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Personality-based Design and Implementation for Personalization of e-Commerce Applications

by

Nancy Ho Woo

*A thesis submitted to the
Faculty of Graduate and Postdoctoral Studies
In partial fulfillment of the requirements for the degree of*

Masters in Applied Science

In

Electrical Engineering

**Ottawa-Carleton Institute for Electrical and Computer Engineering
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Personality-based Design and Implementation for Personalization of e-Commerce Applications

Master of Electrical Engineering Thesis
Ottawa-Carleton Institute for Electrical and Computer Engineering
School of Information Technology and Engineering
University of Ottawa

by

Nancy Ho Woo
January 2008

Abstract

In commerce, user behaviour modelling is an important component of marketing and advertising. Personalization, a widely used feature of e-Commerce systems, is one aspect of such modelling. Current personalization systems require users to register in order to provide their services; and many of the personalization aspects offered are determined by requiring the user to fill extensive forms regarding their preferences. Although there are a few systems that provide automatic personalization, most focus on the link and content personalization only. Work done in user profiling and determining user models for marketing and commerce purposes have little emphasis on user personality; moreover, there has been a growing concern for privacy of information from the ever-growing online community. The objective of this thesis is to provide a model where the personality of the customer is used for personalization. A mechanism is proposed in which personalization does not require registration, the customer personality profile is determined implicitly, and the personalization module is updated dynamically while the customer browses the products. The design, implementation and testing of a bookstore using this model is presented; furthermore the system is coupled with a privacy component to present the concept of privacy-enhanced personalization of web pages.

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List of Acronyms

ASP – Active Server Pages

ASP.NET – dot NET Active Server Pages

CSS – Cascading Style Sheets

HTML – Hypertext Markup Language

JSP – Java Server Pages

LAN – Local Area Network

PCC – Privacy Control Component

RUID – Registered Unique Identifier

SQL – Structured Query Language

UID – Unique Identifier

Chapter 1

Introduction

1.1 Motivation

Personalization is tailoring a product to a customer based on the customer's preferences. In website terms, personalization is tailoring a website to a user based on the user's preferences [2]. In today's integrated e-business environment, where change is fast and unpredictable, what matters most, in the perspective of vendors, is acquiring and building long-term and profitable relationships with customers whenever possible. Personalization is a dominant business model in today's e-Commerce to establish such relationships between buyers and sellers [44], which translates into customer retention and more sales. "It is a fact that personalization is here to stay" [27]

There are several levels of personalization of online business websites: Identical to all customers (basically, no personalization), Personalization by categorization (similar personalization to groups), and Individualization (personalization provided per individual). [45]. In the early days of Internet there was no personalization, much of the purpose of websites was to provide information; but with the growing online communities and businesses going online, personalization has grown into a great topic of research, both to find ways to improve existing systems, or ways to make online businesses more attractive.

Aggarwal et al state that in order to have personalization, registration of the user is needed [3]. This usually implies filling forms with personal information; which is contradictory to the current interest of users where "users are more and more reluctant to provide personal information" [13]; many businesses have resorted to providing incentives for customers in exchange for information. Most of the existing commercial websites require the users to register in order to allow personalization. The reason stated is that it is hard to identify online users that are not registered [3]; IP tracking and cookies are not very reliable because proxies can group users to a single IP, and cookies can be disabled. Despite that, cookies are the most commonly used non-registration-requiring identification

medium thus far.

Current personalization schemes have several stages to achieve personalization: user profiling, log analysis, web usage mining, information acquisition, content management, and web site publishing; where information gathering is usually explicitly attained by having users fill forms and questionnaires with specific interests and preferences [13]. This however is considered cumbersome by users, and yields rather subjective results. There are limitations as to how much effort users are willing to put into explicitly providing their personal preferences [3]; often the information gathered may be too sparse to be of much use; which is why developing mechanisms to implicitly gather information about users has been obtaining attention [3][13][28][36].

Research on consumer behaviour in marketing has shown that consumer's emotions and state of mind play a significant role in their purchasing decisions [5][6][14][16][31]. There is work done in marketing to determine customer's purchasing behaviour and mechanisms to create user models (all based on questionnaires). There are also marketing studies that suggest people's personality is a determinant in their purchasing behaviour [4][20][21][37][48]. Moreover, product brands have been studied to see if the brand's personality is representative of its buyer's personality [1]. It has been shown in fact that product attributes such as color, design, intended use, general appeal, and so on suggest that a product in its own has personality traits that are representative of its buyer's personality [20][21][48]. Despite these indicators, buyer's "personality" has not been explored in the field of e-Commerce and the area remains largely untapped.

In parallel, there has been a growing concern about privacy of information from online users. Although most e-Commerce applications were initially developed with the business side as the main focus, the focus now is changing onto the customer [51]. Many businesses are starting to pay attention and implement security features into their online systems, and expressing more strict privacy policies in the use of their websites; however, the concern is still high on the issue of security and privacy of client information. There are many works that propose different privacy negotiation techniques [10][11][33][42] that try to address this issue. Moreover, in relation to websites that provide personalization, the concern is becoming higher, since many websites use implicit means of gathering user

information, meaning in many cases the customer may not be aware that a website is supervising their actions [26].

1.2 Research Problem

Currently the focus of research in the field of personalization of web pages have been moving towards data mining of the databases and data warehouses of customer information that companies have been storing. Many of these techniques are focused on trying to find meaningful patterns that may reveal some useful information about the customer's purchase history. The problem is that a lot of the information stored can be old, or sometimes the patterns of purchases may not pertain to a specific customer, but to a set of customers; secondly they are done when the customer is not at the website, therefore personalization of the website may not be accurate to a customer's immediate need, and sometimes the information may already be outdated. Also, the customer's purchase interest may have changed since these data were processed.

Other works on personalization of web pages are focused on how to improve the type of information presented to the customer, by designing predictive algorithms that in many cases are complicated to implement. Some online businesses have also expressed that maintaining a personalizable website is expensive; and too many changes would have to be made to their existing system. Moreover, personalization itself has shifted much from personalizing different aspects of a website to focusing on the recommendations that a store would provide to customers. While recommendations are an important part of a website that provides personalization, other aspects of the website should also be explored.

Although marketing research is very rich in keeping the focus on the customers, most of the works explored in personalization does not put much weight in the customer themselves, but instead they put the focus on the application. So even though ultimately the purpose of making applications better translates to providing better service to online customers, the lack of perspective still shows.

One major concern emphasized by Kobsa [26] is that although customers value personalization, there is a growing concern in the online community for the security of their

private information. So far there is little work addressing both privacy and personalization of web pages. There are many privacy related work for increasing security of information, and protocols that regulate information transfer between online applications and communities, however to our knowledge there is still no work in particular that show the integration of both worlds.

In short, this work tries to find an innovative way of providing personalization for online customers without the need for data mining that may result in obsolete information. It tries to address the problem of having users register in order to provide personalization services; and it tries to personalize beyond just links and contents at a website. Finally, we also look into the growing issue of privacy of personal information, and by integrating with a privacy component we try to address the problem of disclosure of personal data.

1.3 Research Contributions

This thesis aims to provide an innovative way to provide personalization for online customers. It tries to address the problem of having a user register in order to provide personalization services; it aims to expand beyond personalization of links and contents; and it addresses the growing issue of privacy of personal information in websites that provide personalization.

In short this work introduces a new approach to personalization of websites, with the following contributions:

- The integration of personality as a factor for personalization; the first work to do so.
- The introduction of “product personality” as a means for determining customer personality
- A model whereby the customer’s personality is determined by his/her interaction with the products and purchases.
- Integration with a privacy component to control information sharing between companies.
- A proof-of-concept implementation of an online bookstore to illustrate feasibility of

the design and to do performance evaluation of the proposed model.

- Outcome of this research is published:
 - N.H. Woo and S. Shirmohammadi, “*Modeling and Measurement of Personality for E-commerce Systems*”, Proc. IEEE Int. Instrumentation and Measurements Technology Conference, Victoria, Canada, May 2008.
 - N.H. Woo, X. Shen, and S. Shirmohammadi, “*Personalization through personality categorization of products*”, Proc. 20th Canadian Conference on Electrical and Computer Engineering (CCECE’07), Vancouver, BC. Apr. 2007.

1.4 Thesis Outline

After the above introduction, the rest of the thesis is organized as follows: **Chapter 2** presents a background and literature review on human personality, brand personality, product personality, personalization systems, and other related works. **Chapter 3** presents the proposed design for the personality determination model, details of the categorization of products, and an approach for providing personalization without the need for registration. **Chapter 4** discusses the design and implementation of an online bookstore integrated to a privacy control component. **Chapter 5** provides the description of the test bed setup for determining the performance of the system and the acceptance of such a system by users. It also discusses the results, observations and feedback from the tests, and contains a discussion of limitations and possible improvements. **Chapter 6** contains the summary and conclusion for the thesis; and includes recommendations for future work.

Chapter 2

Background

2.1 Human Personality

Human personality is defined as the totality of qualities and traits, as of character or behaviour, which are peculiar to a specific person [41]. In the field of psychology there is much work done in categorizing the different types of human personality. Out of a large pool of work done in this regard the “Big 5” [19] and the “Five Factor Model” [5] are amongst those most referenced. Both models classify human personality traits into five distinct factors, however each of the models have its own set of naming convention and differences in their concepts.

The “Big 5” [19] is a human personality categorization model developed by Golberg (1990). This model classified the human personality traits into five factors: surgency, agreeableness, conscientiousness, emotional stability, and intellect. The naming is based on the positive pole of personality traits for each factor; and this model made use of adjectives to categorize/determine people’s personality. On the other hand the “Five Factor Model” [5] proposed by Costa and McCrae (1992) as defined by Baumgartner [5] defines the five factors as the following: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (OCEAN). This model uses descriptive sentences to categorize personality traits, and the naming of each factor does not follow specific order or side (positive or negative). Both models are very similar and are frequently referred to interchangeably by researchers in psychology.

Each factor is a general category in which all other personality traits can be categorized into; both models determined that the set of distinctive traits that identify a person can be classified into the five factors; so that someone’s personality can be represented by their level of belonging into each factor. For example, a person that is outgoing, active, daring, and competitive would have a high rating in the Extraversion

factor (of the five factor model), and Surgency factor (of the Big5 model).

Since the two models are frequently used interchangeably, we will make use of the Costa and McCrae's Five Factor Model [5] as the base human personality categorization model for our work. Based on the definition of the Five Factor Model [5], human personality traits and characteristics can be represented by the following five factors:

- Agreeableness, (altruism and affection).
- Extraversion, (energy and enthusiasm).
- Neuroticism, (nervousness, emotions, and negative affectivity).
- Conscientiousness, (control and constrain)
- Openness to Experience, (originality and open-mindedness)

A person's personality is defined by the subset of descriptive adjectives that fall within the abovementioned five factors, and hence the personality is defined by the combination of the different scales obtained from each factor, usually falling in the extremes. E.g. a person that is perceived as creepy, dark, nervous and antisocial would have a low agreeableness, be introvert (opposite of extrovert), have high neuroticism, have low conscientiousness and be closed minded.

It is important to note that the five factors are dimensions, not types, so people vary continuously on them over time [47]. The five factors are the highest level of representation in which the vast number of personality adjectives and attributes used in personality tests are categorized into, and are the main model of personality we use in this work.

2.2 Product Personality

Researchers in the field of marketing and consumer research are starting to put emphasis on determining the effects of human personality on a person's purchasing behaviour [4][20][21][24][35][48]. In fact some of these works show that there are relationships between consumers' self-perceived personality and their preferred product and/or brand [4][20][48]. On the same note, there are many works done in which they

develop strategies for new product marketing and packaging based on the personality of the group of consumers that they wish to target [1][4][5][20][35]; hence, many products on the market are designed with a personality in mind, created, designed, packaged and marketed with a personality. Some of these works also define guidelines for product designers to follow in order to target sales to specific groups. Thus, it is not surprising to find all sorts of products that have the same functionality designed and packaged in many different shapes, forms and colours. For example, Figure 1 below shows several different cameras which differ in style, shape and size, but are all used for the same purpose of capturing images.

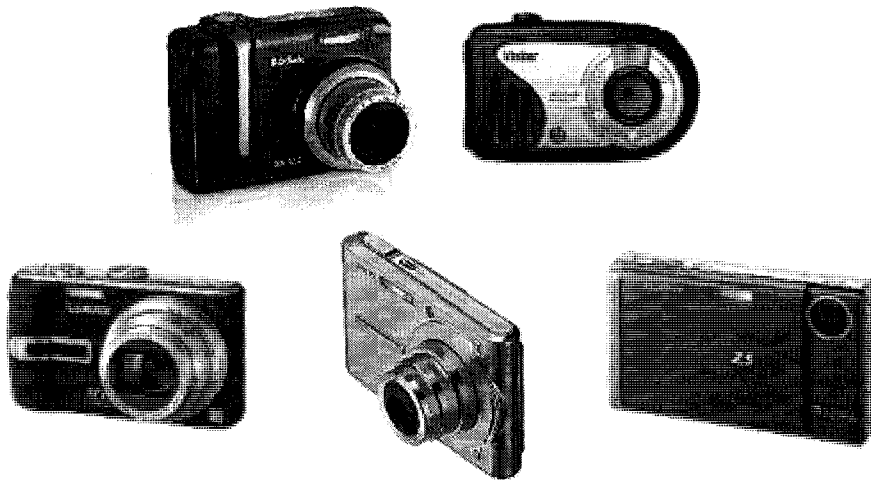


Figure 1. A variety of cameras

2.2.1 Brand Personality

Probably the most notorious work in categorizing products into personality factors is attributed to that of Jenifer Aaker [1]. Her work, although related to products, was focused on the brands to which a product belonged to, hence “Brand Personality”.

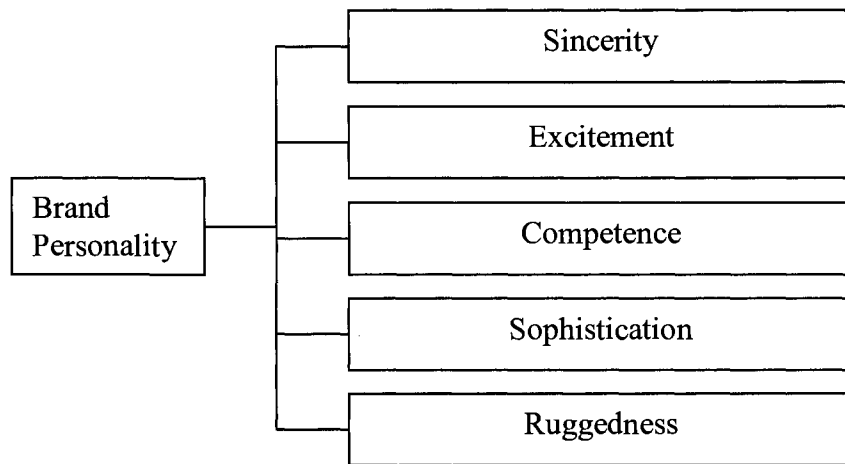


Figure 2. Five Dimensions of Brand Personality by Aaker

Aaker proposed a model (see Figure 2 above), based on the five factor model of human personality, for categorizing product brands; a framework to describe and measure the “personality” of a brand in five core dimensions, each divided into a set of what she calls “facets”, which are simply a set of descriptive adjectives that can also be applied to human personality:

- Sincerity, (down-to-earth, honest, wholesome, cheerful)
- Excitement, (daring, spirited, imaginative, up-to-date)
- Competence, (reliable, intelligent, successful)
- Sophistication, (upper class, charming)
- Ruggedness, (outdoorsy, tough)

This model is very effective in measuring the personality of a brand, and widely used by marketing to determine and re-package their brand image. In fact, Aaker was able to show that there is correlation between the brand-personality of products that are favoured by a buyer to the buyer’s personality. However, it is not as effective for individual products, or those whose brand is not “packaged” for a specific personality type.

2.2.2 Product Personality

According to Govers [21], the concept of product personality was introduced by Jordan in 1997. It differs from brand personality in that it refers to a specific product variant, and not to a global brand. It is defined as “the set of human personality characteristics used to describe a specific product variant”. For example, just like a human, a product can be cute and silly; if we look at Figure 3, the cute features could be that the spider-man toy is small and colourful; and silly because the ever-tough hero is now tiny, and with a big head.

