Consumer Experience Modeling and Enrichment using RFID

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Abstract
Nowadays, brick and mortar retailers face a strong competition with online commerce. Instant feedback, product comparison or recommendations are relevant advantages of online commerce over traditional physical retailers. Ubiquitous Computing technologies such as Radio Frequency Identification (RFID) can help to bring the benefits of online commerce to brick and mortar stores. We have been using RFID EPC Gen2 to identify and track garments in fitting rooms and point-of-sales in a real store in Barcelona, Spain. In this work we present the initial results of a real-customer model analysis using RFID data. We demonstrate how by analyzing basket and fitting room information we can extract differentiated patterns in the customers behavior. This model is intended to be used as part of an in-store recommender system and stock information. Future work includes improvement of data collection and customer identification.

Author Keywords
Data Analysis, RFID, Customer Behavior, Retail, Ubiquitous Computing

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

Introduction

Nowadays, computers are taking over our everyday life. Ubiquitous Computing is a vision that has been embedded in our minds which is accessed through intelligent interfaces [1]. With the increasing adoption of technology, WiFi and smart phones, user behavior (and user modeling) have recently become increasingly popular and have attracted many researchers. Analysis of users' activities and behavior in the daily life, therefore, has become a hot topic.

One of the user activities is in the store. Today, retailers' have a difficult time staying competitive in their respective markets and ensuring their products are distinguishable from their rival companies. With an increasing number of stores and clients altogether, retention of customer loyalty and satisfaction is the main objective of the store manager. In such an intensely competitive environment, preparation and the supply of required information according to customers choice (including, goods, services, etc.) is vital to ensure survival of the firm. On the other hand, there are a huge number of organizations involved in the provision of customer services and needs that have created the problem of searching and selecting for consumers, causing confusion. When entering a large department store, customers are exposed to a variety of goods. Searching and finding the right option to best suit their needs, among all options, is a problem most customers have experienced. This is even more clear for users with some kind of impairment, like visually or mobility-impairments. One way of overcoming these problems is to use programs known like Recommender Systems [3]. To do this we need to do the analysis of customer behavior at store, first we explain how we collect data and then we show some of the analysis results.

Data Collection

In a retail store, Radio Frequency Identification (RFID) tag information is generated based on events such as a product leaving a shelf, or a product being checked-out by a customer at a checkout counter or products have entered to the fitting room by the customer. For this analysis, we have used real data from basket and fitting rooms from a real implementation in a store in Barcelona, Spain [4]. The EPC Class 1 Generation 2 [2] RFID technology is used in this implementation.

The antennas can help locate the available items in a store in real time. By using the antennas inside a fitting room, we can figure out how many products have entered to the fitting room and how many times that particular item has been used. Out of all these products, which ones the consumer purchases.

The type of data that is collected from the garments' tags can be categorized into category, pricing, type of material and gender. Table 1 summarizes the dataset obtained through the RFID and back-end systems.

Parameter	Description
TIME (B)	Time of purchase.
TIME (FR)	Time of detection in fitting room.
TICKET	Ticket number at basket.
RFID	RFID tag code.
PRODUCT ID	Store product ID.
PRICE	Price of prouct in Euros.
SIZE	Size of garment (i.e. L,XL,...).
GENDER	Woman, man or unisex.
CATEGORY	Skirt, trouser, dress, jacket, etc...

Table 1: Dataset relevant parameters obtained through Basket and Smart Fitting Rooms.

Data Analysis

The following diagram in Figure 1 is a result of the data collected from a store based on the movement of the products.

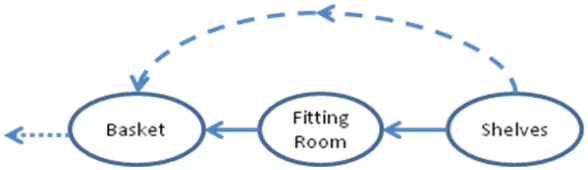

Figure 1: Flow of products in the store.

The dashed line line represents the products that are taken to checkout area directly from the shelf (BWF). The solid arrows represent the direction of which the products have taken, shelf to the fitting room and then to the check out (BF). The dotted line represents the products that have gotten purchased and exited the store (B). This information is collected using RFID and the antenna located on the shelves and the fitting rooms.

