The Inspiring Store: Decision Support System for Shopping based on Individual Interests

Akihiro Ogino, Sae-ueng Somkiat, and Toshikazu Kato

Faculty of Science and Engineering, Chuo University,
1-13-27 Kasuga Bunkyo-ku Tokyo, Japan
{ogino,somkiat,kato}@indsys.chuo-u.ac.jp

Abstract. This paper proposes a ubiquitous environment store, which is composed of cameras, sensors and displays, for supporting decision concerning commodities based on each customer's shopping interest. This store suggests that three analyzing views can be utilized to analyse relations between customers' interests and their behaviours towards commodities. This store collects data on the behaviour of each customer, who has agreed to be observed, and makes individual models by analyzing collected data. This store also provides commodity information, which is decided by the individual's model, to each customer through a display, which is in front of this customer. Comparing this system to a non-system through a purchase experiment of clothes shows this effectiveness of this system.

1 Introduction

Recently, customer have become interested in a larger variety of commodities than ever before. They seek a diverse range of commodities when shopping. However, it is sometimes difficult for customers to find commodities of interest because there is such a vast range of commodities in the modern world. Therefore, customers now need a system to help them find interesting commodities.

In the business field, there is a growing need for finding customer interests in commodities [1], [2]. For example, many companies use the POS (point of sale) system, which accumulates the buying history of customers, to detect their interest in commodities. However, the POS cannot account for interest in commodities, which customers did not buy although the customer has shown interest in them, for example, by picking them up and studying them, before they reach the electronic cash register. There are also recommendation systems on the Internet, which support customer's decision concerning commodities using the purchase histories of customers on a certain site [3]. However, these computer systems have drawbacks in that recommendations sometimes don't match a customer's individual interest in commodities because the systems use a purchase history of other customers. In other words, current systems are too generalized, looking at the interest of large groups rather than individual.For recommending appropriate commodities to individual customers, computer systems need to know which

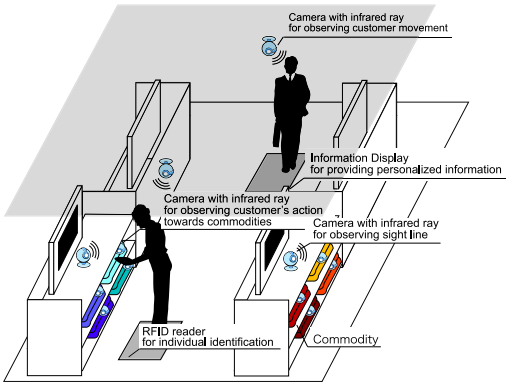

Fig. 1. The Inspiring Store: A store with a purchase support system that provides personalized information concerning commodities in which each customer has interests

commodities they are interested without asking for too much time and effort from customers.This paper attempts to remedy these problems by focusing on the individuals.

This paper proposes a personalized shopping store, which interprets individual interest in commodities and attempts to directly recommend commodities, in which customers may have an interest, to each customer. This paper calls it the inspiring store. The inspiring store observes each customer individually observing what the customer touches and views or where the customer moves using ubiquitous devices, such as cameras with infrared rays and RFID (radio frequency identification) Readers. This inspiring store organizes observed data and makes individual models from the observed data to detect each customer's interest in commodities. This store predicts which commodities suitable for the individual, by using their own model and recommends personalized information concerning commodities through displays for advertisement.

2 The Inspiring Store

Customers with an unclear idea about what they want often have trouble deciding which commodities to buy. Therefore, they sometimes select unsuitable commodities or buy almost the same commodity which they had before. If customers could directly and immediately get information concerning commodities suitable for them through a system in a store, such as information devices and advertisement displays, they will be happy because they could achieve their aims and receive the commodities they want.

During this study a prototype of The Inspiring Store was built based on the previously described motivation, as shown Fig.1. Customers in this store agreed to have their purchase observed and are given member's card, which were RFID cards. If customers didn't have member's cards, this store couldn't authenticate the identity of each customer.