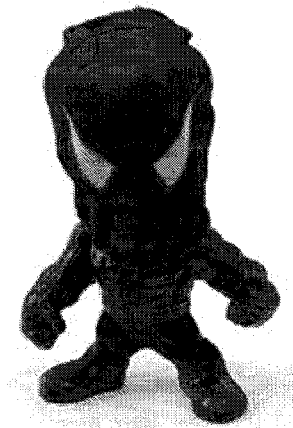


Figure 3. Example of “cute and silly”

Unlike brand personality, there is no particular framework or model developed for categorizing products based on their personality. The reason is that the same adjectives and attributes used to describe the personality of a human can be used to describe a particular product.

In her work “Product personality and its influence on consumer preference” [20] Govers expresses that beyond their functional ability, products have symbolic meaning. That this symbolic meaning can come in part by its associated brand and product-user image, but part of it also comes from the product itself, and it is described by human personality characteristics, and called product personality. She shows that product personality does have influence in a consumer’s decision to purchase. Consumers prefer products with product personality that matches their self-image.

2.3 Personalization

Personalization is a system development approach for designing information systems that change configurations based on each user's needs and preferences [52]. The term was initially used for applications and systems that were customizable. Now-a-days personalization is more widely used for referring to websites. [52] defines web personalization to be the adjustment and modification of all aspects of a website that are displayed to a user in order to match that users needs and wants; which includes contents displayed, layout, links, and so on.

According to Schubert and Ginsburg [45], there are three levels of personalization:

- “Identical representation to all customers”. The presentation of a website is the same for every customer, and there is no automatic user identification nor does the system make use of the existing user profile.
- “Personalization by categorization”. Customers are classified into different groups of interests, and personalization is provided based on the group the customer is classified into. Examples of such are categorization by gender, age group, demographics, etc.
- “Individualization”. It is the highest level of personalization where individual user preferences and interests are taken into account in the process of providing personalization.

Types of personalization offered vary between websites, the most common are:

- Content Personalization, it is one of the most important items to personalize on websites; used to provide optimized information for users.
- Link Personalization, this approach attempts to present additional relevant links for the user, it may modify the original navigation space by improving the paths to related web pages.
- Personalized Recommendations, widely used in e-Commerce websites where the list of sale items recommended to the customer are modified depending on the customer preference.

Others include layout personalization, which is making changes to the look and feel of the website. And anthropomorphic personalization, which is the means of making information act like a human, like a website that greets a user by their name when the user visits that website [4][44][52].

In order to provide personalization, information needs to be acquired from and about the users. The information acquisition is done either by:

- Explicit collection: The customer may specify some interests, which reflect his/her desire to acquire a certain product; which include user feedback and ratings.
- Implicit collection: The e-Commerce merchant may collect the buying behaviour of the customer. The major concern about implicit collection is privacy. [3]

There are several techniques used for gathering information from online customers for the purpose of providing personalization like the following:

- Content-based filtering: Systems that make use of this technique track the customer's behaviour and provide personalization based on the customer's history. It analyzes the common features among the items a customer has already rated highly. For these systems, the feedback of other customers is not relevant in the decision of personalization for a specific customer.
- Collaborative filtering: These systems provide personalization by finding the closest peers for each customer, that is, other customers with the most similar tastes and preferences. Usually these systems invite users to rate objects or divulge their preferences and interest and then return information that is predicted to be of interest to them. This is based on the assumption that customers with similar behaviour have analogous interests.
- Rule-based filtering: Customers are asked to answer a set of questions. These questions are derived from a decision tree which, as the customer proceeds with the answers, will progress into a result of preference which can then be used for personalization.
- Hybrid approaches. These systems make use of any combination of the previously

described techniques either separately, where the result of each is then combined to provide personalization, or together in one same system where priority is given to the result of one or the other.

2.3.1 User Modelling or Profiling

According to Kobsa [27] user modelling traces back to the works of Allen, Cohen and Perrault, as well as the works of Elaine Rich in 1979; following which many application systems were developed that collected different types of information about their users.

In the context of the Web, user profiling is the process of gathering information specific to each visitor, either explicitly or implicitly (see section 2.3). A user profile may include demographic information about the user, his/her interests and behaviour when browsing a website. This information is exploited in order to provide personalization to users. [13]

A user profile can be either static or dynamic. In the case of static, the user information is rarely or never changed. In the latter, the user profile data may be frequently changing. Information gathered can be done explicitly through questionnaires or forms that the users are asked to fill, usually resulting in a static profile; or implicitly by recording and tracking user browsing patterns and/or navigational behaviour [13].

2.4 Pluto - A Privacy Control Protocol for e-Commerce Communities

Pluto [9] is a topology and Kerberos [25] based protocol for controlling and accessing privacy-preserved information from networked applications. It is a system designed incorporating legal and legislative requirements.

The Pluto protocol is comprised of two levels: community design level and actual data level. At the community design level, a privacy control component is used, which contains a purpose mapping that will be used to interpret the request purpose of a data query, ensuring that data is only released for authorized purposes. The data design level

addressees the requirements on data shared by the Pluto protocol.

A variation of the Kerberos protocol [25], adapted to carry purpose information, is used to secure data across open networks, and to authenticate the users through a Kerberos-like ticket. This ticket is generated and provided by a third party component that acts as the ticket officer, called the Privacy Control Component (PCC), therefore applications and clients would not have to know or trust each other as long as they can trust the information from the trusted third party. Figure 4 shows how applications and the privacy component are setup on a network.

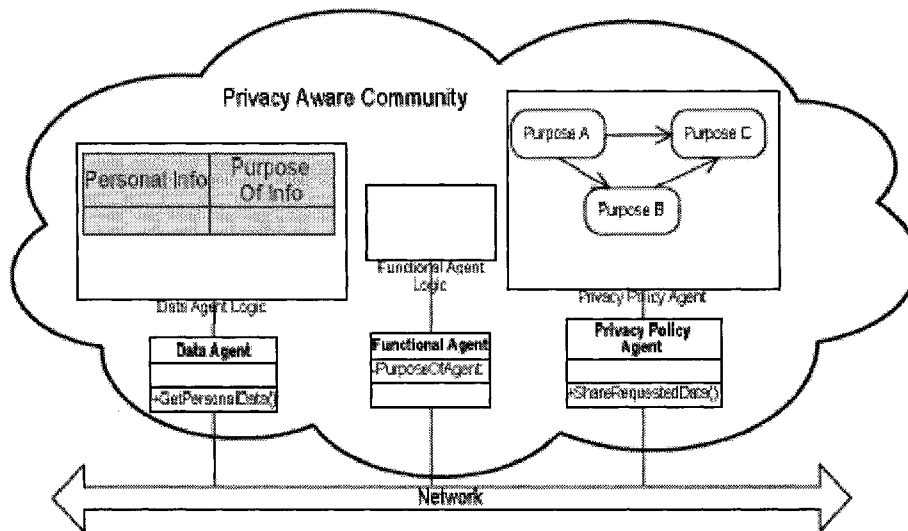


Figure 4. Pluto: Privacy Management in e-Communities

In order for a purpose to be valid it must meet the requirements as shown in Figure 5:

1. The user initiated a request for that purpose. (Receiving private information may have legal implications; therefore restricting data request can minimize exposure).
2. The user has been granted, by the privacy policy entity, permission to make requests for that purpose. (Users may have restrictions on the type of data they can access)
3. The application has granted permission to the community for this community

to make request of that purpose. (Applications may belong to several communities for which access to some may be restricted)

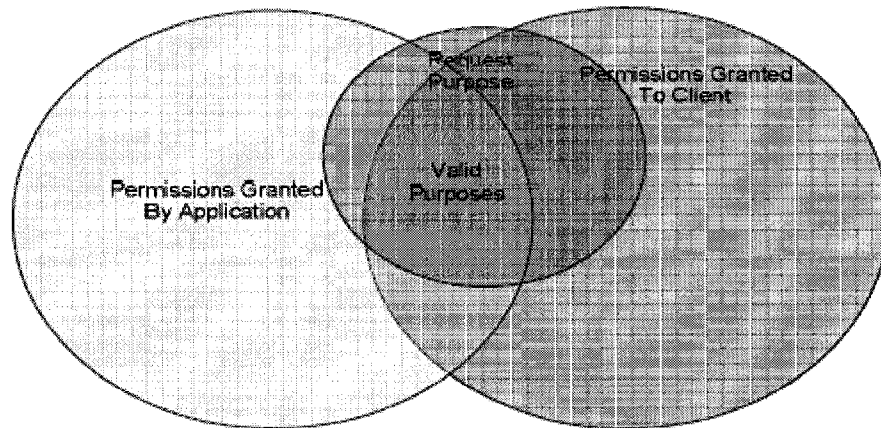


Figure 5. Pluto: Privacy Policy Map

The request flow is as follows:

1. A user makes a request to the PCC stating the purpose and the application they wish to contact.
2. The PCC determines the authority the requester has in the community, and given that the requester has the authority, a ticket for information transfer is granted. Details of the ticket structure is shown in Figure 6 below:

Client Portion Encrypted with Client Password	Service Portion Encrypted with Service Password						
	Session Key	User Name	Address	Service Name	Life Span	Time Stamp	Valid Purposes

Figure 6. Pluto Ticket

3. The requester commences interaction with the application in the community. The application validates the requester's authorizations from the information contained in the ticket.

The authors state that the protocol introduces mechanisms for creating and passing purpose-based policy filters to applications that can be used to ensure privacy information. They also state that the protocol by itself does not solve the entire problem. In order to

maintain privacy, the applications must know the reason they contain data and for what purposes are there data released. If an application does not have purpose information about each record, then it will have no means of comparison to filter the records.

2.5 Other related literature review

2.5.1 Recommendation systems

Because recommendation systems are beyond the scope of this work, we will only briefly touch on it here.

As its name describes, these are systems used to provide recommendations to customers. For example, in Amazon.com, products that other customers also bought are recommended and customer ratings are presented; and in Google-news where the top stories are recommended based on the article's view ratings and number of similar articles published. With the growth of personalization applications, recommendation systems have grown into its own category of research. Most e-Commerce websites that provide personalization will likely have a recommendation section that would make use of some sort of recommendation system or technique.

Most recommendation systems tend to use the techniques described in section 2.3 for determining the items to recommend to customers, these are: content filtering, collaborative filtering, rule-based filtering, and hybrids [2][13][28][52].

2.5.2 Data mining

Data mining is the process of discovering previously unknown, actionable and profitable information from large consolidated databases. It is the acquisition of new, valid, valuable knowledge from data. [29]

The idea of integrating data mining to personalization of web pages was first proposed by Mobasher et al [36]. The idea is to use data mining techniques to find customer behavioural patterns and purchase patterns that may be useful for providing more accurate personalization. There are now many works where mining techniques are suggested, and data mining is used not only on information already stored in databases and

data warehouses, but also client side mining, where the customers' usage logs are mined for valuable information [3][12][13][15][36]. Furthermore, a new term to data mining was introduced, Web mining, where systems explore websites, web logs, and server logs for similarities and patterns of information that may be valuable for an online business.

2.5.4 Color Meaning

Understanding the meaning of color and how colors interact is important in print and electronic design in order to convey the right tone, message, and evoke the desired responses. It is said that colors are a non-verbal form of communication, and that they create physical and emotional reactions. The problem is that the meanings attributed to colors vary greatly between not only different cultures, but also between people. Many literature can be found describing the meaning of color, amongst them [7][17][30][49]. It can be noted that there are controversies and differences in the attributed meanings to each color; moreover, these meanings change as the cultural background of the interpreter is different. Color representation can be different in Asia versus America and other parts of the world. Because of the differences in what a color may represent, for the purpose of this thesis, we have selected a set of colors with the meanings which are applicable to North America.

The following is the categorization and basic meaning of different colours applicable to North American culture [30]:

- Cool colors, they tend to have a calming effect. At one end of the spectrum they are considered cold, impersonal, and antiseptics colors, but they are also comforting and nurturing.
- Warm colors, they convey emotions from simple optimism to strong violence. The warmth of red, yellow, pink, or orange can create excitement or even anger.
- Mixed Warm and Cool Colors, they contain attributes from both the warm and cool colors which can calm and excite at the same time. These are colors derived from a mix of a cool and warm color such as blue and red or blue and yellow.
- Neutral colors help to put the focus on the other colors or serve to tone down colors

that might otherwise be overpowering on their own.

Colors and their attributed meaning:

- Cool:
 - Blue - strong, important, peaceful, intelligent
 - Green - growth, health, environment, harmony
- Warm
 - Red - love, passion, heat, joy, power
 - Pink - sweet, nice, romance, playful, delicate
 - Yellow - happy, joy, cheerful, remembrance
 - Gold - riches, extravagance, bright, traditional
 - Orange - energy, warmth change, health
- Mixed
 - Purple - royal, precious, romantic, sacred
 - Lavender - grace, elegance, delicate, feminine
 - Green - growth, health, environment, harmony
 - Turquoise - feminine, sophisticated, retro
 - Beige - conservative, relaxing
- Neutrals
 - Black - conservative, mysterious, sophisticated
 - Gray - formal, conservative, sophisticated
 - Silver - sleek, glamorous, rich
 - White - purity, innocence, softness
 - Ivory - quiet, pleasant, understated elegance
 - Brown - earthiness, wholesomeness, simplicity, friendliness
 - Beige - conservative, relaxing

Specifically applicable to western culture, the colors are also attributed with the following meanings [17]:

- Blue, Red, White and Grey - Stability, Power, Trustworthiness, Conservatism

- Yellow, Brown, Orange, Green - Nature, earthiness, warmth
- Red, Orange, yellow - warmth and energy
- Blues and Aquas - water and coolness
- Primary colors (Red, Blue, Yellow) - Convey fun

2.6 Analysis

As we have seen, extensive work has been done in the field of personalization of web pages; despite the efforts, there are still some problems that need to be addressed as technology moves forward, and more and more users go online. The issue of registration as a must in order to provide personalization, the problem of getting interest and preference information from users by having them fill extensive questionnaires, the problem of data mining for possibly obsolete information, and the ever-growing privacy concerns for personal information, amongst others already mentioned.

In this work, we aim to address some of these problems with the following techniques:

- An architecture for providing personalization without the need for user registration. As it is stated earlier, customers find the registration process restrictive, and many customers are driven away from pages because they require the customer to register in order to use their services. Our approach allows for non-registration; however companies can request registration for more privileged tasks.
- The approach of using the concept of product personality (see section 2.2) as a factor for user profiling. Although the history of user-product interaction being used for user profiling is not new, just using the product's attributes such as price, category, description, etc is not sufficient to represent a user. With the concept of product personality, where a product is viewed to have human personality traits, a customer personality profile can be determined.
- Using the personality of a customer for providing personalization. Thus far, customer personality has only been considered in marketing research and consumer behaviour studies, and has been found to be a valuable tool for targeted adaptation of product

design; but it is yet to be explored in the field of e-Commerce where the growth of usage is progressing each day.

- Coupling the system with a privacy protocol (see section 2.4) to provide security of private information for customers; addressing the growing concern for privacy of information.

With this in mind, let us have a look at the design of the proposed system next.

Chapter 3

System Design

3.1 Product Categorization Model

The brand personality model [1] defined by Aaker is specifically for use in marketing for product-brand imaging. But a particular brand may also have different types of products that are packaged with different audiences in mind. In marketing, products are not only developed to represent an image through their brand, but also through the product itself. As Govers [20] suggests, it would be overlooking the products if we only see them through their brands; secondly, every product can be described by human personality attributes; therefore there was the need to develop a model that would house both the human personality categorization and brand personality to be used for categorizing product personalities.

Based on both the five factor model [34] for human personality and Aaker's model [1] for brand personality, we have defined five different types of personality traits for categorizing products, each one with a small set of descriptive adjectives that are representative of each category.

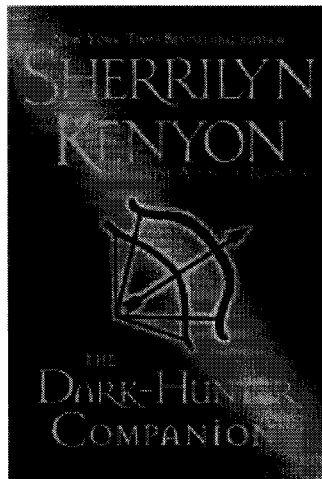
Product personality categorization model:

- Type1: Colourful, honest, cheerful, wholesome, warm
- Type2: Spirited, daring, exciting, active, bold, adventurous
- Type3: Mysterious, tough, dark, emotional
- Type4: Intellectual, factual, reliable, dependable.
- Type5: Sophisticated, romantic, beautiful, affectionate

This model will be used to categorize the products based on the product's set of attributes, namely color, shape, style, brand, intended use, category and design. Unlike the five factor model and [1], no name is explicitly attributed to each category type; instead

each category is simply identified by its type number, and the adjectives define each. Furthermore, the applicability and effectiveness of this model will be determined by the results of the tests, as part of the objectives of this thesis.

