Recommendation-Aware Smartphone Sensing System

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ABSTRACT
The context-aware concept is to reduce the gap between users and information systems so that the information systems actively get to understand users' context and demand and in return provide users with better experience. This study integrates the concept of context-aware with association algorithms to establish the context-aware recommendation systems (CARS). The CARS contains three modules and provides the product recommendations for users with their smartphone. First, the simple RSSI Indoor localization module (SRILM) locates the user position and detects the context information surrounding around users. Second, the Apriori recommendation module (ARM) provides effective recommended product information for users through association rules mining. The appropriate product information can be received effectiveness and greatly enhanced the recommendation service.

Keywords: Context-aware, smartphone sensing, recommendation service.

1. Introduction

In the concept of enterprise management, enterprises need to identify their target markets and create demand to bring profits. Therefore, in the present era of information explosion, how to quickly and accurately meet the target demand, timely supply the demand, and cope with planned marketing strategy to bring enterprise profits is one key concern of enterprises nowadays. With the rapid growth of data mining approach, the association rules derived from the analyses of huge transaction records can be applied to individual transaction records, so individual consumer marketing strategies can be developed [1]. Adopting the aforementioned method of developing marketing strategies will increase the overall sales revenue. In addition, the method of developing marketing strategies is more informed and effective and will bring the enterprises greater profits.

According to Kowatsch & Maass (2010), they found that consumers, in physical shopping environments, are strongly dependent on information present in such physical environments [2]. In other words, consumers are strongly dependent on the relevant information provided by the retailer regarding the commodities. Therefore, this study developed a recommendation system in physical shopping environments based on the concept of context-aware with Radio Frequency Identification (RFID) and smartphone as the medium. Consumers will use the handheld smartphone to read the RFID tag on commodities via RFID reader; smartphone will then provide and recommend relevant information of the commodities to consumers as to enhance the visibility of information for consumers in a physical shopping environment. It is thus to be concluded that one smartphone recommendation system which functions as the medium of information provider via a context-aware environment indeed influences consumer behavior.

2. Materials and methods

2.1 RFID Positioning Mechanism

Recently, there are many positioning algorithms or wireless mechanisms for RFID extensively proposed [3]. Hightower and Borriello (2000) presented the famous SpotON Indoor Positioning Technology, this technology is for detection of unknown objects with RFID-based indoor positioning technology [4]. The experiment used the RFID reader as the core and established center coordinates and massively spread tags on coordinates to record the received signal strength indication (RSSI) on each tag at its corresponding coordinates. The record of these RSSI was then used as data to analyze and infer the positions of the tags. The main localization mechanism are including Signal strength (SS), Time of arrival (TOA), Time difference of arrival (TDOA) [5], and Angle of arrival (AOA) [6]. According to the aforementioned positioning methods, there are varieties of positioning methods that are based on RSSI and each method has distinctive advantages and disadvantages. Take LANDMARC positioning mechanism [7] as an example. It is one indicative indoor positioning technology among current studies, but it is, at the same time, one with high costs and requires massive arrangement. The cause of the shortcoming is that LANDMARC positioning requires all three pieces of hardware equipment including RFID Reader, Reference Tag, and Tracking Tag to maintain indoor positioning accuracy. However, in the real physical environment, the arrangement of RFID equipment requires maintenance and raises environmental impact issues [8,9]; such issues need to be overcome one by one. Therefore, the goal is to establish context-aware in a physical shopping environment, in other words, it is to establish a RFID-positioning-technology-based consumer recognition function so that the system can provide relevant information based on a consumer's position so as to achieve ubiquitous computing concept.

2.2 Data Mining Technique

Generally speaking, data mining can be interpreted as knowledge discovery in database (KDD). In other words, knowledge can be extracted from massive data stored in one large database; such large databases can be on-line databases of data warehouses. The so-called "knowledge" indeed refers to some rules. Grupe and Owrang (1995) also claimed data mining is to dig out new facts which are still unknown to experts from the existing database [10]. After that, Fayyad et al. (1996) also discussed data mining is one step of the knowledge discovery process; to obtain special patterns from a large amount of data through data analysis algorithms [11]. Cabena et al. (1997) also explained data mining is the process of extracting previously unknown information with the highest relevance from databases, in order to use it in the decision-making process [12]. Recently, Han and Kamber (2001) summarized that data mining can extract the knowledge from large amount of data and discover interesting patterns [13]. In the traditional data mining approach, there are four popular methodologies, including data classification, data association, data clustering, and sequential patterning mining [13]. In 1994, Agrawal and Srikan presented the Apriori algorithm to handle the association rule mining [1]. It also called the market basket analysis and the goal is to investigate the possible relationship between different products from complex and huge transaction datasets. In this study, the proposed system will apply the association rule technique into transaction database and obtain the purchasing behavior or personal shopping behavior. Then, the system can send the related product information to users' smartphone and enhance the recommendation service quality.

2.3 Sensing Technique in Purchasing

According to the study of Kowatsch & Maass [2], it is found that consumers, in physical shopping environments, are strongly dependent on information present in such physical environments. In other words, consumers are strongly dependent on the relevant information provided by the retailer regarding the commodities. Therefore, the study developed one Mobile Recommendation Agent (MRA), a recommendation system in physical shopping environments based on the concept of context-awareness with Radio Frequency Identification (RFID) and Personal Digital Assistant (PDA) as the medium. Consumers will use the handheld PDA to read the RFID tag on commodities via RFID reader; PDA will then provide and recommend relevant information of the commodities to consumers as to enhance the