Poster: Understanding Customers' Interests in the Wild

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Abstract
Today, retailers spend considerable efforts to provide a personalized shopping experience to their customers. As data-driven marketing helps to meet customer requirements, it is important to understand individual needs. However, offline stores—unlike their online counterparts—have great difficulty knowing their customers' needs due to a lack of proper context information. In this paper, we proposed a framework for estimating customer interests by using various sensor devices. The participants in our pilot study expected that recommendation services that adopt their interests would help to reduce their shopping time. As a result, shop assistants will have a stronger ability to understand, analyze, and even predict customer interests in the near future.

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Customer interests;

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H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous; H.1.2 [User/Machine Systems]: Human factors

Introduction
For the current and future success of both online and offline stores, offering customers a unique shopping experience is

Figure 1: A pilot study environment including 30 exhibitions and corresponding video clips.

becoming increasingly critical. According to Gartner [1], the majority of both online and offline stores believe that the shopping experience is the most important factor in differentiating themselves from their competitors. Additionally, the majority of customers are willing to pay more for a better shopping experience [1]. To fulfill customer expectations, online stores—such as Amazon—have been collecting different types of customer data to measure the interests of different customer segments and design personalized services—including tailored recommendations and offers [2].

In order to offer personalized services, understanding customer needs is greatly important for both online and offline stores. While data-driven marketing has developed several methods for identifying these needs [5], offline stores offer essentially the same shopping experience to every customer due to a lack of methods for precise customer interest measurement. The majority of offline stores still rely on shop assistants to cater to individual customer needs and preferences. An efficient way to precisely measure customer interests is needed. In this paper, we propose a method of predicting customer interests based on sensors that are already part of their wearable and mobile devices.

Predicting customer interests has been a major research topic in the ubiquitous domains of computing and human-computer interaction. Prior studies have mainly addressed the estimation of customer interests in online store environments, since a variety of data is widely available [4]. These studies have shown that, in addition to customer purchase and purchasing rate histories that explicitly represent customer interests, other data—such as user behavior data (e.g., item views and clicks, attention duration, etc.)—is also valuable in predicting customer interests [2]. In prior studies that specifically focus on the prediction of customer interests in offline store environments, Luo et al. [3] proposed a method of predicting interests based on online behavior using information such as customer search logs and online shopping logs. However, no prior study has investigated the prediction of customer interests based on sensor data.

As a first step toward prediction of customer interests in offline stores, we design our experimental framework to collect wearable and mobile device sensor data in order to build an automatic classifier that estimates customer interests. Our experimental framework consists of three parts: (i) a motivation scenario where customers visit an offline shop and a virtual agent presents product details to

Agent app, Sensing app, Sensor tag	Accelerometer, Gyroscope
Empatica E4	Accelerometer, PPG, EDA, Temperature
Look & Tell	Camera, Microphone
CCTV	Camera

Table 1: A list of devices and sensors.

Figure 2: Snapshot of sensors and apps.

customers, (ii) measuring customer interests as ground truth for training classifier, and (iii) collecting sensor data from wearable and mobile devices.

In a pilot study, participants experienced our demo and gave positive responses to our promising framework via survey. Most survey respondents preferred to use interest-based recommendation systems and were willing to provide context information (e.g., location) from their smartphones or smartwatches.

Framework Design

Promising Scenario

In order to build a test environment that mimics common offline stores, we first designed a showroom with 30 exhibitions in circular order (Fig. 1). Typically, shop assistants will briefly describe a product when a customer examines it in an offline environment. If the customer asks for more information about the product, the assistant can provide several details.

In this project, we assume that the same guidance can be provided by a virtual agent. Thus, we implemented an agent app to replace the shop assistant for a pilot study. As such, the app can create a unique shopping experience. Like a shop assistant, it can provide a brief description or details about the displayed products and subsequently acquire and estimate the user's interests via nearby devices.

Interests Estimation

We assume that customer interests can be extracted from corresponding physiological status. Thus, in the pilot study, we tried to capture customer interests using wearable and mobile devices. Table 1 summarizes the sensors we used, while Figure 2 describes how they were deployed. For example, the accelerometer and gyroscope can detect coarse-grained location changes and meaningful gestures of the app user. Through photoplethysmography (PPG) and skin conductance measurement, heart rate validity (HRV) and electrodermal activity (EDA) analyses are possible, which help to estimate physiological activeness. Device cameras and microphones are able to monitor what the customers see and hear—these are useful in understanding the individual's stance and intention.

Pilot Study

Set-up

Through ads on local online community bulletin boards, we invited random visitors to our showroom to participate in the pilot study described in Section framework design. The visitors who fully experienced the showroom environment and provided feedback received compensation of approximately $20 USD. As a result, 56 subjects (M:F=40:16) participated in our pilot study; their average age was 23.07 (SD=4.29, min=19, max=41).

Our pilot study was performed by the following process: We provided study participants with the devices noted in Section framework design and they experienced the showroom exhibitions with the guidance of the agent app demo. Subsequently, the participants answered a survey questionnaire. Our questionnaire consisted of two parts: What do they think about interest-based services? And how likely would they be to provide personal data for a novel service while considering privacy? For the first part, we investigated the questions: (i)*How inclined are you to use a route recommendation system based on your shopping interests?*, (ii)*How satisfied are you with a souvenir service that generates a pamphlet (including product details) based on your interests?*, (iii)*How much do you prefer to use a product recommendation system based on devices you currently use?* The second part consisted of questions: (iv)*Which of the following devices would you allow to collect*

data? (smartphone, smartwatch, smartglass, or none) [multiple choice], (v) *Which of the following data types would you allow to be collected from your smartphone? (internet history, social media history, location information, or none) [multiple choice]*

Results

We collected survey responses from 54 out of 55 users. The results show that the users are willing to welcome interest-based recommendation services, allow data collection from a smartphone and smartwatch, and provide location information. When questioned about the usefulness of three examples of interest-based services, *"very satisfied"*, and *"satisfied"* were selected by (i) 85.5%, (ii) 85.4%, and (iii) 69.0% of respondents, respectively. Most appreciated that their shopping duration was reduced. The data collection survey revealed that most users were willing to allow service providers to access smartphones (85.2%) and smartwatches (72.2%), respectively. However, they preferred not to allow access to all smartphone data. Location information (68.5%) was the only preferred data type, while others were selected by less than 20% of respondents.

Conclusion and Future Work

In this work, we studied a framework that can estimate customer interests in offline stores. Through the pilot study, we can understand the brief design requirements of promising services. Although participants welcomed the interest-based recommendation system for a convenient shopping experience, they did not want to sacrifice privacy. Therefore, it is necessary to take sufficient consideration of what data can be obtained for development of the service.

The successors of this work have a higher probability of understanding what context information can detect customer interests. In order to understand users, it is important to carefully consider what information they are reluctant to provide. We hope that the ubiquitous computing communities enjoy constructing a unique shopping experience.

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