In order to show how a product can be categorized, consider this example: The following two products (Figure 7 and Figure 8) are both books under the book category of “Romance”, however in the product personality categorization they would fall under different types; in this case we take into consideration the book cover design, the colours used, the story, and the setting in which the story develops.

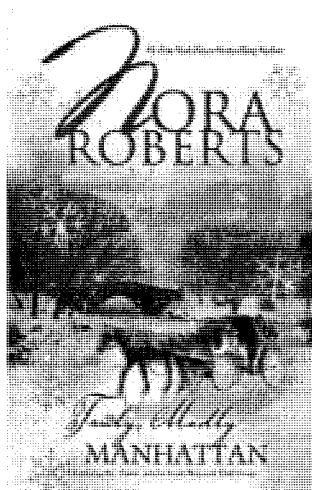


Type 3

It is a Dark-Hunter vampire novel.

The book is of fiction and mystery. A dark, mystical setting is the stage for the story. The book design is primarily to give the feel of mystery. Black and red is used in significance to dark night and bloodshed mainly because the story is about a vampire hunter.

Figure 7. Example: A book of Type3



Type 5

It is a Romantic novel.

The book is pure romance and love.

The stage of the story is in Manhattan New York in the middle of winter and the holiday season, where snowfall makes for an even more romantic setting. The book design is of a snowy horse-carriage and a blend of light transparent purple that give the feel of romance, fitting for a romance novel.

Figure 8. Example: A book of Type5

In the above manner, other products can also be categorized into one of the five types of personalities defined for products.

3.2 Determining a customer's personality

Based on the idea presented in [1][20][48] that there is correlation between product personality and the owner's personality, we can categorize the products of an e-Commerce store into the five product personality types, and we can induce by attribution that a customer's personality can be determined by his/her interests in specific products; meaning that the product's personality of the products the customer favours can be the self-perceived personality of the customer; and hence use this information to provide personalization.

There are different ways in which a customer will interact with products in an online store: viewing the product, searching for a specific product, adding or removing the product to the shopping cart, and purchasing a product. Based on this list of possible interactions, we have developed a point system in which each different interaction is attributed a number of points which is a weight attributed based on the personality of the product and will help determine the personality of the customer.

The points are attributed in the following manner:

- Viewing a product: +1pt
- Viewing a product that was searched for: +2pt
- Adding a product to the shopping cart: +1pt
- Removing the product from the shopping cart: -1pt
- Purchasing the product: +2pt

Each customer profile will have a score associated to each of the five personality types; each time the customer interacts with a product, the points pertaining to that interaction is added to the corresponding personality score that matches that of the product personality. Then the personality of the customer would be the type with the highest score in the customer's profile. In the event that the scores tie, then the first in line of the tied scores will be selected as the governing personality of the customer. Figure 9 shows a flow

chart of the personality determination procedure described.

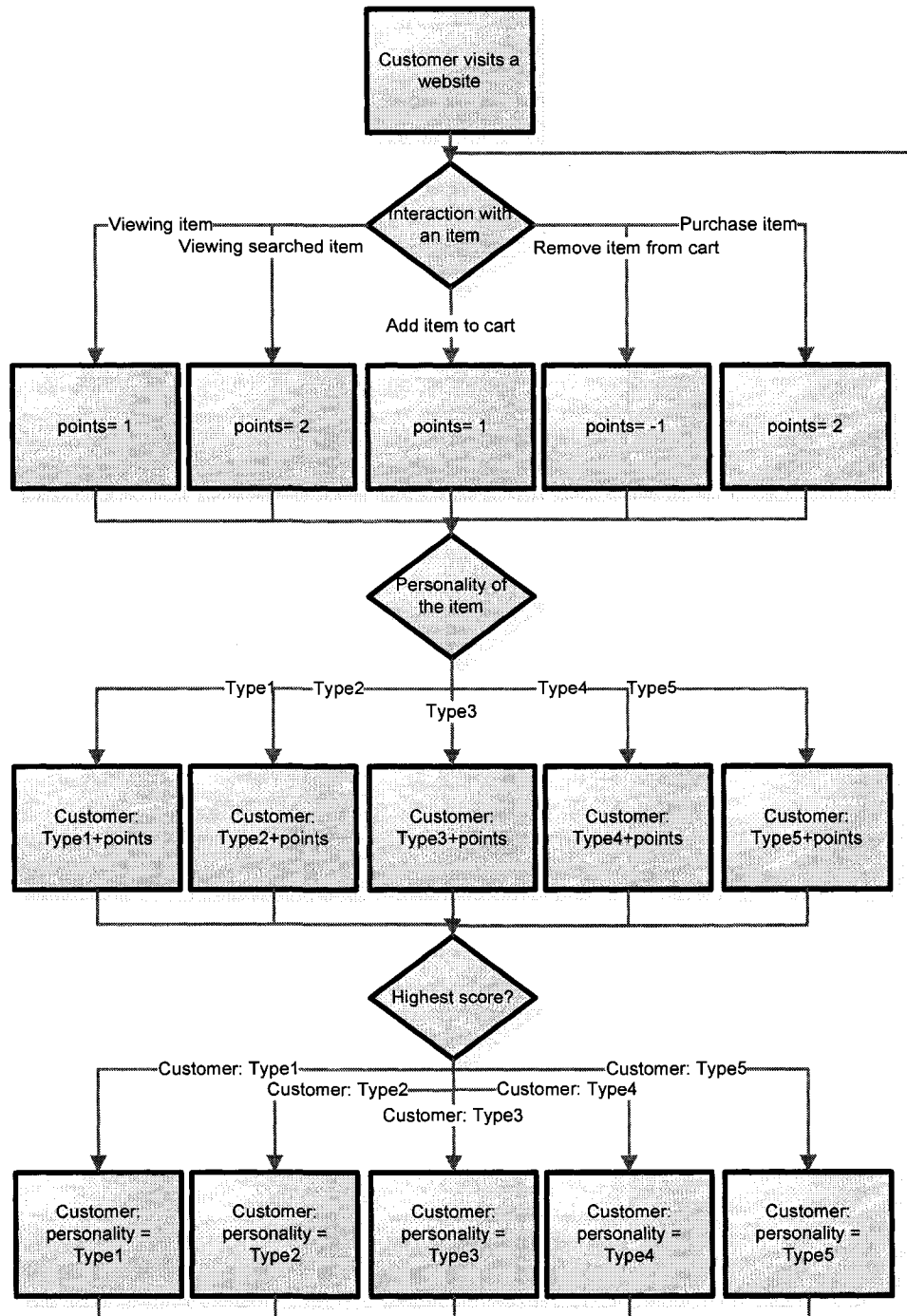


Figure 9. Flow chart for determining customer personality based on product interaction

The selection of the weight or points attributed to each interaction was determined in the above manner for the reasoning that customers are most likely to just browse through

a website's products for much longer than purchasing. Searching for a product is attributed with higher weight because it is more likely for a customer to be searching for an item of interest. Although it may seem that the weight for purchasing a product is small, when a purchased product would be most representative of an interested customer; we did not assign a more considerable weight to the purchasing interaction, since we determined that a customer will already have the weight of viewing the product (+1 or +2 if the product was searched for), adding the product to the cart (+1) and ultimately purchasing (+2) which results in a total of +4 points for interaction with this particular product. Hence, for a customer to purchase a product, it is not just a 2 point weight, but actually 4 points.

3.3 Providing personalization without the need for registration

The need for registration in order to provide personalization is due to facilitate tracking and identifying the customer. In addition, it reduces the amount of information that is being stored; if a customer does not register, this person's information does not need to be stored in the servers, hence saving storage space. Today; however, most e-businesses have large storage servers, and many of them continuously save logs and customer information in their databases and data warehouses which are later used in combination with data mining applications (see section 2.5.2) to extract useful information. Therefore we can assume that storage is not an issue.

There are two scenarios to consider: 1) It is a new customer visiting the website, and 2) It is a returning customer. In the latter case, the customer may or may not be registered to the website.

We will use cookies for the identification of customers. When a customer first visits the website, a random-generated unique identifier (UID) is created for the customer and stored in a cookie in the customer's computer. This UID is also used as the identifier to store the customer interaction information and profile information in the server database. Then, when a customer returns to the website; first, the system will try to identify the customer by retrieving the cookie, if the cookie is found, then the UID from the cookie is used to retrieve the information from the server, and the personalization settings will take

place. In the event that the cookie is not found, the customer will be treated as a new customer, and a new UID will be assigned to him/her. This will be the case for handling anonymous customers - those who are not registered.

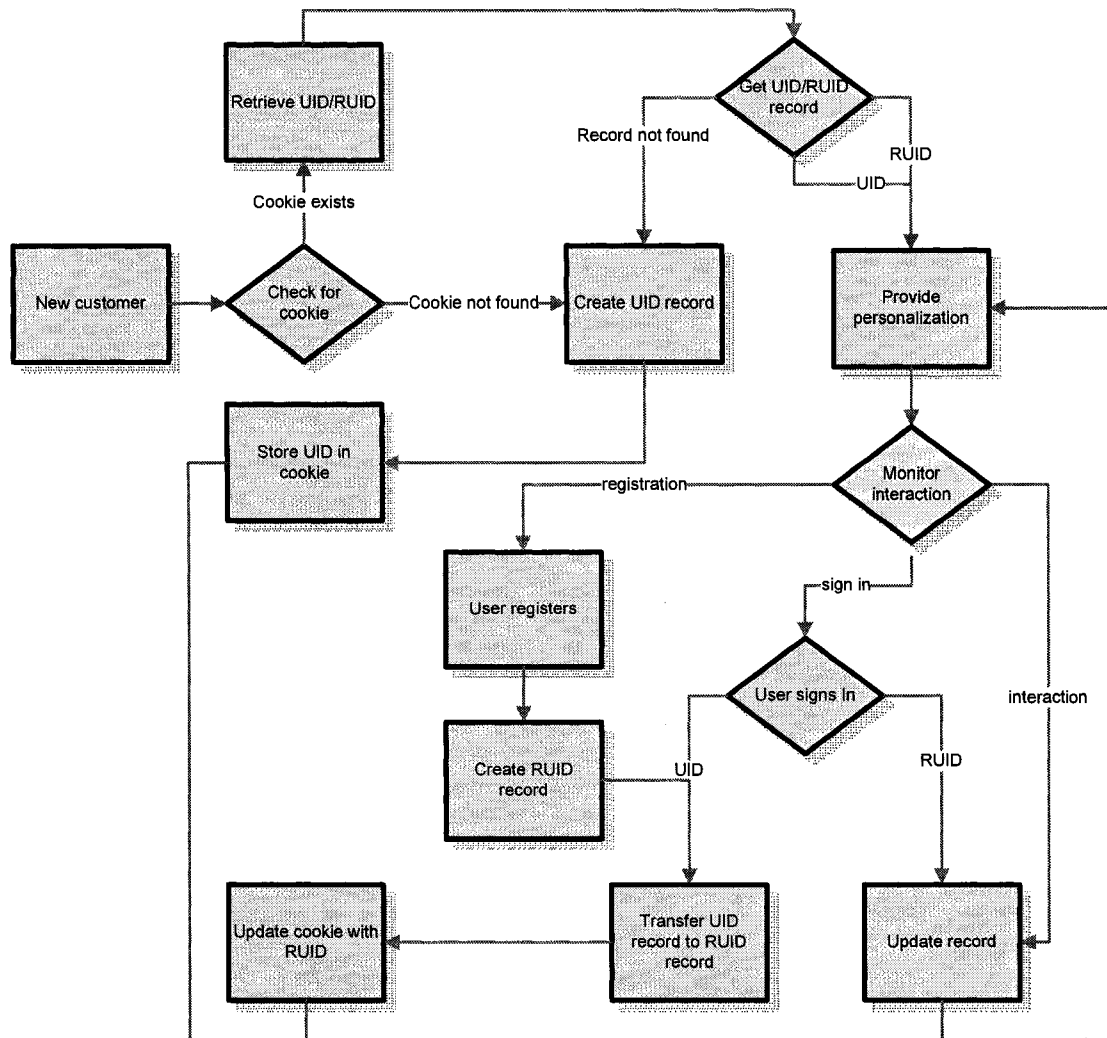


Figure 10. Flow chart for the user identification process

For registered customers, the registered user identifier (RUID) is different from the UID used for anonymous customers. In the same way as for anonymous customers, when a registered customer returns to the website, the system will attempt to retrieve the RUID from the cookie in order to retrieve the customer's record in the server. In the event that the cookie is not found, the customer is treated as an anonymous customer and a UID record is

created for the customer until he/she signs into his/her account. Once the customer signs in, then in the authentication process, the RUID record of the customer will be updated with the information of the UID record, and the latter will be discarded. In the same way, for new customers, they will be assigned a UID record until they register and sign in, then a RUID record will be created for them and the information from the UID record will be transferred, then the UID record is discarded. Figure 10 shows the flow chart for the user identification process.

Although it is mentioned that storage space is not a concern, storing large amounts of information would eventually pose as a problem; therefore, to free some space, records of anonymous profiles that are older than 3 months are removed from the server storage. This timeframe for deleting anonymous record can be configured depending on the website.

Chapter 4

Prototype Design and Implementation

An online bookstore was developed and implemented with the features described in the previous chapter in order to determine the performance and acceptance of a system that would provide personalization based on product personality.

4.1 System Architecture

The system architecture follows the most widely used structure of building e-Commerce websites. It uses a 3-tier architecture where there are the web pages in the presentation layer, the business logic, and the data access layer. The following diagram (Figure 11) shows a general view of the 3-tier architecture used:

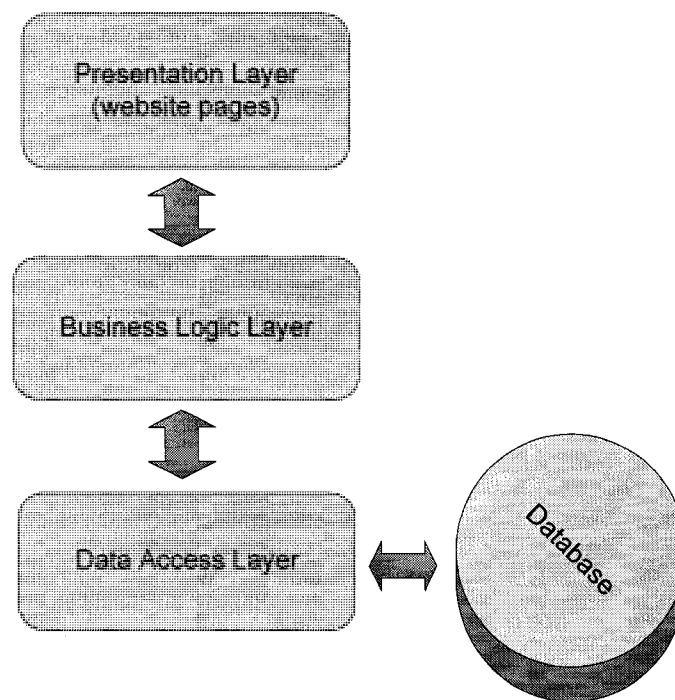


Figure 11. Three-tier architecture

Due to changes in inventory and/or product information, and changes in the database of products, the system makes use of dynamic web page generation, meaning that the web pages presented to the user are created on the fly; which is the case with most websites that provide personalization.

4.2 Prototype Design

4.2.1 The bookstore

The system is a bookstore, where a set of 534 books are included in the database of products. Each book is categorized into a personality type, and this information is also stored in the database as part of the book information.

The web pages are data driven pages that are built on the fly as the customer browses through the website. Like most e-Commerce websites, the bookstore has a shopping cart in which the customer can place items they intend to purchase; an account page where the customer can modify their personal information (although in the proposed approach registration is not necessary for personalization, it is needed for purchasing products, since personal information would need to be verified, such as name, shipping address and payment information, therefore an account page is provided); a checkout process where the customer makes the purchases; a sign in/out option; and a theme selection page where the customer can select the layout they prefer the most without having to register. The website presents a list of books as a “daily pick” for the customer in the website welcome page; this list of books changes based on the personality profile of the customer; a default list is also presented in the event that the customer personality profile is not existent at the time.

Because the emphasis of the thesis is on the effectiveness of providing a comfortable environment to the customer, the list of books that are presented to the customer in the welcome page (as shown in Figure 12) is selected as the first 10 books returned by the database query regarding a particular personality. Hence, the system’s daily pick for different customers with the same personality will not vary.

