An Intelligent Assistant System to Support Buying Decision in E-Commerce

Dr. Ibrahim Al Bidewi¹, Mona Izzat Abu Ghazalah²
¹,²University of king Abdul-Aziz,
Faculty of Computing and Information Technology
JEDDAH, KSA

Abstract
E-Commerce has emerged as an important information technology tool to business. Many companies and organizations have been using E-Commerce. Due to the huge amount of information available in the Internet and the difficulty to search all shopping websites and compare their prices and services, the consumers experience hard time finding products or services. Intelligent systems came to resolve issues that consumers face when browsing E-Commerce sites. A user profile can help the intelligent system provide personalized services to consumers to save their time. User profile and the intelligent system can filter unwanted products and services to help consumers, during their online shopping, make the right decision. There are many intelligent systems available nowadays; one of which is fuzzy logic. This thesis presents a model of an Intelligent Buying Decision (IBD) that is based on fuzzy logic methodology to support the buying decision. The aim of modeling an intelligent system IBD is to predicts consumer interest according to user profiles by sorting the output depending on their preferences.

Key words: E-commerce, Intelligent Systems, Fuzzy Logic, User Profile.

1. Introduction

With the explosion in the growth of information in the Internet, people are faced with growing, overloading, and duplicating information. They find out that it is almost impossible to find products or services they desire, unless they make big effort. This fact annoys most customers shopping online and leads them to quit shopping. Consumers, who spend many hours browsing electronic commerce sites looking for a product or a service, can get lost between web sites visited without finding what they were looking for. However, if we can provide consumers with systems that can recommend, help, and support
their buying decision, they will successfully achieve their goal. Systems that can recommend, help, and support customers are increasingly used by E-Commerce sites to make suggestions to their customers. They focus their recommendations on the user preferences representing the collection of product attributes. But they do not give the customers the feeling of special or individual treatment. Intelligent systems overcome the problem by using consumers’ profile. User profile with intelligent assistant can filter unwanted products and services to aid consumers in their online shopping decision. The more a system knows about their consumers’ profile, the better it can effectively serve them. This paper surveys the related work to consumers’ online shopping behavior in e-commerce sites to discover the user profile and applying the fuzzy logic to help consumers in their buying decisions.

2. Related work

2.1 Electronic Commerce

Information technology is growing and changing every day which reflects on society and economy. In addition, the impact of Internet on the commerce is very huge. E-Commerce makes revolution in commerce and has played an active role in transforming the world into one huge market and creating the digital economy [1]. E-commerce is the buying and selling of goods over the Internet. It is the paperless exchange of business information. Since the emerge of Internet, the total number of trade electronically done is growing day after day. Nowadays, most of E-Commerce users browse the World Wide Web because it has extensive technologies. Factors like the credit cards and ATM acceptance, and telephone banking helped and contributed in E-Commerce growth and expansion.

2.2 Intelligent Systems

Online stores offer consumers huge choices. Nevertheless, finding desired products that meet consumers’ need is not an easy task because they face the problem of information flooding for that reason; most online stores now make an electronic decision aid and support available to smooth the progress of information processing. These electronic decision aids are variously referred to as recommendation agents, smart agents, shopping assistants or intelligent systems [2]. Intelligent systems can improve the quality of consumer buying decision and decrease the effort in decision making; but, there are still some issues that must be considered before evaluate intelligent systems. For example, information is often incomplete and
sometimes irrelevant or duplicated. Moreover, intelligent systems cannot represent actual human behaviour; another issue is that consumers sometimes change their goals in the middle of shopping [3]. Intelligent systems include many methods like fuzzy set, rough sets, neural networks, and others [4].

**2.3 Fuzzy logic**

Fuzzy logic is a way of processing data by allowing partial set membership rather than crisp set membership or non-membership. It provides a simple way to arrive at a specific conclusion based upon vague, ambiguous or imprecise input information. Fuzzy logic control problems on how a person can make faster decisions. Unlike Classical logic which requires deep understanding of a system, fuzzy logic is another way of thinking, by using our knowledge and experience to model complex systems [5].

Fuzzy logic is a suitable way to mapping an input to an output. This is the starting point for everything else. For example the input is the service at a restaurant; the output will be the tip that should be paid. The issue is how to map inputs to the appropriate outputs. Between the input and output is a black box that does the work. The black box can be fuzzy systems, linear systems or expert systems etc.

**2.4 User Profile**

User profile is structured representation of the user's needs. It is very useful to the system, agent, and other. User profile helps the consumers in his/ her tasks to pursue their goals. When we say user profile, we mean all user information, like his needs, wishes, and interest. Therefore, we can take the profile into account. One approach to collect user information is to ask the user to clearly provide information about himself or herself, such as filling in a form that inquire about all information the system need to build up his or her user profile; thus, you can provide personalized service to that user depending on the information provided. However, there are at least two problems with this solution. One issue is very tricky users will desire to change their own profiles; the second one is that when the user's interests change which will not indeed be reflected in the profile, unless the user keeps updating his or her profile. However, users don’t update their profiles after installation [6].