There are three locations where information can be obtained through RFID:

- Fitting room products: products that were entered into the fitting room.
- Basket product: products have been sold.
- Available products: products are on the shelves, with product ID, and all other information available.

Our goal in this article is to obtain information about the customers behavior, by analyzing specific garment's information and its movement inside the store. This analysis can be divided in to two parts: product, and gender.

Product

Table 2 summarizes the analysis of the products flow in the store versus a sample of the products' category. The first column is the category of products. The second column is the number of each product sold. The third and forth columns are the product's gender (c.f. Table 1). The fifth column represents the number of product that were taken into the fitting room and then sold (BF). The eighth column represents the products that were purchased directly from the shelf, by passing the fitting room (BWF).

	B	W	M	**BF**	W	M	**BWF**	W	M
Skirts	**53**	53	0	**33**	33	0	**20**	20	0
Trousers	**189**	121	68	**127**	83	44	**62**	38	24
Tops	**143**	143	0	**81**	81	0	**62**	62	0
T-Shirts	**83**	83	0	**48**	48	0	**35**	35	0
Dresses	**48**	48	0	**37**	37	0	**11**	11	0
Jackets	**85**	68	17	**47**	39	4	**42**	29	13
Trench	**104**	70	34	**37**	31	6	**67**	39	28
Stitch	**405**	289	116	**191**	156	35	**214**	133	81
Shirts	**200**	83	117	**84**	48	36	**116**	35	81

Table 2: Comparison of products' category vs. gender, in the two store analyzed areas. W stands for woman, M stands for man.

The percentage between the total amount of products sold coming out of fitting rooms versus the products that were bought directly from the shelves is 47% versus 53%.

Gender

In this subsection we study the behavior of man versus woman shoppers at the store. Figure 2 shows that out of all sold products that were placed in the basket, coming from fitting room or not, 66% were products for women and 30% were men products. The missing 4% were unisex products.

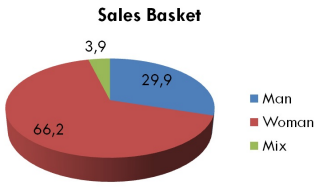

Figure 2: Product's gender comparison in the basket.

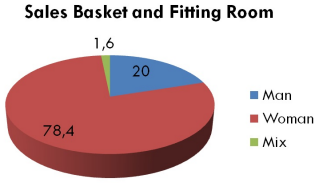

Figure 3: Product's gender comparison in the basket, coming from fitting rooms.

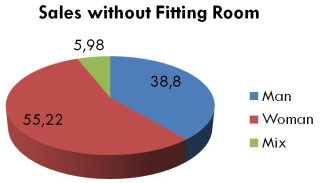

Figure 4: Product's gender comparison in the basket, without coming from fitting rooms.

Figure 3 shows all products sold that came from the fitting rooms. 78% of these were women's products, while only 20% were men's products. Considering that these products went through the fitting room, we can consider that the shoppers were actually women and men, respectively.

Finally, Figure 4 indicates the shoppers that purchased products without using the fitting rooms. From the products that are picked up from the shelves and directly taken to the checkout stands. 38.8% of the products were men's products, and 55.2% of the products were for women.

Conclusion

We have presented a preliminary analysis of a dataset including products information, and its flow, within a real retail store in Barcelona. Each garment has a RFID EPC Gen2 tag attached, and there are antennas and readers in the basket, fitting rooms and shelves. The aim is to model customer behavior, and the final goal is enriching customer experience.

For modeling user behavior, we have to define a system without changing the behavior of the customer. It is necessary to probe their behavior by using some technologies without customer sense of being monitored. For this reason, we have developed the system for modeling customer behavior without affecting the customer decision by using RFID and tag.

In this paper, we have analyzed the user activity in the store. Based on our analysis by using RFID data, we find that customers have different behavior to different product categories at the store. Also women and men have different behavior in using fitting room and buying products.

As future work, we plan to improve data collection and customer identification. By creating these improved models, we aim to design a system that can help the consumer to choose the appropriate products within the store.

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