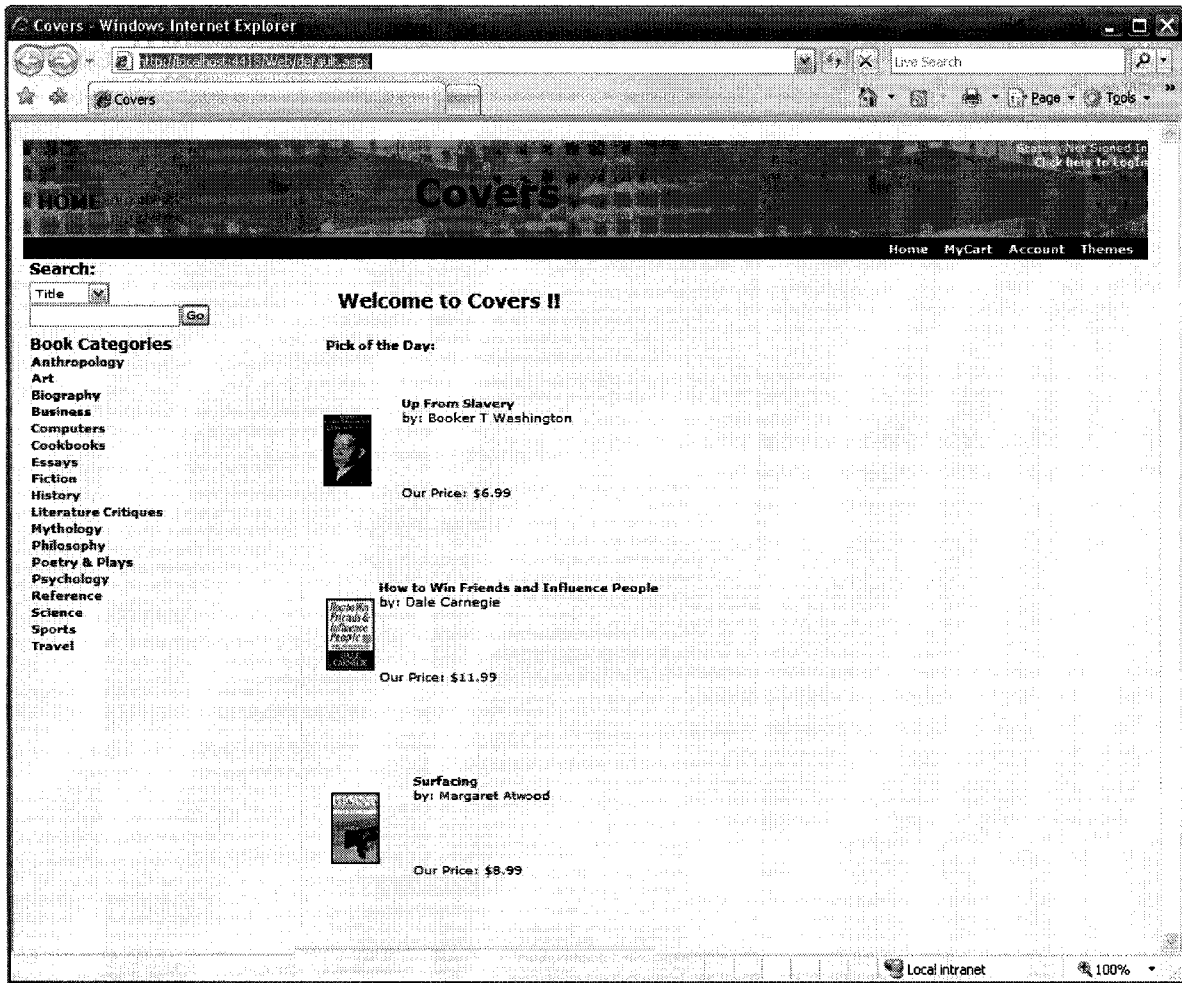


Figure 12. The bookstore welcome page

There are six layouts made available to the customer (see Figures 13, 14, 15, 16, 17 and 18), five of them corresponding to each of the five personality types defined in section 3.1, and the sixth is the default layout presented to the customer in the event that no personality profile is existent at the time. These six layouts are used as the personalization aspect of the website to determine if in fact the interaction of the customer with a set of books show correspondence to the resulting layout presented.

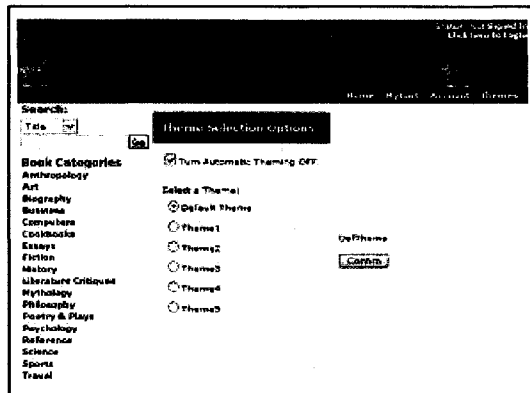


Figure 1. Default layout

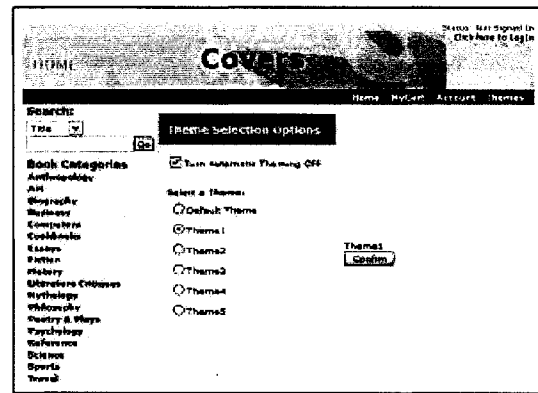


Figure 2. Personality type1 layout

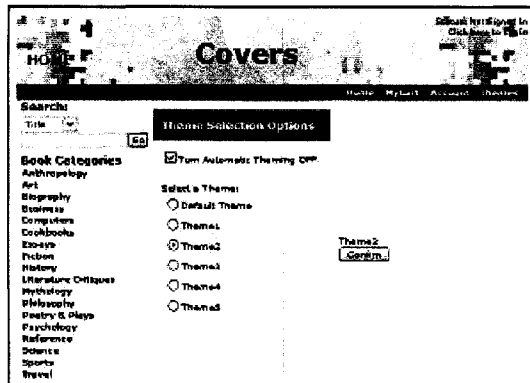


Figure 3. Personality type2 layout



Figure 4. Personality type3 layout

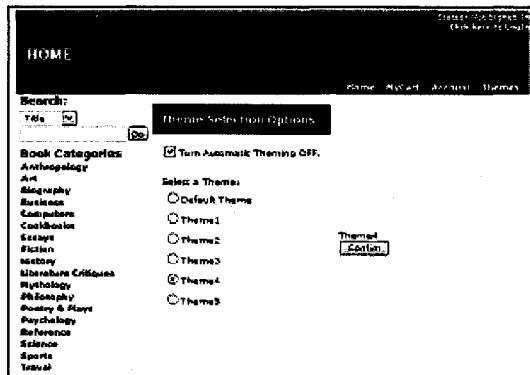


Figure 5. Personality type4 layout

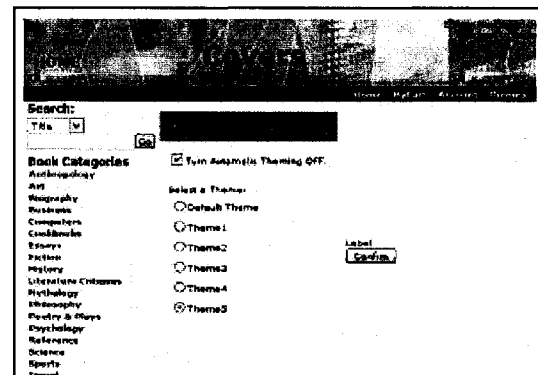


Figure 6. Personality type5 layout

The color scheme and design of the layouts are made based on the information gathered on the meaning and significance of colors (see section 2.5.4), in relation to the personality type description. For a personality of type1 (Figure 14) which is cheerful, colourful, honest, warm, we chose colors that would represent these meanings: yellow,

orange, green and blue, lively colours. In a similar way for a personality of type5 (Figure 18), the colors selected: lavender, pink, ivory, blue; were used in combination to provide that meaning of sophistication, romanticism, feminine and affectionate feeling. Each layout and color scheme was designed by selecting colors with meaning that would coincide with each personality type defined; therefore for a mysterious, tough, dark, emotional type3 personality the colours used were black, grey, dark red, dark green (Figure 16).

4.2.1 Database Design

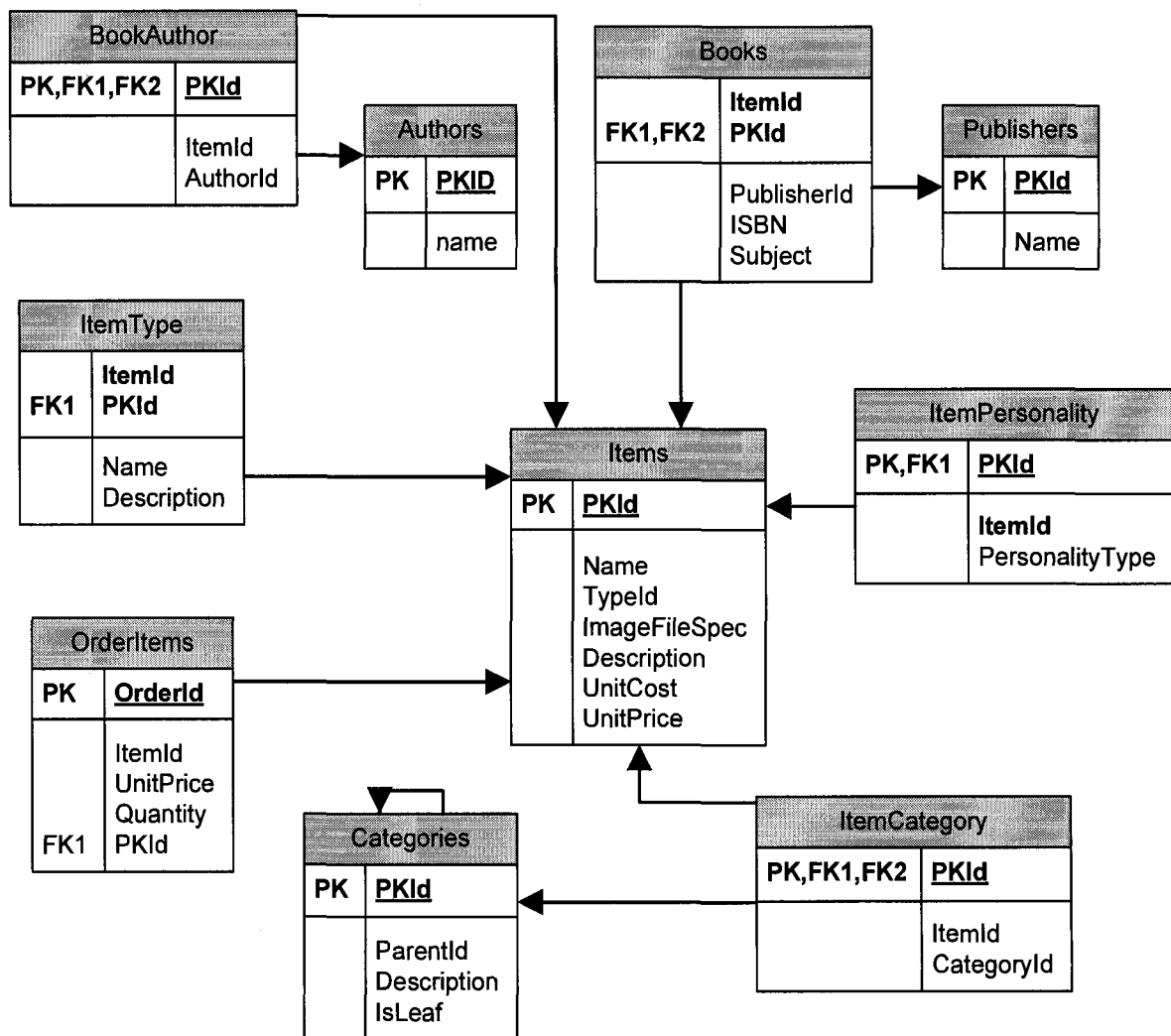


Figure 19. Database design for books

In order to make the website as realistic as possible, a considerable amount of books was necessary, each with a set of attributes that would need to be categorized for access, like price, author(s), book information, display image, title, and so on. A set of 534 books was used, and the storage of information for them in the database was designed as shown in the Figure 19.

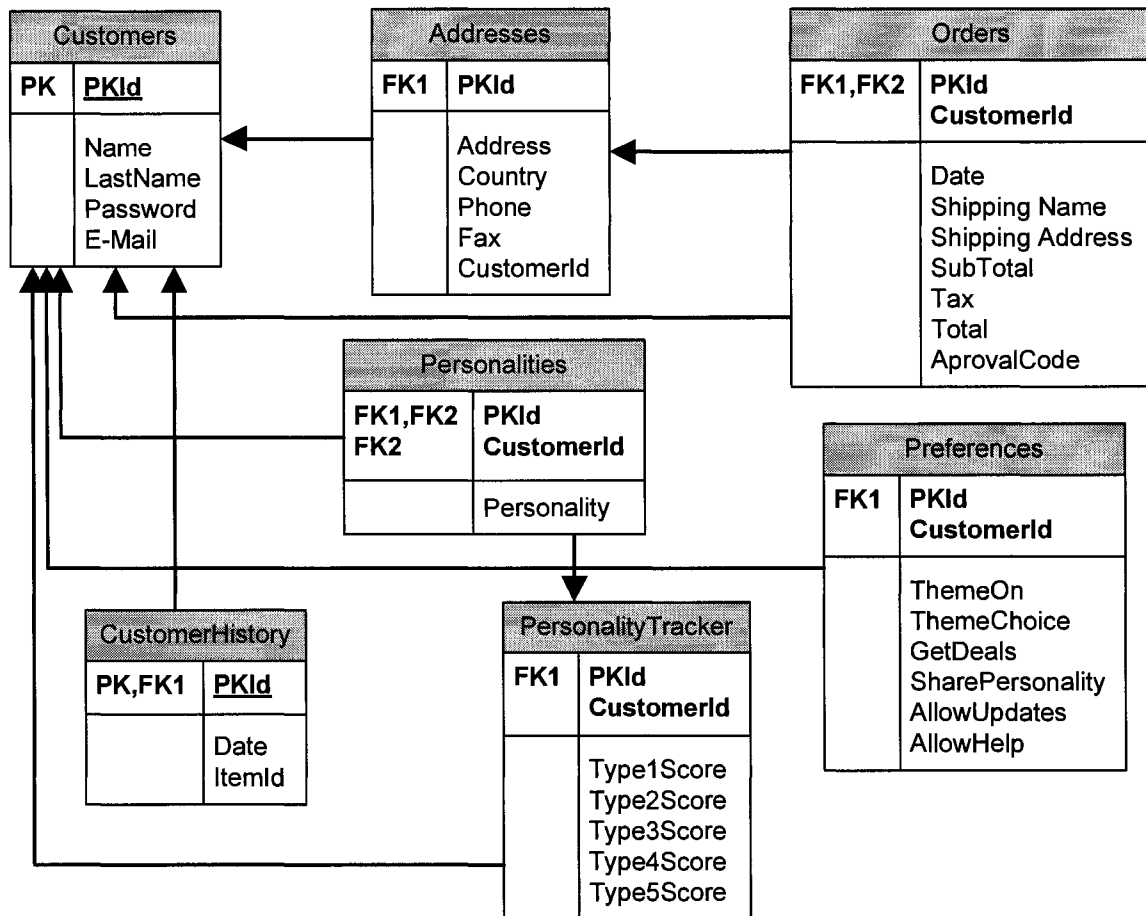


Figure 20. Database design for customer information

In the same manner, customer information was stored in the database as well, and the type of information store needed also to be easily accessible in order to enhance performance. For the customer there was the following information that needed to be considered in the design of their storage: customer demographic information such as name, address, phone, etc; customer personality profile information; customer login information;

customer purchase information; and the customer interaction history. Figure 20 shows the data table design and relationships for storing the customer information in the database.

4.2.2 System behaviour

The idea behind the implementation of the bookstore is to dynamically provide a change in the environment that would fit the customer's personality determined by his/her interaction with the items, resulting in a more comfortable environment for the customer to shop in. Therefore, the system will monitor the interaction behaviour of the customer with the different items in the store, log this information, and in real time update the customer profile, and make changes to the website environment that the customer is in as he/she continues to browse around the website.

