data in the database, we can associate shop data with location data by selection of the representative

points of the SVG maps with this tool. We can arrange the item data with position by registering in the database to associate item data with shop data.

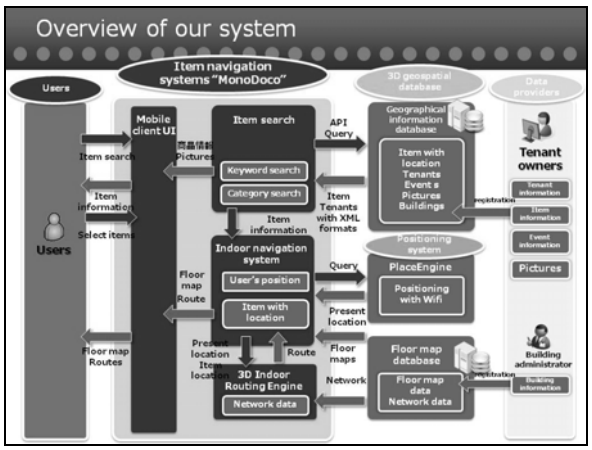


Figure 1.Overview of the system

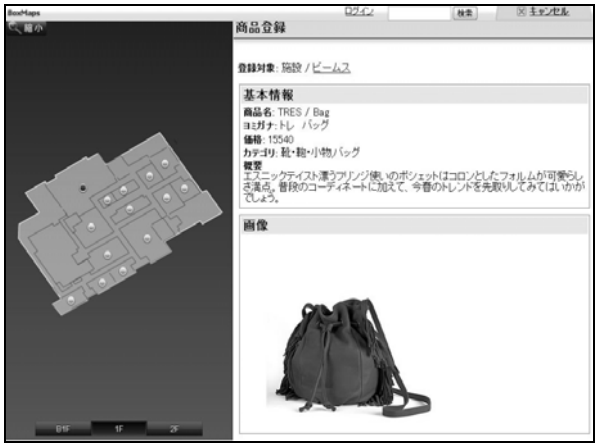


Figure 2.Geographical information database

3.3 Client Application

3.3.1 Item Search

As for an item search system, we developed two types of search method. One is search based on item categories, the other is full text searching. After users search items, this system display results of item search in a circular pattern.

Then, if users click “See the details”, they can see a bigger image and more detailed information of the item. Next, if they select an item and click “Add to a tour”, the item of position becomes routing point of navigation.

Figure 3 shows the flow of the item search system.

3.3.2 Indoor Navigation

(1) Building Map and Floor Map

To create floor map for users, we overlaid an image of floor map from a website on SVG map with position coordinate. To create a building map, we piled up the floor maps.

(2) Present Position

We used “PlaceEngine” which is positioning system with Wi-Fi provided by Koozyt,inc. to get the present position of the examinees in shopping mall.

(3) Route Search

We developed route search engine based on the network data in a shopping mall to display a shortest path from present position to shops which sell the items user selected.

When users click “Start navigation” after they added items to the tour box, “MonoDoco” provides a short path on both the building map and the floor maps to go around the shops which sell items users selected.

(4) Notice and Check-in

When user reached at the shops, ”MonoDoco” advises user’s arrival based on user’s present position. If user check the item and click “OK”, ”MonoDoco” displays the route to the next shop.

Figure 4 shows the flow of the indoor navigation system.

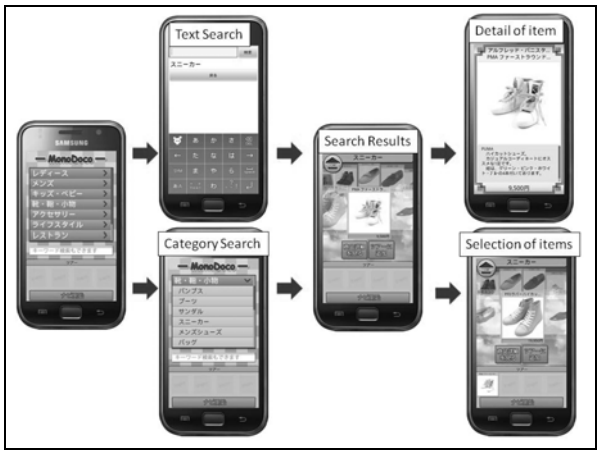


Figure 3.Item search system

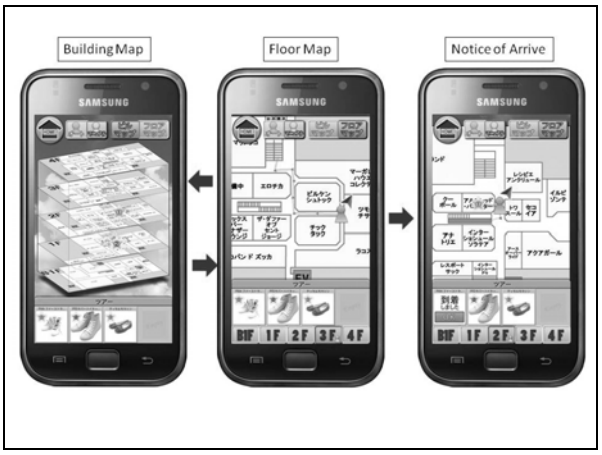


Figure 4.Indoor navigation system

4. EVALUATION

4.1 Experimental methodology

(1) Environment

We had an experiment to evaluate this system. Table 1 shows the experiment environment and examinees in this paper.