**3. Review of Related Literature**

Tewari et al [7] present MARI system ("Multi-Attribute Resource Intermediary"). MARI is a visual technique by which buyers of multi-attribute goods and services in electronic marketplaces can express
their preferences, and receive real-time feedback about the most suitably business partners that meet their needs. The work on MARI is motivated by the desire to create and implement a new model for multi-attribute preference-specification and product-space visualization. The system gives users the option of being able to iteratively improve their preferences based upon dynamically generated decision-support feedback. This work highlights the important subject on how users express preferences in complex product domains and how information is processed and the nature of final decision making.

Ma and Aimeur [8] introduce intelligent agent based on Case-Based Reasoning (CBR). The system filters out unwanted products to fulfill user’s preference and get products highly similar to the user’s query. Users profiles allow the XMLFinder agent provide more efficient recommendations. The system uses knowledge on users’ specific needs and product characteristics to establish relation between them and thus, make the proper recommendations.

There are a lot of shopping assistant Menczer et al [9] provide one of them the IntelliShopper. It has many advantages for online consumer. It is a proactive shopping assistant; it remembers the users’ requests and autonomously monitors E-Commerce sites for new items that might match users’ needs and preferences. It is a personal that learns and understands the consumers from their movement during their online shopping within different ecommerce sites. It is a private shopping assistant that protects the consumer by concealing the identity and behavior of the user (e.g., IP). There are three agents in the architecture of the IntelliShopper system. One is the privacy agent located between the consumers and IntelliShopper server. The privacy of the consumer is guarantee because there are no personal information about the consumer is stored in the IntelliShopper database. The second is the learning agent that takes consumers needs and saves them in the database; it forwards those needs to the online vendors then retrieves the results back to the consumers. The learning agent that observes the users while shopping and learns their preferences to various products; so, it can learn the user profile without requiring any feedback from them. The monitor agent makes the IntelliShopper autonomous in that it shops on behalf of users; in fact, it even queries the database to retrieve what the consumer is interested at. IntelliShopper is designed to empower online consumers.

In the past few years, E-Commerce has become the most important research area. It has many advantages to the consumers. But in many cases, customers take long time to locate the desire product. Due to the huge amount of information available in the in Internet, consumers may face massive difficulty in finding the information, and thus, get confused while browsing E-Commerce sites. In addition, it is impossible to search all shopping websites and compare between them to come up with a decisions. Therefore, there is a
need to find a way to filter the information and present only those products that fit the customers’ needs. Mobile agent comes to solve this problem. Lu and Zhang [10] provide mobile agent using fuzzy logic developed based on the Kaariboga Mobile Agents system. Kaariboga enables mobile agent to navigate and communicate via the network. The system works when the user dispatches the mobile search agent with a list of shopping stores. Before the agent leaves, it creates a local agent which accordingly creates a counter to monitor the search agent. When search agent goes to the first store, it starts to search product prices in the store database; then, it sends back a message containing the result to the local agent. If the local agent does not receive any answer from the search agent for a period of time, the local agent re-d dispatches another search agent to complete searching. After the task is complete, the local agent uses the collected information to do the fuzzy mobile data mining and then displays the result to the user to make the decision to buy product or not. Pan and Zhang [2] overcome the problem happening because of the overloaded information on the Internet by building an intelligent recommender system to retrieve product that interests the consumer. This paper applies this system in virtual mall to help consumer find out what he or she really wants. The system starts when the consumer enters the easy mall, the system acquires consumer's wishes via choices of attributes using the rough set technology. Then, the shop assistant converts the inaccurate information and ambiguous text into fuzzy variables. In this stage, the Case Base Reasoning (CBR) methods choose the appropriate product from product database. In the last phase, it will present the list of products to the consumer to pick from. The system not only provides human-like interface, but also, provides accurate products for consumers. Lee and Liu [11] propose iJADE (Intelligent Java Agent Development Environment) provide intelligent layers. One of the iJADE applications is iJADE Web miner. iJADE Web miner is an intelligent agent based on web mining application which has an agent based facial pattern authentication scheme FAgent, and a web mining tool that uses fuzzy shopping agent FShopper to select the best product. There are two kind of Fshopper: one is the Fshopper Broker (FB) and the second is the fuzzy buyer. FB is a stationary agent contains all information about the user (e-form). The Fuzzy buyer is a mobile agent performs all process in the virtual marketplace. In the CRD module, when the customer browses E-Commerce sites, they fill up electronic forms (e-forms) to give his or her needs and requirements. Therefore, when the consumer inputs a product attribute (e.g., color, size, style, fit) the FB first validates the data against the e-form; then, it converts the fuzzy attribute into fuzzy variables. After that, the Fuzzy buyer starts to communicate and negotiate with selling agent. Once the fuzzy seller collects user fuzzy attributes, it performs the product selection activities based on a fuzzy neural network. Then, the fuzzy buyer will return the recommended products to the user. Liu et al
[12] uses another fuzzy model two-input-one-output. The input values are quality, price the output value is satisfaction score. The system allows users make basic selections first; after that, the system will provide the user with a satisfaction score. If the user is satisfied with the score, the system will give detailed information. The system will produce different sets of satisfaction scores based on the user’s profile. The scenario for this shopping agent is that customers visiting the online shop are divided into three categories: one is teenagers, two is college students, and three is IT professionals. Customers are required to tell the system which category they belong to. Then, they could make selections on the price and quality of computers in the store. For the price of computers, the system gives different intervals for customers to choose from, for example, US$ 0–200 and US$ 400–600. For the quality of computers, the system provides five options to customers, Poor, Below Average, Average, Above Average, and Good. After customers make those selections, the system will compute the satisfaction score for that selected computer. If customers are satisfied with the satisfaction score, the system will list out all the computers in the selected range for customers. If customers are not satisfied with the satisfaction score, they can go back and make selections again. Therefore, this shopping agent will help customers to make decisions as well as help the System to narrow down the searching range for computers. Hua et al [13] proposes approach based on fuzzy logic for product filtering. The proposed fuzzy logic based system will analyze the collected customer data and learn customers’ shopping behavior. The system is build by using MATLAB. In this, only two attributes are taken into account, which are price and quality.