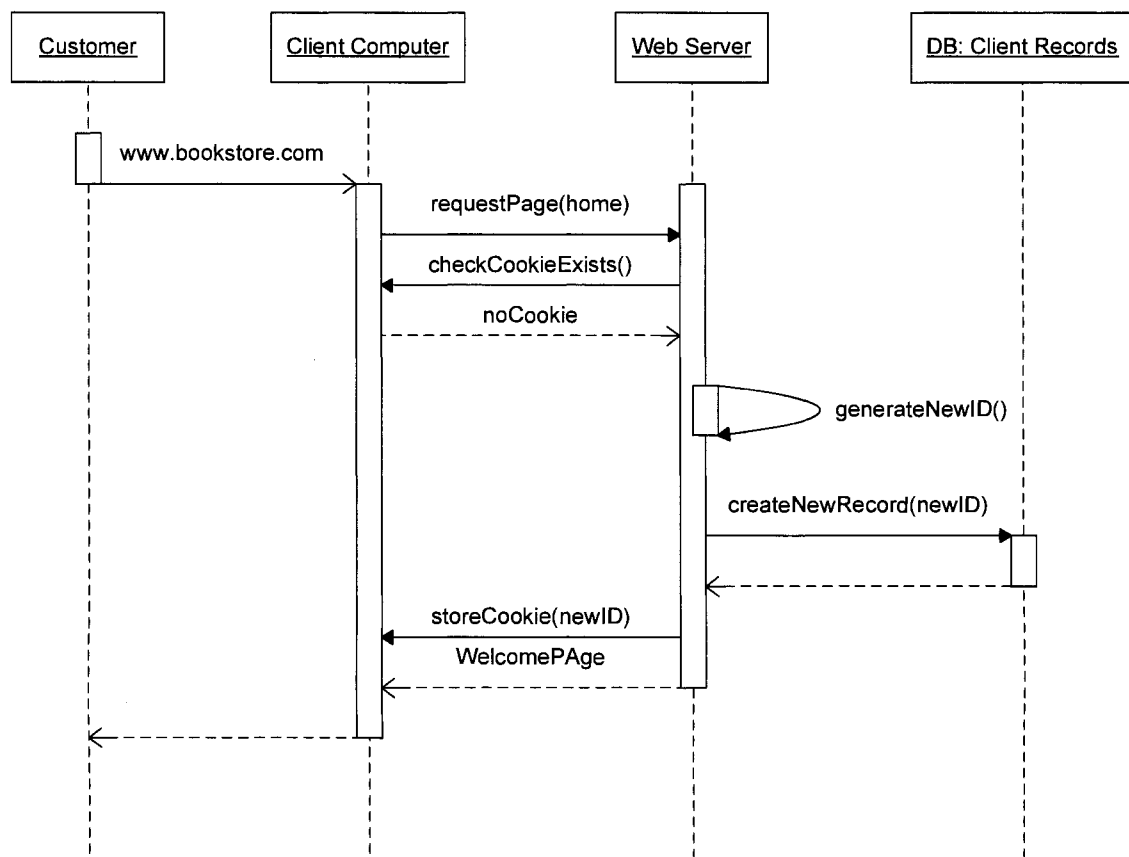


Figure 21. Sequence diagram of a new customer visiting the page

We have described in section 3.3 how the system can provide personalization to customers without the need for them to register. In our implementation, personalization is provided based on the history of customer interaction with the products; in the event of a returning customer, the system will proceed with retrieving the customer history, and setting the personalization aspects once the customer has come into the website (sequence diagram shown in Figure 22). However, in the event that it is a new customer, no history is available; in this case a new profile is created for this customer, and the personalization aspects will use the default set initially, until the customer starts interacting with the products of interest (see sequence diagram in Figure 21).

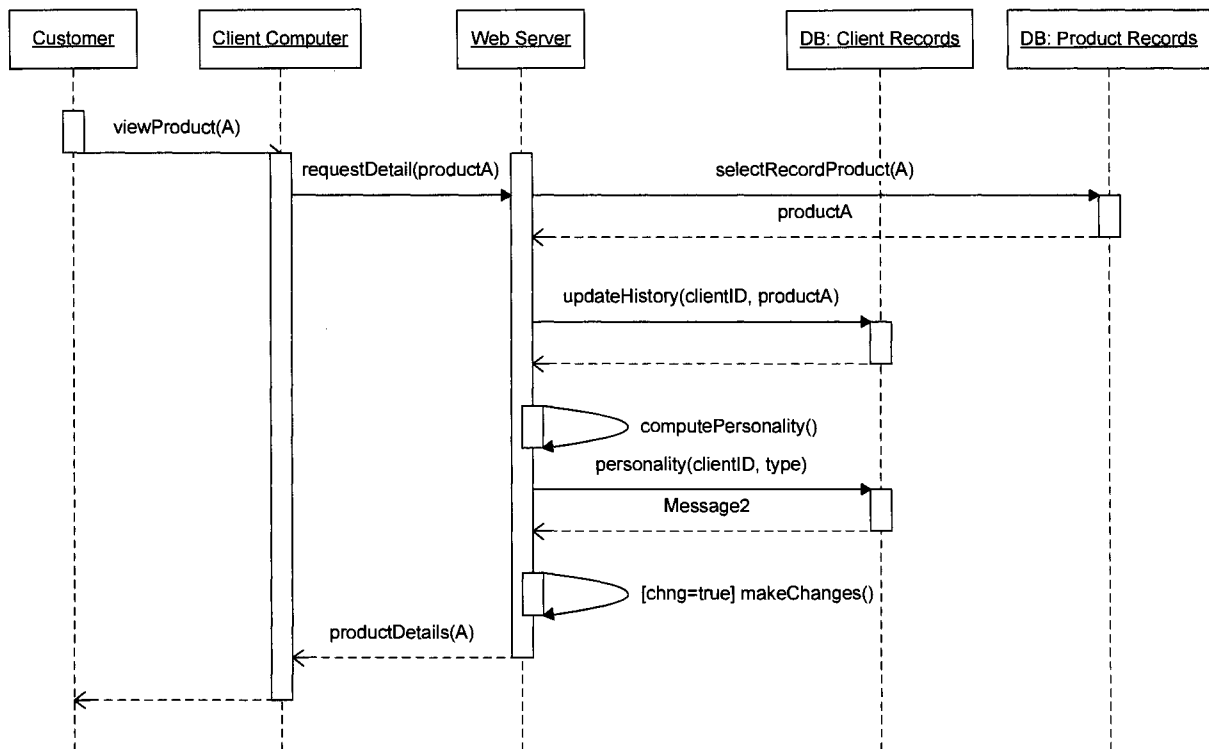


Figure 22. Sequence diagram of a customer interaction with a product

Each time the customer makes an interaction with a product, the information is sent to the server, where the interaction points are added to the customer's personality score holder. The score for each type is updated, and the personality type with the highest score is set as the governing personality of the customer; if the governing personality type has

changed, then the personalization aspects of the website are modified to reflect the changes.

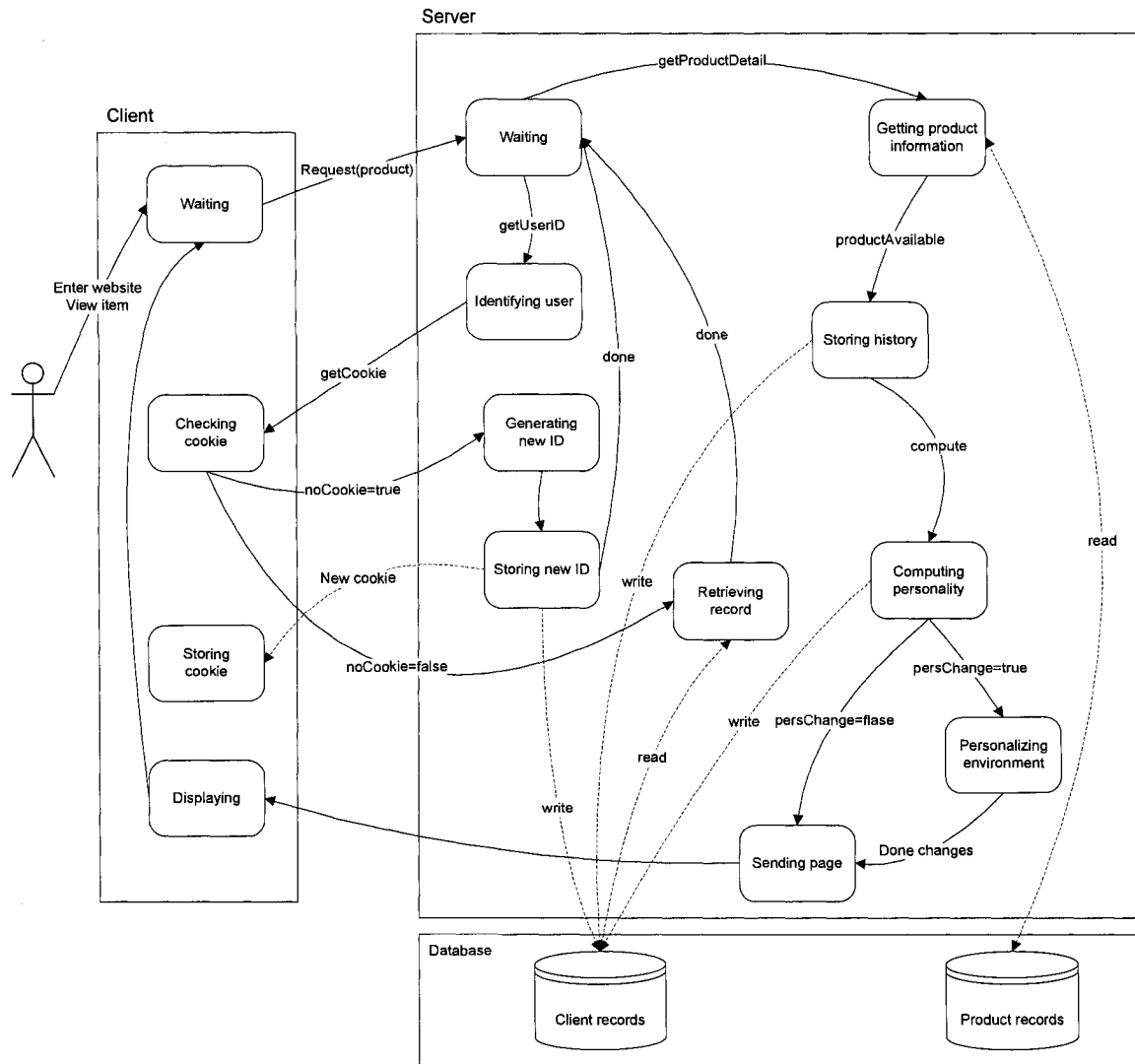


Figure 23. Interaction diagram of the system

The system is implemented using ASP.NET technologies. There are many web programming languages and tools available for implementing data driven web pages, such as ASP, ASP.NET, ColdFusion, JSP, and others. But the decision to use ASP.NET is due to the fairly easy to use Integrated Development Environment (IDE) that Microsoft Visual Studio.NET 2005 provides. Another reason is that there is a community that already makes use of ASP.NET and there seems to be a trend on it becoming widely used for e-Commerce websites, some popular website like mySpace.com, dell.com, and monster.com are using it

as their development environment. Also guidelines, tutorials, support and books on its usage are readily available and accessible. Figure 23 shows the overall behaviour of the system.

The database used for storage of information is Microsoft SQL Server 2005. An express version of this server is installed with the Visual Studio.NET suite; however, we make use of the full version, since it gives more control over the data as well as database management.

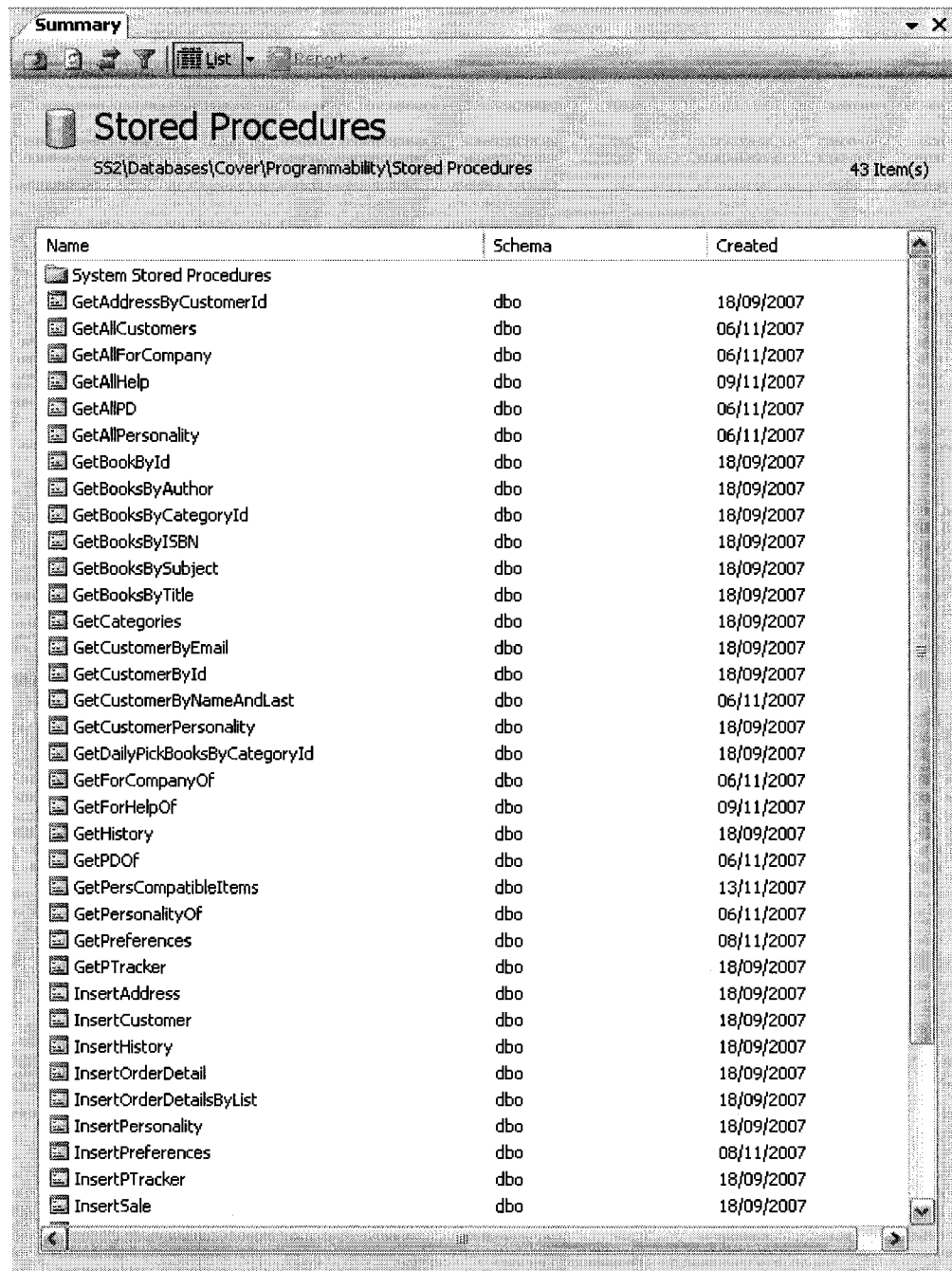
As it was mentioned earlier, the architecture used is the 3-tier architecture. In the data access layer is all the code used for querying the database for both the product information and the customer's records. Most of the queries are stored as SQL procedures in the database (shown in Figure 24), which are called with parameters depending on the type of information requested. In the business logic layer, we check of customer information entries, correctness of email address syntax, phone number syntax, and other information correctness that is needed before data is stored into the database or returned to the customer. The presentation layer is where the personalization is housed; the pages are built on the fly as information is retrieved from the database concerning the page requested as well as the customer's personality profile.

For coding the web pages, HTML and ASP.NET were use for the presentation and design, and C# was used as the processing code to communicate with the server. Using this code-behind technique makes for cleaner code, and more easy to trace when debugging.

Although ASP.NET provides a tool for user profiling that can be customized to store the profile data that each developer desires, we did not make use of the tool because the profile information that it can store is limited, and we would have to adjust the database retrieval code to handle both the product retrieval structure and the customer records in the ASP.NET style, and that would become too complicated. Instead we used our own implementation and data access with the SQL server to keep track of user profiles and data; and made use of ADO.NET technology to establish the communication between the web pages and the SQL database.