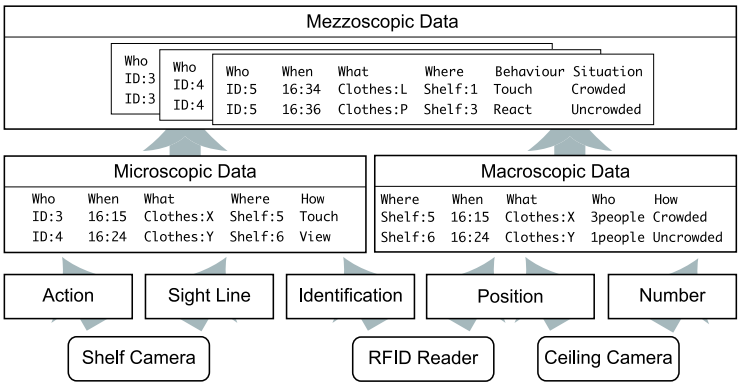

Fig. 2. Micro,Macro and Mezzoscopic Viewpoint: they are viewpoints that detect each customer's interest for making individual's models and to grasp store's situation for providing personalized information to each customer

This inspiring store is 30 square meters and has 6 intelligent shelves, which are composed of cameras with infrared ray (Panasonic Network Camera BL-C31) and a RFID reader (Omron V720). Each camera observes a designated commodity and observes customers' actions towards commodities by checking image differences between a previous image and a current image. The RFID reader identifies members and the member's position. The intelligent shelves also have an information display, which shows information using a web browser, for providing personalized information concerning commodities to each member. This store additionally has 6 cameras with infrared rays on the ceiling for observing the store's environment, such as the number of unknown customer in this store.

This inspiring store makes member's models, which simulate each member's decision concerning commodities based on their own criteria, by analyzing observed data on the relation between an individual's interest in a commodity and individual actions towards the commodity. The store selects commodities, in which they will have interest, based on each member's model and then delivers personalized information concerning commodities to an information display on the intelligent shelf when a customer comes in front of the intelligent shelf. This store collects data on customer reaction towards recommended commodities on the information display and then uses this data to make a more reflected model.

3 Modeling Customer's Interest

Criteria on which to base customer's interest in commodities is needed in order to select suitable commodities for each customer. It is also needed to have an understanding of the store situation for delivering personalized information because it is difficult to provide the personalized information to the customer through an information display directly if the customer is in a crowded place.

This study introduces three viewpoints as shown Fig.2. There are Microscopic, Macroscopic and Mezzoscopic viewpoints.The viewpoints arrange observed data, to make individual's models of interest in commodities and to have an understanding of store's situation.

Microscopic viewpoint is for organizing observed data to check members' identity and their actions towards commodities in the store. This study uses the Microscopic data to detect relations between a member's interest in commodities and the member's action towards the commodities. By analyzing each member's relations, this store can understand common features of commodities, which each member has shown an interest in and then has acted towards. This study organized the Microscopic data using three types of observed data along with the time it was observed. One type of data was sensed identity from an RFID card, which belonged to each member. Other types of data were a customer's action and sight line captured on cameras, when customers handle or look at commodities. This study manages Microscopic data by 4W1H (Who, When, Where, What and How) as shown Fig.2. For example, Microscopic data of ID:3 in Fig.2 show that the member of ID:3 touched the clothes of ID:X at 16:15 in the shelf of ID:Y.

Macroscopic viewpoint is for understanding the environment of the store, such as each customer's position.This study uses the Macroscopic data to decide when is the best time to provide personalized information or the contents of information provided to each member. For example, if there are many customers in front of a intelligent shelf, it's not the best time to show personalized information to one customer. Therefore, for example, this store decides that it is better to provide common information in which most customers will have interest or it would be better to send personalized information to each customer's mobile phone. This study organizes the macroscopic data by two types of observed data with time. One is data on sensed position of each member by their RFID card and captured position of unknown customer by ceiling cameras. Another is data on captured rough numbers of customer by ceiling cameras. This study also manages the Macroscopic data by 4W1H as shown Fig.2. For example, the Macroscopic data of shelf:5 in Fig.2 show that there are 3 people in front of clothes of ID:X on the shelf of ID:5 and the data also show a crowded situation for providing personalized information.