Intelligent shopping system help consumers save their time when shopping online stores. However, consumers are not only after finding the best online prices; they are also after the best quality, brand, services, and many other points of interests. Since not all consumer have the same taste and preferences so intelligent agent is important in online stores. Zeng and Meng [14] propose system consists of five agents that interact with each other: interface agent, buyer manager, buyer agent, evaluation agent and preference agent. These agents work together by message delivery mechanism as follows:

1. Interface agent: it communicates with the user, knows the consumer requirement and personal preferences; then, it sends these information to the buyer agent. After the shopping task is done, the result is sent back to the interface agent to post it to the user.
2. Buyer manger: it creates a group of buyer agents and sends them to search for the offers from multiple suppliers. The buyer manger supervises each agent and organize task among them.
3. Buyer agent: when they are created, they are sent to search for product information and when they find the supplier, each agent asks for an offer for the product from the supplier. After buyer agents have the offers, they return and give the result to the evaluation agent.

4. Evaluation agent: after receiving all the offers of the products from suppliers, it will start to compare between offers and since online shopping is not price comparison, the system applied the multi attribute utility theory (MAUT). The evaluation agent will computes the utility value of each product and select the maximal utility value as the recommended product.

5. Preference agent: in case the consumers dislike the recommended product, the preference agent will get the consumer preferences from the preference knowledge base and make preference analyzing. According to the consumer's up to date preferences, the preference agent can improve the offers of the product until the consumer is satisfy.

From the early days, people were negotiating in order to reach an agreement. Now in E-Commerce negotiation is primitive. Thus E-Commerce need automated negotiation. To apply negotiation to E-Commerce Wang et al [15] use intelligent agent to negotiate a solution autonomously. Intelligent agent used to retrieve information such like product information, compare prices and other services to consumers.

Nie et al [16] proposes approach combining semantic similarity with collaborative filtering to generate recommendation lists for users.

Websites causes overload of information. So consumers have to spend much more time browsing the net in order to find the information needed. Cao, Y. and Li [17] overcome the above problem by developing intelligent recommendation system to provide personalized information services. For such frequently purchased products as books, CDs, and DVD films, recommendation systems can be developed to reason his or her preferences by analyzing his or her personal information and browsing the history, and the products he or she purchased. But, less frequently-purchased such as notebook, computers, and digital cameras enterprises lack of enough information about the customer’s past purchases and his specific requirements for a particular product, so it is difficult and impossible to reason a customer’s previous preferences. Fuzzy-based recommendation systems are thus expected to have specific domain knowledge and capability to interact with consumers.
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We find out that most of the systems try to save searching time for users because Internet is overloaded with information. As a result, finding what consumer wants is very difficult; this is negatively reflected on consumers satisfaction. Consumers could use recommendation systems to narrow down their choices and make selections more efficient. Recommendation systems can meet this goal by giving attention to personalized information services to fit consumer's interests. It is necessary to understand consumer's interests and preferences. After that, we can provide suitable products or services. Fuzzy logic came to help online consumers in their decision making by using set of rules to view what is best for consumers.

References