The client side of the system implementation was done using cookies to store the customer's UID/RUID on the client computer, and Javascript scripting language to code

some client side functionalities, like form-field validation, in order to lessen the load on the server. And for the design of the website layout and design of the web pages, cascading style sheets (CSS) in combination with skins of ASP.NET were used to define the different sets of layouts corresponding to each personality type described in section 3.1.



Name	Schema	Created
System Stored Procedures		
GetAddressByCustomerId	dbo	18/09/2007
GetAllCustomers	dbo	06/11/2007
GetAllForCompany	dbo	06/11/2007
GetAllHelp	dbo	09/11/2007
GetAllPD	dbo	06/11/2007
GetAllPersonality	dbo	06/11/2007
GetBookById	dbo	18/09/2007
GetBooksByAuthor	dbo	18/09/2007
GetBooksByCategoryId	dbo	18/09/2007
GetBooksByISBN	dbo	18/09/2007
GetBooksBySubject	dbo	18/09/2007
GetBooksByTitle	dbo	18/09/2007
GetCategories	dbo	18/09/2007
GetCustomerByEmail	dbo	18/09/2007
GetCustomerById	dbo	18/09/2007
GetCustomerByNameAndLast	dbo	06/11/2007
GetCustomerPersonality	dbo	18/09/2007
GetDailyPickBooksByCategoryId	dbo	18/09/2007
GetForCompanyOf	dbo	06/11/2007
GetForHelpOf	dbo	09/11/2007
GetHistory	dbo	18/09/2007
GetPDOf	dbo	06/11/2007
GetPersCompatibleItems	dbo	13/11/2007
GetPersonalityOf	dbo	06/11/2007
GetPreferences	dbo	08/11/2007
GetPTracker	dbo	18/09/2007
InsertAddress	dbo	18/09/2007
InsertCustomer	dbo	18/09/2007
InsertHistory	dbo	18/09/2007
InsertOrderDetail	dbo	18/09/2007
InsertOrderDetailsByList	dbo	18/09/2007
InsertPersonality	dbo	18/09/2007
InsertPreferences	dbo	08/11/2007
InsertPTracker	dbo	18/09/2007
InsertSale	dbo	18/09/2007

Figure 24. List of stored procedures created for data access

4.2.3 Integration with the Privacy Control Component (PCC)

The Pluto protocol (see section 2.4) was used as the privacy protocol for information exchange between the bookstores. As the protocol describes, a privacy control component (PCC) is introduced into the community of entities interested in data exchange as the moderator. The PCC has a repository of permissions that govern the data exchange, and the address or location of each entity on the network. The PCC is also in charge of generating the tickets with the permission information for each entity that requests to communicate with others, this ticket is what establishes the communication link between two entities, and it also contains the permission information of the requester so that the requested party can use to filter the data that can be disclosed.

As it has been mentioned, the integration with the privacy component is done to address the privacy of information concerns of customers. This protocol was chosen because it is designed for use in privacy of data exchange for and across communities, which in our case is a bookstore community. Second, the integration with this particular protocol was done as part of a bigger e-Commerce project with IBM.

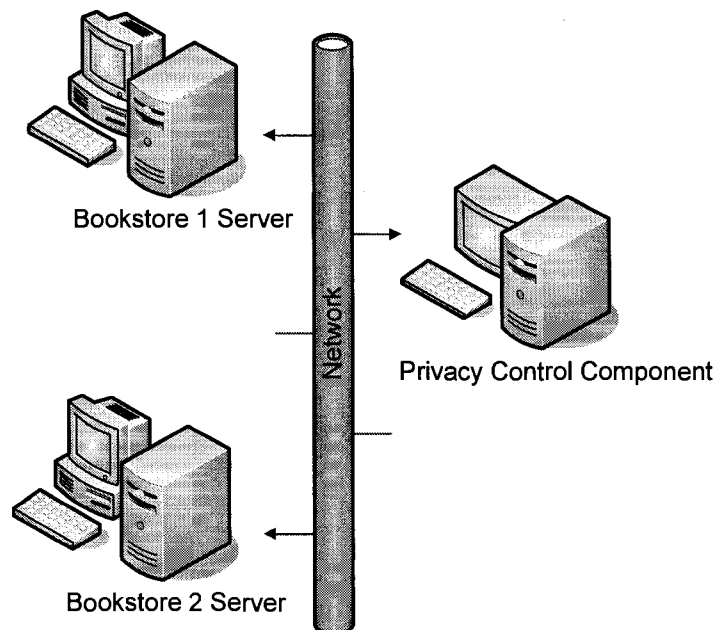


Figure 25. Bookstores and Privacy Control Component networked.

For the integration with the Privacy Control Component (PCC) two bookstores were

used as the stores that would request customer information from each other with the permissions granted by the PCC. All three systems are connected to a local area network (LAN) as seen in Figure 25.

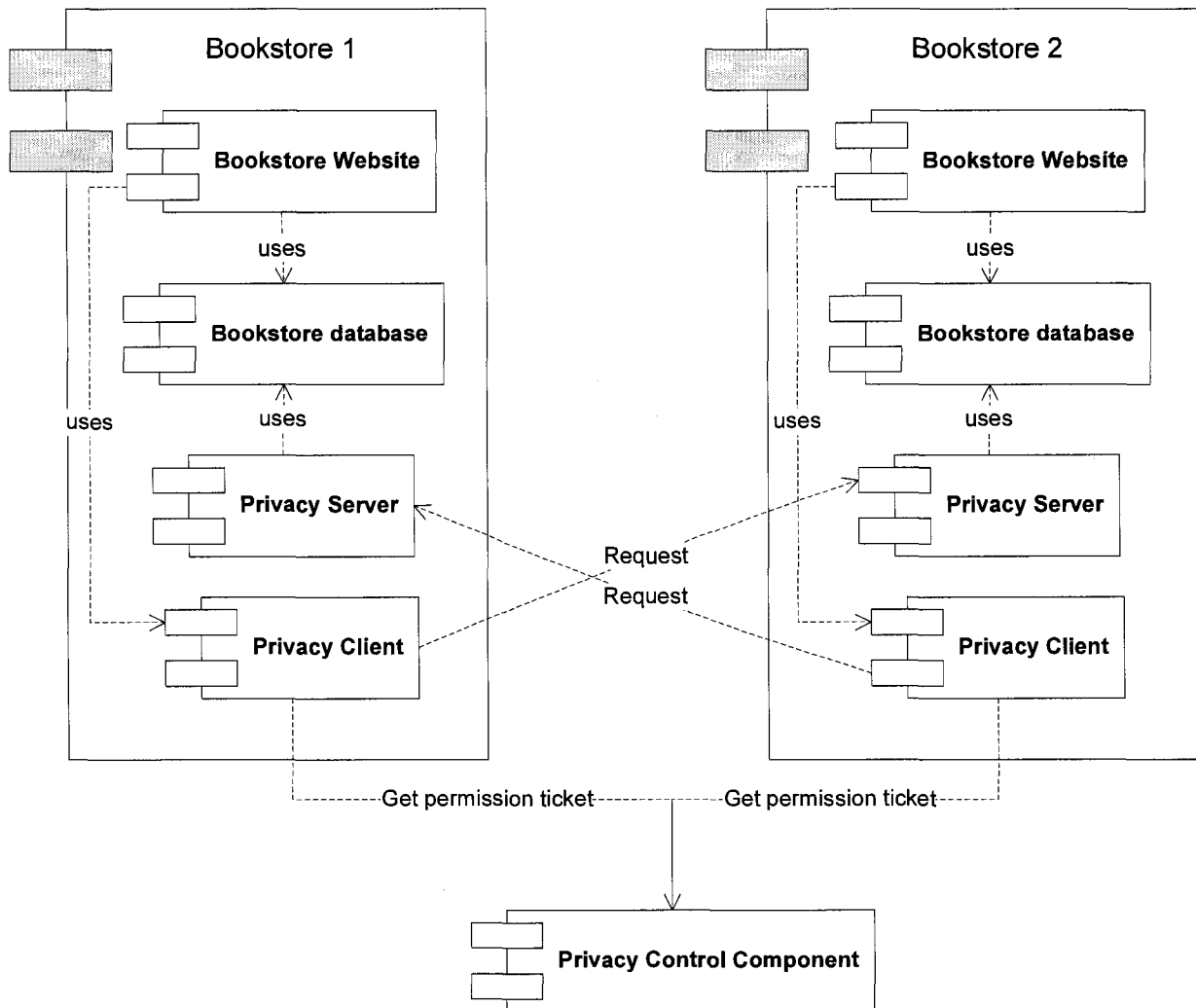


Figure 26. Component diagram of the two bookstores and the privacy control component

Using the Pluto protocol (see section 2.4) the two bookstores communicate with each other for queries about customer information. However, they first need to register with the third party PCC who will issue a ticket with the granted permissions and the network address of the store they would like to communicate with. Each bookstore will have a *privacy client* which is used to make the ticket requests to the PCC, and connect to the other bookstore once the ticket is granted. They will also have a *privacy server* which will be in

charge of authenticating the ticket information and permissions, and if the permissions are granted, then exchange the information that the other store is requesting. The Figure 26 below shows the interaction between the components of the bookstores and the PCC.

The privacy client is incorporated with the bookstore system as an integrated component. However, the privacy server is kept as a separate component with its own interface and only handles the information requests regarding permission sensitive information. This way the load on the web server is lessened, and kept purposely for serving customer requests to the website.

The overall system would look as follows: Figure 27 shows the bookstore communication through the Pluto protocol, and ticket requests made to the PCC. And in Figure 28, the overview of the system setup is shown.

Each bookstore would register with the PCC, a set of permission information was also defined for each store, in order for the stores to communicate with each other regarding requests. Secondly, according to the design of the Pluto protocol (see section 2.4), the set of permission would be the set of rules that each bookstore would use in order to filter the information that can or cannot be accessed and/or exchanged.

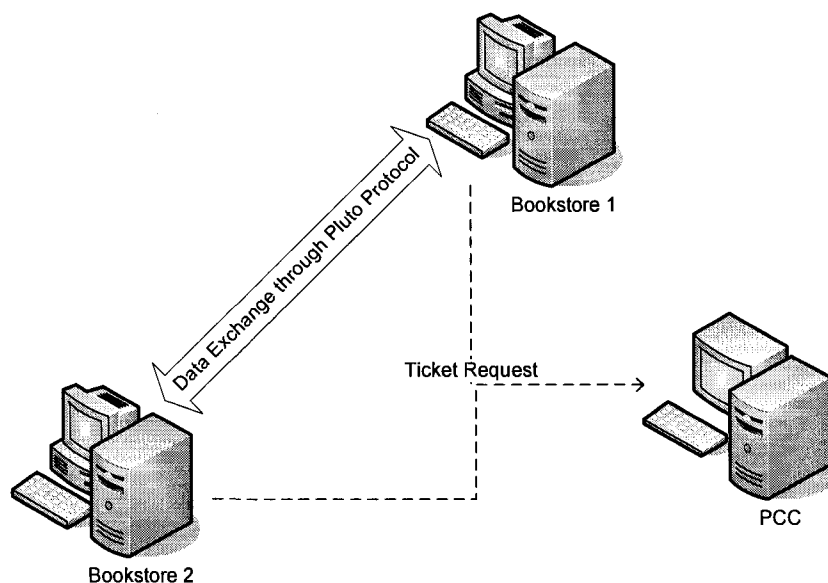


Figure 27. System Interaction

There were four scenarios defined for the possible data permissions and requests:

1) A bookstore can be a *deal giver*. In this case, a store may request the list of customer emails of another store to send them a particular deal that they have to offer at the time.

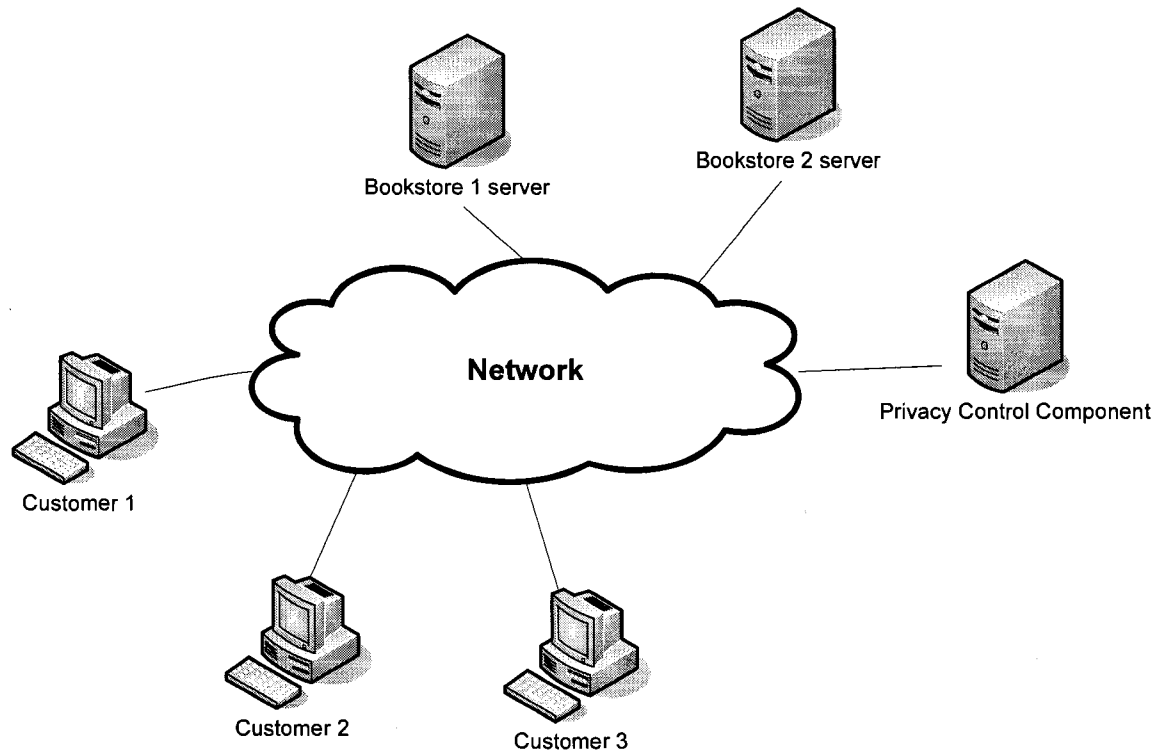


Figure 28. System setup

2) The bookstore could also be a personalization providing website that uses a similar mechanism as the store who they may request customer information from. The defined role for this scenario would be *personalization provider*. This permission is used when a customer registers at the new store, and this store would request information from other stores in the community for information about this customer for personalization purposes.

3) A bookstore is also defined to have a *client helper* role where when a customer enters the registrations page, if they have an account in another store and have given the permissions to access their information; then this new bookstore at which they are at can make a request for the client information to aid in the form filling process (which is many

cases are quite extensive).

4) A company merge. A permission called *company* which can be used to request client information in the event that there is a company merge. Usually when merges happen, customer information may still be kept confidential within the one store and not shared with the merging party; this all depends on the company privacy policy. But in our case, regardless of the company policy, if the client expressed that they would not like to share their information in that regard, then when the information request is made for this scenario, the system being queried will not release the information.

Admin Page for PCC requests.

Requester's Details:

client name: Covers

client passwd: covers

server name: Bookstore

Get Ticket and Connect

Connection Status:

Search Criteria:

☒ All Records

☐ by Customer Name

Send

Msg:

returned DataSet:

Figure 29. Administrator page

Each bookstore system is designed to have an administrator page (see Figure 29) where each of the four scenarios can be tested. Moreover, scenarios 2 and 3 are also included in the system test as part of the registration page, where it aids the user in the filling of the forms (further discussed in chapter 5).

The permissions are defined in the PCC as part of the setup (see Figure 30).

Information about the bookstores are also stored in the PCC such as the network address, the application name, the password or key used to encrypt the messages sent in the tickets, each store's permissions, and each store's role.