Mezzoscopic viewpoint is for detecting a current member's interest in commodities by analyzing the order, in which the commodities were touched, and the common traits of commodities. This study can use this Mezzoscopic data to decide which commodities are favorable for customers in order to make recommendations to each member. For example, this store provides un-check commodities to a member from criteria of recommendation when the member already has checked some commodities in this store using the Mezzoscopic data. This study also uses the Mezzoscopic data to check a reaction to personalized recommendations. For example, if a member sees a personalized recommendation, which shows a commodity with the place in which the clothes of interest are stored, and moves to the place from their current position, the member has an

interest in the recommended commodities. Therefore, this study saves data on react towards recommendation as " having reacted ", as shown Fig.2. This study manages Mezzoscopic data, which are organized by Micro and Macroscopic data, by 4W, behaviour and situation as shown Fig.2.

4 Experiment

4.1 Experiment's Scenario

This study evaluated each customer's satisfaction concerning personalized recommendations using this inspiring store. This experiment provided a task to each examinee: Each examinee entered the store, after determining a trait of interest from clothes, such as a colour, type and material, and tried to find clothes that suited their decided trait from about 60 items of clothing. For example, a examinee selected the colour blue as their criteria of trait, and tried to find blue clothes in the store during experiment.

The evaluation experiment was conducted by using 18 examinees acting as member's customer in this inspiring store and purchasing items of clothing twice as follows.

1. No use of personalized recommendation based on this inspiring store method.
2. Use of personalized recommendation based on each examinee's model made during the first experiment.

The identity of each examinee was registered in a member's database before starting the experiment and individual examinees have RFID cards with their identity. The examinees came to the experimental clothes store independently and bought items of clothing which they were interested in. The examinee can feel free to move in the store. Each time of experiment used different clothes set and the implementation interval of this experiment was 3 days.

In the first experiment, this store accumulated Macro, Micro and Mezzoscopic data of each examinee from observed data, which are their actions towards items of clothing. Then, the store made a model of each examinee by analyzing common feature of the clothes in which they showed interest though their actions.

In the second experiment, this store gave personalized recommendation of clothing commodities through a display and accumulated data on examinee's reaction to the recommended information. The recommended information about clothes was decided by the model of each examinee, which was made during the first experiment. The store displayed the personalized recommendation on clothes using the display in front of the examinee, when it observed identity or presence of a member.

4.2 Results

Table.1 shows number of their responses to recommended information, the reaction results and satisfaction concerning recommendations of each examinee. Therefore, they have checked many clothes concerning a target feature.

Table 1. Number of examinees' response, Reaction results and Satisfaction

Examinee	Number of Checked	Reacted	Not Reacted	Ratio of reaction	Satisfaction
A	6	5	1	0.83	A
B	5	4	1	0.80	A
C	4	3	1	0.75	B
D	7	5	2	0.71	B
E	9	6	3	0.67	B
F	6	4	2	0.67	B
G	6	4	2	0.67	B
H	8	5	3	0.63	B
I	5	3	2	0.60	C
J	5	3	2	0.60	B
K	12	7	5	0.58	B
L	8	4	4	0.50	C
M	4	2	2	0.50	C
N	2	1	1	0.50	C
O	5	2	3	0.40	C
P	4	1	3	0.25	C
Q	6	1	5	0.17	C
R	1	0	1	0.00	C

Examinees of about 56% have satisfaction concerning personalized recommendation by shown Table.1 . This study could consider that examinees of A and B satisfied personalized recommendations because they react in a positive way towards the recommendation and showed satisfaction grade of A. This study could also consider that examinees of A and B satisfied personalized recommendations because they react in a positive way towards the recommendation and showed satisfaction grade of A.

Most examinees who put a grade of C couldn't get good recommendation from the inspiring store because there are not many checked items of clothing in first experiment.

5 Conclusions

This paper proposed the inspiring store with ubiquitous computing for supporting commodity decision based on each customer's interest in commodity in their shopping. This paper also describes new ideas, which are an acquisition and modeling method of customer's Interest. This study introduced three viewpoint, Macroscopic, microscopic and mezzoscopic, in this acquisition method and shows a mechanism used it for organizing data on relation between customer's interest in commodities and their action towards commodities.

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