Table 1.Experiment environment

Area	“Queens East” in Yokohama, Japan
Positioning system	B1-2F：positioning system with “PlaceEngine” (positioning system with Wi-Fi) 3F・4F：none
Mobile Client	Galaxy S Android OS2.2
Network speed	About 5Mbps (docomo FOMA Data Network Card)
Examinee	36 people

(2) Item Data

To arrange item data with position, we collected images and information of new products and hot-selling products from websites of each shop in Queen’s east. We registered item data in geographical information database and associate shop data with item data to add position data to the item data.

(3) Experiment Description

Examinees go shopping with “MonoDoco” for 30 min~1hour in Queen’s East. After the shopping, we have some interview with them about this system.

4.2 Results

After the shopping, we interviewed with the examinees. Figure 5-8 shows attributes of 36 examinees in this experiment.

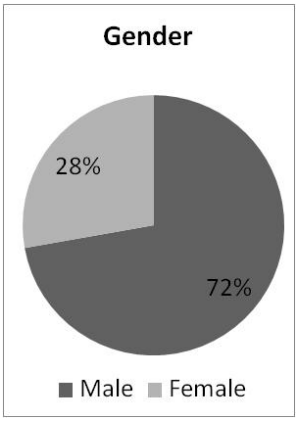


Figure 5.Gender

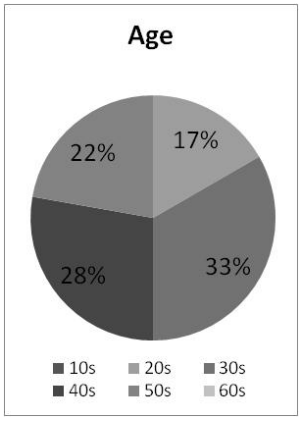


Figure 6.Age

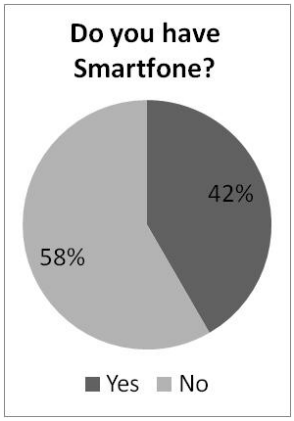


Figure 7.Smartphone users

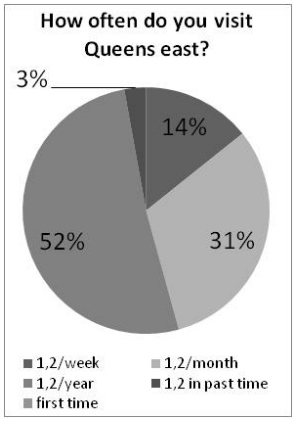
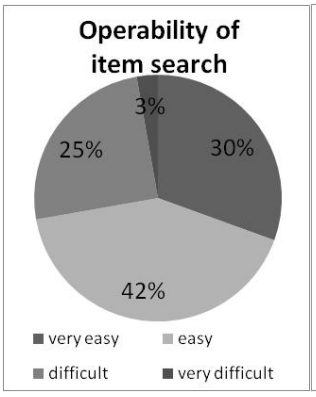


Figure 8. Visit frequency

First, as for evaluation of item search system, 83% of examinees answer that an operability of this system is easy and 72% of them answered that it is useful (Figure 9).

Second, as for evaluation of indoor navigation system, 86% of examinees answer that an operability of this system is easy and 86%of them answered that it is useful (Figure 10).