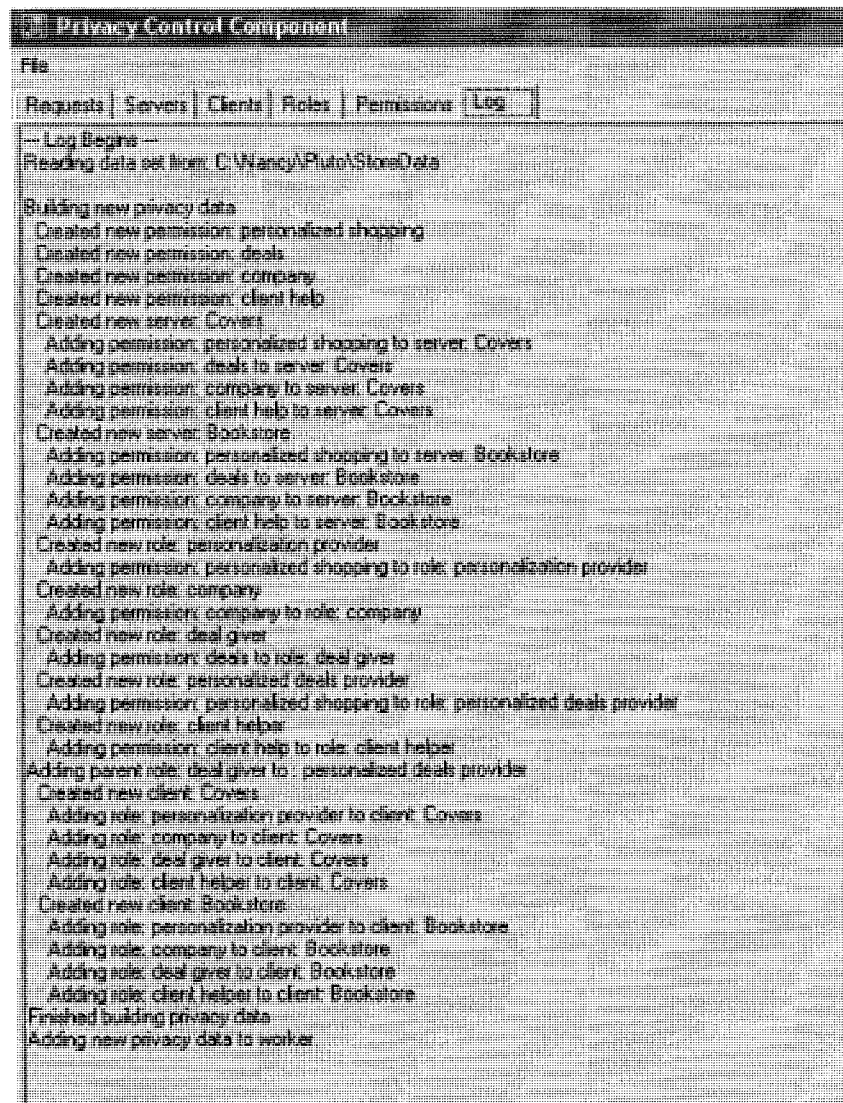


Figure 30. Permissions and roles in the PCC

Chapter 5

Performance Evaluation

In this thesis, the implementation of the bookstore system is the test bed for determining the applicability of using product personality as the determinant factor of a customer's personality and hence aid in providing better service in a website that provides personalization services. We also explore the satisfaction of customers in terms of privacy of information by coupling the system with a privacy component and the Pluto protocol (described in section 2.4) to control the information exchange privileges of the different bookstores.

The testing of the system was designed in order to determine the following:

- Is the system consistent in determining the user personality based on the product personality categorization model?
- Does the environment play a part in the user's comfort level in a website?
- Does the environment play a part in the user's interest in a website?
- Importance of personalization with no need for registration?
- Importance of having control of ones personal information?
- Importance of having a control entity to ensure permissions to access private data?

There are three testing phases in which a group of volunteers were subjected to. In each of the test phases, the test subjects are asked to answer a set of questions which are designed with the goal of answering the above. These questions are later analyzed for meaningful results. In the first phase of the test, the test subjects are asked to answer a set of questions concerning their self-perceived personality, interests in books, their daily behaviour and likes, and their opinion on privacy of information online. In phase two, we test the accuracy of the personality determination of the system based on the concept of product personality by having the test subjects explore the bookstore and execute a set of tasks. And the third phase is used to test the acceptance of the privacy component in the

exchange of private information, the test subjects are asked to visit a new bookstore where they are new customers and are asked to perform another set of tasks in this new store.

In the second phase, a single bookstore system is used in which it provides personalization of the bookstore environment. The bookstore environment will dynamically change as the customer interacts with the products available in the store. The customer personality is computed and determined each time the customer executes an interaction with a product (as described in section 3.2).

In the third phase, a second bookstore system is introduced as a new store; both bookstores old and new are registered with the PCC, and customers in the new store can transfer their information from the old store to the new when they register. Furthermore, the customer's privacy preferences in the old store are what govern the permissions used in the new bookstore to request the customer's information from the old bookstore.

The test subject is introduced to the test environment where there are three computers set up, and told the details of the tests. They are told that the test is divided into three phases, and the details of each phase are presented as they progress into each. Each test subject is told to relax and focus on one phase at a time, and that they can take breaks if they feel the need to.

5.1 Testing: Phase 1 details

The first phase consisted on getting to know the test subject. Aside from telling the subject about the system and the purpose of the test, the subject is asked to fill a form that contains questions about the subject's personality, preferences, daily behaviour and their opinion on privacy of information online.

The following show the questions presented to the test subject:

1) Please circle the top 6-8 traits that best describe you from the list below:

-radical	-mystical	-cheerful	-intellectual	-moody
-happy	-social	-active	-romantic	-sophisticated
-quiet	-sensitive	-sporty	-funny	-tough

-strong -intelligent -opinionated -discreet -caring
-soft -calm -collected -imaginative -aggressive
-shy -practical -enthusiastic -tranquil -competitive

- 2) Please provide some details about your daily behaviour
- 3) Please provide some details on your likes and dislikes
- 4) Please describe the types of books that you are most interested in
- 5) Please tell us your opinion on customer's private information sharing between companies
- 6) Please tell us, under what circumstances would you be willing to provide your personal information at an online store, and explain why.

The set of personality traits presented to the test subjects in question 1 were selected from a pool of adjectives that describe human personality. The list is a balanced list where there is equal presentation of the number of traits corresponding to each personality type defined in section (3.2). Therefore by the test subject indicating which traits are most representative of them we can determine which is the personality type they perceive themselves as. The answers of questions 2 and 3 are used as supportive information to their selection in question 1, and the rest of the questions are used for comparison to the results in phase 2 and phase 3 of the experiment.

After the test subject finish answering the questions presented, they are introduced to phase 2 of the experiment.

For this phase of the experiment, no systems were setup, since it was solely to get to know the test subject, their behaviour, preferences and interests.

5.2 Testing: Phase 2 details

A bookstore called Covers is presented to the test subject. It is further explained that the website provides personalization of the environment, and the layout may change as

he/she explores the website, this way the test subject is aware and not taken by surprise when changes occur. The following use case diagram (Figure 31) shows the actions the customer can perform at the website:

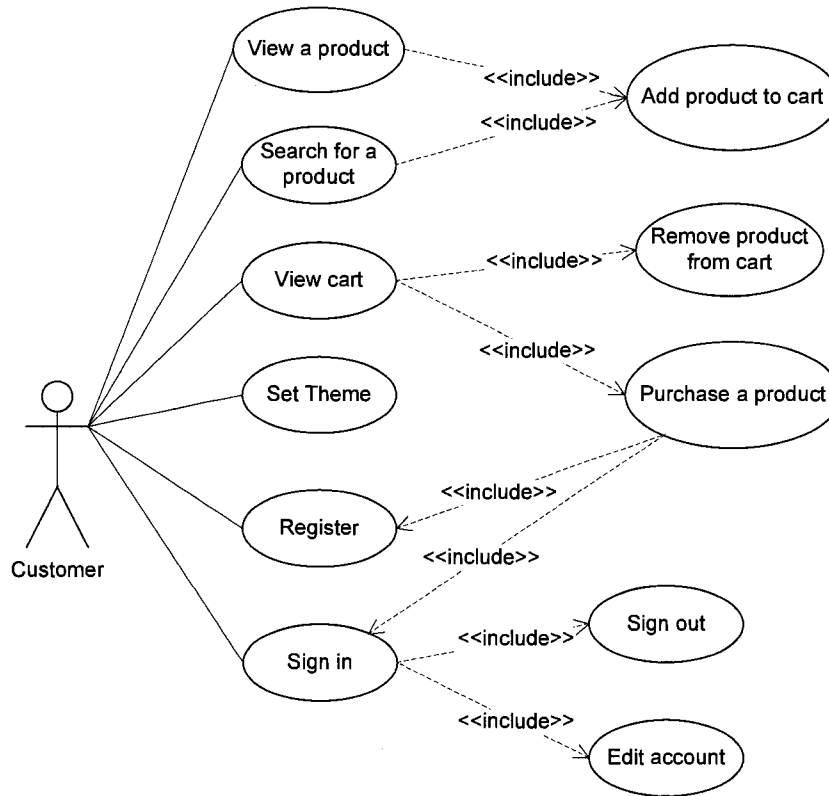


Figure 31. Use Case diagram

The test subject is asked to explore and become familiar with the website. Then, when they express their readiness to start the test, they are presented with a set of tasks to perform:

- 1) The test subject is asked to browse the website for 5-8 books that they are interested in. They are told to either search for them or look them up from the category.
- 2) As the subject explores the website, they are told to express their opinions as they see changes in the website environment. Furthermore, they are asked for their opinion on the changes and if the changes affect their level of comfort.

3) For an extra observation to this phase, dynamic personalization of the website is disabled, and the test subject is asked to set the theme of their preference without having to register to make the changes (see Figure 32). Their opinion of having this feature is recorded.

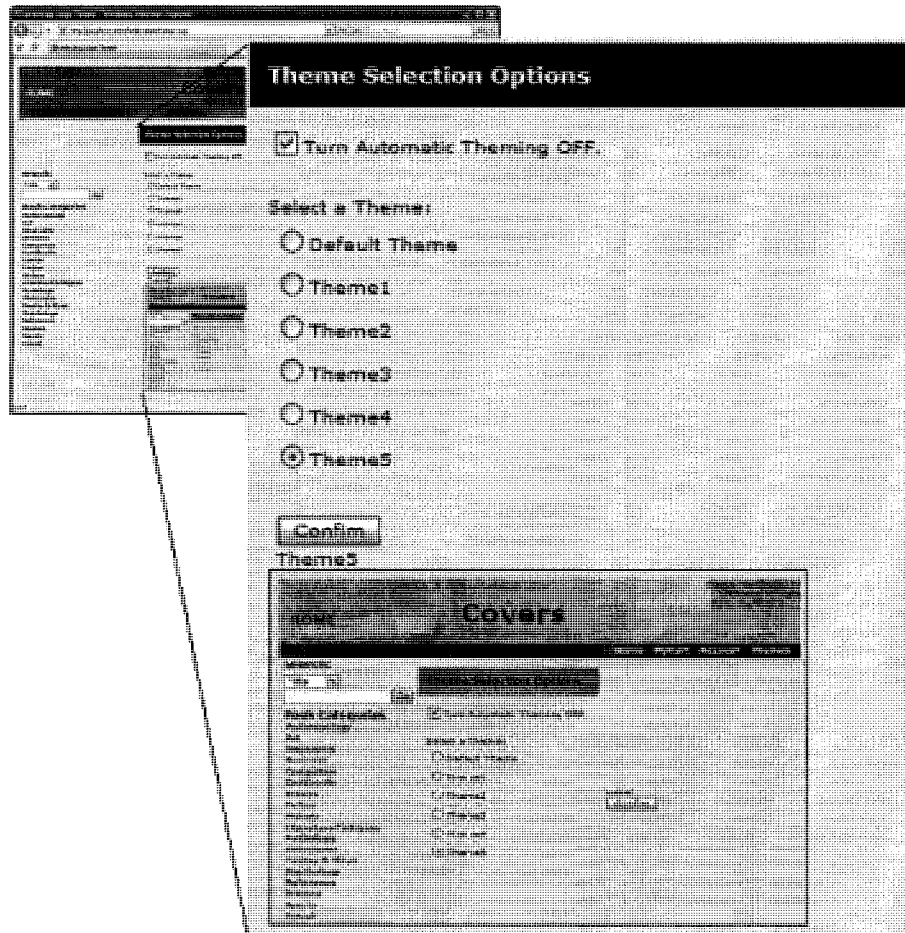


Figure 32. Setting themes

4) Lastly, each subject is given enough store credit to purchase two books, and is told to at least make one purchase. This task is used to enforce registration of the customer, where they will be presented with the privacy options to their account information, which will later be used in phase 3.

Once all the tasks are completed the test subject was asked to answer the following questions:

- 1) What is your opinion about the website's dynamic changes?

- 2) What did you like best, what did you dislike?
- 3) Did the website's environment changes reflect your interest? Explain why.
- 4) How important was not having to register but be able to change the environment setting? Explain why.
- 5) Did having a different environment make you more comfortable exploring the website? Explain why.
- 6) Did having a different environment make you more interested in exploring the website? Explain why.
- 7) Would you consider returning to a store like this one over visiting conventional stores?

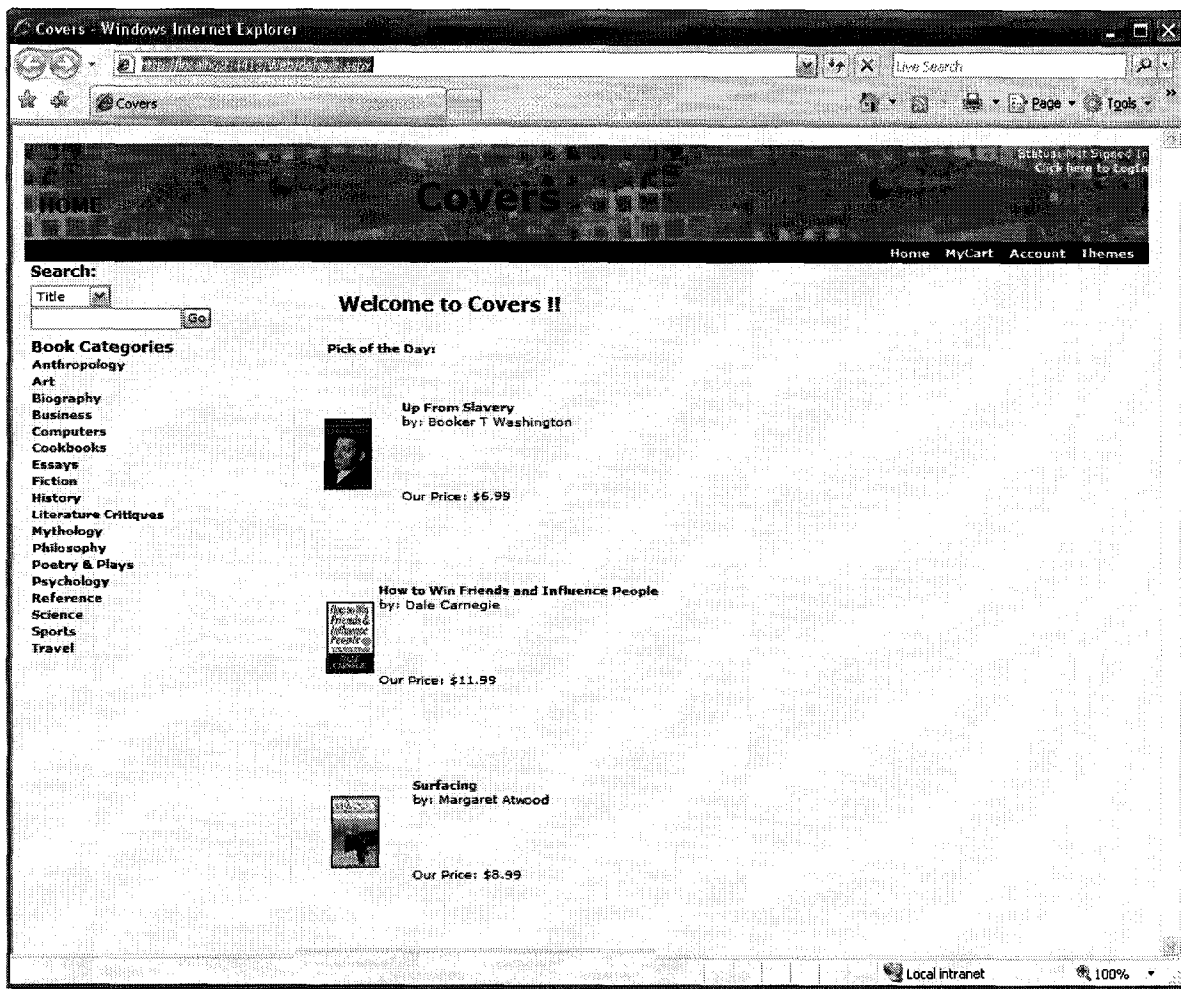


Figure 33. Covers bookstore

After they complete the questions presented, they are introduced to phase 3 of the experiment.