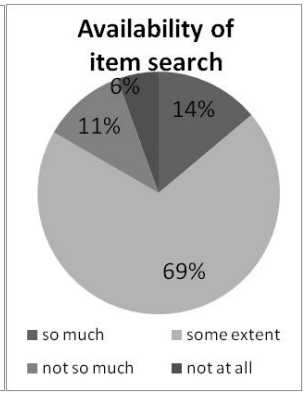
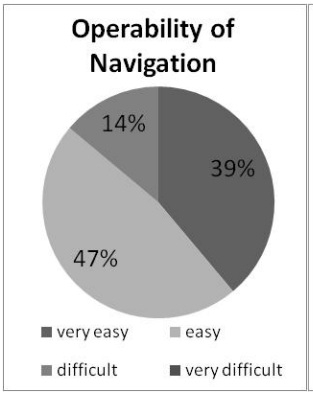


Figure 9.Availability and operability of item search



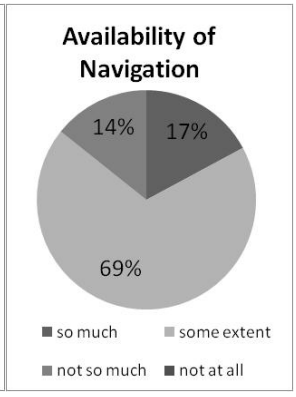


Figure 10.Availability and operability of indoor navigation

Third, as for the evaluation of the total system ”MonoDoco”, 83% of examinees answer that an operability of this system is easy(Figure 11) and 91%of them answered that it is useful. 89% of examinees are interested in this system (Figure 12)

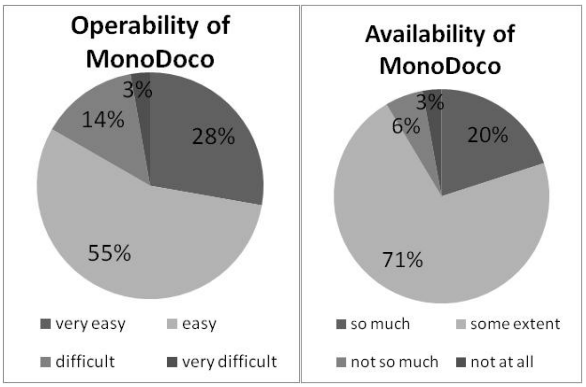


Figure 11.Availability and operability of total system

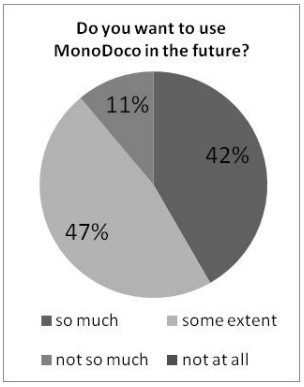


Figure 12. Interest in this system

Floor maps, building map and route are very useful function for users especially (Figure 13). 86% of examinees answered that display of items on floor maps is useful (Figure 14). 83% of examinees have difference of visiting shops with this system (Figure 15).

As for buying behavior during the experiment, 33% of examinees bought items and 11% of them bought items with this system (Table 2).

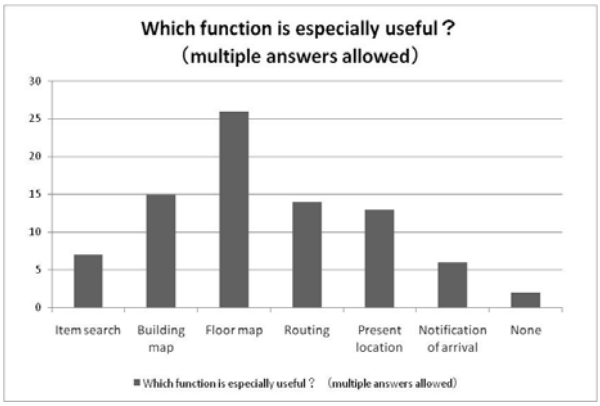


Figure 13.Useful function

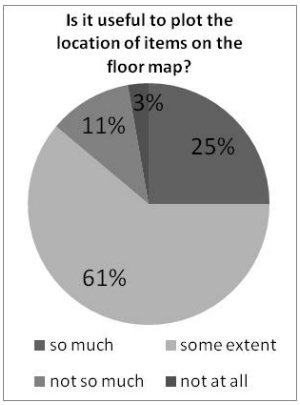


Figure 14.items on the map

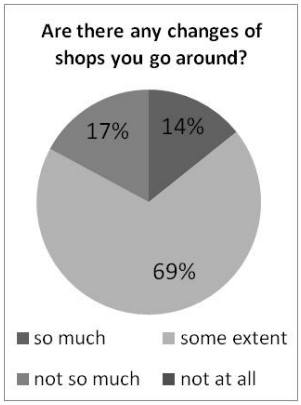


Figure 15.change of buying

Table 2.Earnings

	Purchaser	Earnings
Selected items with MonoDoco	4 people	14,218 yen
Total	12 people	47,978 yen

5. CONCLUSIONS

In this study, we developed the system which navigates customers based on items with position. As results, this system is useful for over 90% of examinees and effect on buying behavior of over 80% of them.

As for future works, first, we will improve this system. For example, we will study on interlocking system of item stock, automatic collection of item information, enhancement of the item search by color and price and improvement of interface of floor maps and building map. Second, we will analyze the difference of action log of examinees between with this system and without it.

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