One computer is provided as the interface for the customer where they would use and internet browser to visit the bookstore called Covers (see Figure 33). Another computer acted as the web server for the Covers bookstore.

5.3 Testing: Phase 3 details

The purpose of phase 3 is to determine the acceptance of the privacy component; and to see if having such system increases the trust of customers to provide personal information.

In this phase, the test subject is introduced to a new bookstore. They are told that this bookstore just opened, but it provides similar features as the previous one; however, they are completely independent other than the fact that they belong to the same mother company. Their inventory and customer information are completely independent of each other. But if the customer has an existing account with the other store, depending on their privacy setting indicated there, the new store can help the customer import their information.

The registration page is shown in the following few figures where the customer enters account registration information. In Figure 34 a blank form is shown and the “AutoFill Form” is available to the customer, the customer information will be acquired given the customer provides his/her email address. Figure 35 shows the result of the “Autofill form” action where the customer information was not found either because there was no such customer found, or there was insufficient permission to acquire the data (the customer may have indicated that they do not wish to release their personal information for this purposes). And Figure 36 shows the form being filled with the customer information acquired, and the customer is asked to check that the information is correct.

Account Details

Please complete the form below and click the Create Account button to update your account information.

Email Address: (required)
Password: (required)
Confirm Password: (required)
Name: (required)
Last Name: (required)
Address: (required)
Country/Region: (required)
Phone Number: (required)
Fax Number:

AutoFill Form

Enter your EMAIL, then click the button above to autofill the form if you have an account with our affiliations and have indicated to allow you access to your information for this purposes.

- ☐ Yes, I'd like to receive exclusive deals from this company and it's affiliations
☐ Yes, I would like to have the same personalized settings as here when I visit this company's affiliations websites
☐ Yes, I would like to be able to access my information for auto-filling registration forms at this company's affiliations websites
☐ Yes, I consent to disclosing my information within the company in the event of system changes.

Create Account

Cancel

Figure 34. Registration help

Account Details

Please complete the form below and click the Create Account button to update your account information.

Email Address: (required)
Password: (required) *
Confirm Password: (required) *
Name: (required) *
Last Name: (required) *
Address: (required) *
Country/Region: (required) *
Phone Number: (required) *
Fax Number:

AutoFill Form

Sorry! your information was not found

- ☐ Yes, I'd like to receive exclusive deals from this company and it's affiliations
☐ Yes, I would like to have the same personalized settings as here when I visit this company's affiliations websites
☐ Yes, I would like to be able to access my information for auto-filling registration forms at this company's affiliations websites
☐ Yes, I consent to disclosing my information within the company in the event of system changes.

Figure 35. Registration help failed

Account Details

Please complete the form below and click the Create Account button to update your account information.

Email Address:	john@mycom.com	(required)	AutoFill Form Please check that the information is correct, enter a password and click "create account"
Password:		(required) *	
Confirm Password:		(required) *	
Name:	John	(required) *	
Last Name:	Doe	(required) *	
Address:	12 Forest Road, For	(required) *	
Country/Region:	USA	(required) *	
Phone Number:	(425) 433 3344	(required) *	
Fax Number:	(425) 344 5678		

☒ Yes, I'd like to receive exclusive deals from this company and it's affiliations
☐ Yes, I would like to have the same personalized settings as here when I visit this company's affiliations websites
☒ Yes, I would like to be able to access my information for auto-filling registration forms at this company's affiliations websites
☐ Yes, I consent to disclosing my information within the company in the event of system changes.

Figure 36. Registration help success

The tasks asked of the test subjects to perform in this phase is much shorter, they are the following:

- 1) The test subject is asked to explore the website, and look at a few books of interest.
- 2) The test subject is given enough store credit to make a purchase. If they do not make a purchase, then they are asked to register to the website, and explore the auto-form filler option.
- 3) After they conclude their registration they are asked to verify the account information correctness if they made use of the auto-form filler option.

Once they concluded the tasks, they were asked to answer the following questions:

- 1) Did you find the auto-form filler helpful? Explain why.
- 2) For stores where registration forms are extensive, would you take advantage of this feature if you were registering for another company with ties to one you have already registered to? Explain why.

- Other comments or observations expressed by the test subjects during or after the experiment was concluded were recorded as a possible source of important information to the analysis of the test results.



On this last phase, one computer was provided as the interface for the test subject to interact with the bookstore through a web browser. A second computer acted as the web server for the bookstore called Bookstore that the test subject was interacting with. A third computer acted as the web server for the bookstore called Covers who the test subject previously visited. And a fourth computer was used to house the PCC. Figure 37 shows both bookstore websites together with the PCC-application all running at the same time.

5.4 Selection of test candidates

A total of 21 tests were executed. The test candidates were all students from the University of Ottawa ranging from undergraduate to graduate level, and some differences in cultural and ethnic background. It is determined that this selection of students could be representative of a small online population since they fall within the range of most online customers, and are likely those with the most purchasing power. Amongst the 21 subjects, 11 were female and 10 were male, each very able to express themselves clearly in the English language.

5.5 Test Results

The experiments were executed with the purpose of determining the following points of interests of this thesis:

- Is the system consistent in determining the user personality based on the personality of the products they interact with?
- Does the environment play a part in the user's interest in a website?
- Dynamic changes versus setting the theme manually, which is preferred?
- Is it important for the users to not have to register to make preference changes?
- Is having control over their personal information important for the users?
- Importance of the control entity to ensure permission rules are followed in information

exchange and disclosure scenarios.

After the results of the tests were analyzed, it was found that the system determined the test subject's personality based on their interaction with the bookstore's products with 85.7% accuracy. The other 14.3% was not accurate, first because the results of the system did not match the self-personality profile indicated by the test subject in phase 1; and second, the self-personality profile of some test subjects were not indicative enough to place them into one of the five personality type described in section 3.1. These results were based on both the answers from the test subjects and the observations during the experiment.

Contrary to the results above, if only the results from the test subjects' answers in the questionnaires are taken into consideration, only 76.2% accuracy would be obtained. 23.8% of the subjects indicated that the system environment change did not reflect their interests. After consulting with the test subjects as to why the result did not match their interests, it was found that it was not that the system did not determine the right personality type they would belong to, but the reason was of personal preference in the design, colour pattern, and/or layout or the environment presented to them. The reasoning of the disinterest is not surprising since the design of the different layouts we made based on the symbolic meaning of colours described in section 2.5.4 which pertains to most North American representation; whereas, the meaning or colours may differ in different countries, as well as people's personal preferences.

Despite the system being able to record customer interaction and determine their personality in real time even from the first interaction with a product, the accuracy of the system was not stable until some history of interaction was established. The first few interactions with products, when these were of different personality types, made the system change environment too often. In fact, some tests subjects expressed that they did not like the constant changes in the beginning, but would prefer more subtle changes instead. Like most systems that depend on a history of customer interaction, accuracy increases over time, unless there is a change in interests and personality.

In relation to providing a comfortable shopping environment to the customers,

66.7% of the test subjects indicate that the change of the environment does make them feel more comfortable at this website. The other 33.3% indicate that either the environment really doesn't play a part in their comfort in an online store, or that the changes to the environment were not only not comfortable, but actually annoying since it kept changing all the time. However, almost all test subjects agree that the environment changes should be more gradual and subtle, instead of a complete sudden change to a different layout. Some test subjects indicated that the environment changes should not be made based on the personality determined of a customer, but instead make the changes based on the product department they belong to so that the website gives the effect of a customer walking into another section of the store.

The other key point to identify from the environment changes was to determine if these changes played a significant role in keeping customers interested in the store. 61.9% indicated that it did make the website more interesting, but it was not a major factor of interest. The test subjects indicated that the website content, products, information and features are more important than the environment itself.

Some drawbacks indicated about the environment changes, other than it was too abrupt, was that because of the change, it made it hard to go back to find a previously view product because the location was remembered based on the mental image of the layout of the page; because of the design change, the product was harder to locate again.

There was a greater preference for manually setting the theme versus having dynamic changes. The main reason why the test subjects did not like the dynamic changes, as it was stated earlier, was due to it being too abrupt. On the other hand, if the user is to choose and set the theme of preference themselves, they would know beforehand what to expect, and they can select to make changes when they desire the change.

All the test subjects showed great interest in the idea of not having to register and still be able to make personalization to the website. Many of them indicated that it is quite annoying to have to register and provide personal information when they simply want to see what the website has to offer. It is hard enough to keep track of account names and passwords for work and other daily necessities, but it becomes a nuisance to keep track of accounts and login information of websites that one does not visit regularly. Another reason

why they were interested in this feature is the fact that they did not have to surrender or provide any personal information, which most expressed as privileged information only to be provided when making a purchase.

Most test subjects indicated that it was very important to have control over their personal information. They indicated that they would only provide personal information online only when making an online purchase when it is absolutely necessary so that the purchased item can be delivered. However, some exceptions were mentioned. In particular, one test subject indicated that a lot of our private information is readily available online already, that with websites like Facebook and mySpace where people already have their personal information posted, providing similar information at an online store would not be a concern, but account information was an exception to purchasing only. It was also found that females were more likely to give out personal information in return for some offer of value like a discount or a gift.

In regards to the results in phase 3, the test subjects found that it was good to have a privacy feature coupled with the system. Particularly, they liked how the customer had control over their information privacy. However, they still had their doubts as to how the system actually ensures that their information is not disclosed or shared without them knowing. Second, they expressed great interest in the auto-fill form option provided in the system for helping customers fill their registration form by requesting the information from another company where they have given their permission. But they were more concerned with that of other companies trying to acquire the information by posing as the customer; despite having explained that the system will not disclose any information unless the requesting party has a ticket and the required permissions to access the information, and that the PCC would not give permissions or grant tickets to companies or online entities unless they are registered with the PCC, and that even if they finally get hold of the information that the information was encrypted and they would need the encryption key in order to see the information – this further supports the idea that customers are still very concerned about privacy of information.

In short, Table1 below shows a summary of the results collected:

Table 1. Summary of Results

System was 76.2% to 85.7% accurate in determining the personality type.
Environment as a factor of comfort, 66.7%, but dislikes in the constant changes in the beginning. Suggestion to make environment changes per-store department instead of per-personality.
Environment as a factor of interest, 61.9%, but importance is still in store inventory, and product information and prices.
Manual setting of the website's theme was preferred over dynamic changes.
100% acceptance of no-registration for personalization.
95.2% indicated that privacy of personal information is of great importance. But 100% indicated that information affecting banking, credit and debit would not be disclosed unless absolutely necessary.
The acceptance of the privacy component was not as promising. Though most users liked having control of their information, and it does give the users more confidence in the website; they still remained skeptical as to the actual security of their information.

5.5 System limitations and other discussion

We must emphasize that the system is not a fully functional online store with all sorts of security features in place; nor does it have an extensive enough product database to reflect that of a real online bookstore, but for the purpose of this thesis, it is deemed sufficient enough to be able to extract meaningful results from. Secondly, although the results collected from the tests are very promising; expanding to a greater set of test subjects would yield stronger results; only 21 test subjects are not sufficient enough to draw conclusive results representative enough of the huge online population.

While designing the customer information transfer scenarios, there was a decision conflict about transferring the personalization information. For a customer visiting a new store that also provides personalization based on personality determination of their interaction with products, would the customer want the current profile to be overwritten by the information transferred from the other store? It is understandable that a transfer of personalization information from an existing source would be useful if the customer is new to the store, since historical information would strengthen the profile determination, but if the customer's preferences and interests have changed since then, then the historical

information may do more damage than good in creating the customer's personality profile. In our system, we made use of the transfer of the personality information, since the experiment was not designed for observation over long periods of time; and test subjects were mostly new to the system, with little or no history present.

Another major decision to be made was to determine if the tickets granted by the PCC would consider the permissions to be exclusive or inclusive. Although in the experiments executed the test subjects were only exposed to a single permission to access their information for the purposes of helping them fill the registration form. The PCC is designed to handle queries of multiple permissions. Hence, when one bookstore Covers is offering a special promotion for a particular personality type that may be of interest to some customers of the other bookstore Bookstore, Covers can make a request to the PCC for permission to contact Bookstore for the purposes of "giving deals" and "personalization". But the question arises when Bookstore is compiling the list of information: should Bookstore provide Covers with the list of all customers that indicate they want deals plus those who indicate they are alright with disclosing their personalization preferences, or should the list be comprised of only those who expressed both permissions only? This question comes about because Covers could technically request two separate tickets for the two permissions and get the first list instead of the second. After discussion with the author of the Pluto protocol (see section 2.4) we came to the conclusion that the protocol is designed for a trusted community in which each entity registered with the PCC would play by the rules, and in the even that tickets are generated with several permissions, only information that meet all the permission criterion would be disclosed to the requesting party.

As it was reflected in the test results, the limitation on the environment design and colour scheme used for each was made apparent in the user feedback. There was initial concern that although the design of the different website themes was based on choosing colours that carried the same meanings and descriptive adjectives corresponding to each personality type, that there would be cases where the customer may not like or find the design representative of their preference. However, the test results show that it was not the case with the majority of the test subjects therefore lessening the effect it had on the overall results. But this concern should not be taken lightly in the case of websites that may be

interested in providing design-related personalization to customers. Moreover, the design of the layouts did not take into account people with disabilities; although the customers were given the option of being able to choose the layout and theme they deem preferable, the design of these did not take into account disability; which is a concern that should be addressed.

For this thesis we limited our personalization criterion to providing environmental comfort and mainly to determine if product personality is a considerable determinant of a human personality. However, personalization of websites go beyond that of what we have provided, as we have mentioned in section 2.5.1 a mayor player in providing personalization are recommender systems, and with the promising results obtained from our tests, product personality may be a promising new factor to be added to help refine recommendations.

The implementation of the system was made using ASP.NET technologies; however there were limitations to the knowledge of the developer in regards to implementing e-Commerce applications, and how to optimize performance. Surely, by incorporating caching and more robust data transfer, the performance of the system would greatly improve. Secondly, the design of the database of product information and customer profile were amateurish, improvement in these designs would make data access more efficient.

Chapter 6

Conclusion and Future Work

6.1 Conclusion

Promising results are shown that in fact there is correlation between product personality and the personality of their buyers in an e-Commerce setting. The simple model of five personality types presented to categorize products is found to be fairly accurate in determining the personality of the customer that interacts with the products they are interested in. Although it was found that environment changes in a website do not affect the interest of customers, it does play a part in the comfort level a customer may feel while visiting an online store. Moreover, it is found that it provides customers with a sense of interaction, and the illusion that they may be going into another section of the web store.

It is found that it is feasible to provide personalization without having a customer register, however registration is still the most efficient way to avoid personalization data lost due to the limitations of cookies. It is found that customers liked the idea of being able to personalize their website without the need for registration; hence it is a promising aspect of personalization systems that should be further explored.

The coupling of the personalization system with the Pluto privacy protocol showed an increase confidence in the trust towards the website. But privacy concerns for customer's information still remained high and uneasy. Although the customer was given control over their own data during registration, there was really no way for the customer to know and have the guarantee that the company would not share this information with others even when stated clearly in the privacy policy of the website.

6.2 Future Work

The personalization component utilized in this system was mostly limited to the

environment; and briefly used in the welcome page to show a set of products that were compatible with the customer's determined personality. However, given the favourable results of the experiments in effectively determining a customer's personality based on their interaction with products, a more considerable focus should be placed in determining the effect and reaction of customers to products presented as being personality-wise compatible with them.

Another limitation to this work was that coupling with other personalization techniques was not fully explored. Some aspect of content filtering was utilized, where the history of the customer interactions were used, but collaborative filtering as one of the major techniques utilized by most e-Commerce businesses to provide recommendations should be considered as a new adaptation to the system, and see how the results can compare when the two are coupled. Consequently, content filtering and data mining could also be considered.

Given the positive results towards the idea of being able to have personalization without the need for registration, it would be a probable path to explore, and maybe come up with better identification technologies that go beyond cookies and IP tracking. In a more immediate sense, companies should consider providing small levels of personalization capabilities for unregistered users, and keep more privileged functions to registration, this way there is still incentive for attracting customers.

A big step forward would be to couple and explore the effectiveness of this system with recommendation systems. Although recommendation systems were beyond the scope of this thesis, the application of this new way of providing personalization to customers should theoretically benefit recommendations, and in turn e-Commerce applications and customers.

Most importantly, the system was tested in the context of an online bookstore; other e-Commerce businesses should also be considered in future implementations to determine the effectiveness of this approach.

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