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WIN-EC: An Electronic Commerce Model
For Small Business

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Abstract

The accessibility of the Internet and the World Wide Web has provided an excellent means for presenting, disseminating and distributing information. As well, this is a new and convenient channel for businesses to reach customers and other businesses. In this paper, we describe WIN-EC, an electronic commerce model for small business. We discuss various services that a typical small business may want to provide its customers. Possible technologies to implement the services are examined and finally, a prototype to generate such a model will be suggested.

Keywords: electronic commerce, community network, small business

Introduction

We have developed a generic electronic commerce model for small business, WIN-EC. The model provides a template for the quick and easy development of electronic commerce sites, in particular for those firms who do not have a lot of money, time or web expertise. A pilot implementation is currently underway on a local community information network.

The Waterloo Information Network

The base for our electronic commerce model is the Waterloo Information Network (WIN), developed by researchers in the Computer Systems Group at the University of Waterloo. (Cowan et al 1998; Cowan 1998) This is a next generation community network, providing a large repository of valuable information and services. The WIN design is based on an advanced open architecture to achieve easy scalability and ease of information maintenance. It uses databases to store the information in the community network, and uses the Web to deliver and display the information. (Cowan et al 1997) It also utilizes advanced hypermap technology to provide better representation of data and information.

Current community groups presented by Yahoo and Alta Vista, for example, normally return queries with a random collection of facts and little or no context. Unlike these models, WIN takes a uniform approach to present community information. WIN's architecture satisfies the open concept in the sense that the technologies used in the network can be expanded or replaced without rebuilding the entire community network.

This innovative community network uses hypermap to display locations on a map image. Objects in the hypermap are associated with meaningful data to provide users with detailed information about the objects. Users navigate in the network via hyperlinks and tables of contents. More important, text and hyperlinks are stored in databases rather than flat files. This helps to automate the process of maintenance and cuts the cost of insertion and deletion in the table of contents. Hyperlink integrity is also kept at a constant cost. In addition, storing data in the databases makes searching easier and more extensive. The WIN pilot project built for the City of Waterloo can be found at http://www.city.waterloo.on.ca.

Goals

Our main goal is to provide an electronic commerce model for small businesses in next generation community networks. Our current focus is the customer-to-business and business-to-customer (B2C) commerce. The more complex business-to-business orientation will be examined in the future once we successfully implement our B2C model.

We want to have a secure and complete model for this type of business. Many controversial issues such as digital certificate distribution, security features, services handled by the community networks, and so on will be identified for discussion. In many cases, we do not propose a unique valid answer but rather a range of possible answers that can be customized to best fit the business interests and requirements.

We also want to implement a program to generate such a model. The program should be accessible via the Web so that a typical small business can go there and build their Web sites to boost their current business quickly. Although there are issues that may need to be taken care of by people, we would like to automate the whole process as much as possible.

Assumptions about Small Business

When designing the WIN-EC model, we made generalized assumptions about the small businesses using our system. These assumptions serve as a frame of reference and our model is only realistic with these settings. Any changes in presumption mean that we may have to redesign or modify the model.

The assumptions are as follows:
1. People who run businesses are not necessarily highly computer literate. They may know how to use simple application software and browse the Web, but they do not know or need to know all the technical details such as the operating system, system architecture, programming languages, HTML, CGI, middleware, and so on.
2. Typically, they do not have their own server to house the Web sites and the database, nor do they have the expertise to maintain these infrastructures.
3. They are willing to pay a small fee to reach a broader base of customers and experience a new way to do business.
4. They want the Web sites to be up and running as soon as possible to get competitive advantage.
5. Things they want to offer on-line include advertising, providing information about their businesses, buying and selling, booking appointments and reservations, searching, and transferring confidential information.

The WIN-EC Model

In our model, we use the notion of an account as a basic unit associated with a business. The model identifies all the components of an account, a secure mechanism for account creation and account access, and an architecture for the e-commerce server. Below we describe each component in detail.

An Account

An account is a virtual representation of the business in the Internet. To be more concrete, an account consists of a collection of Web sites that provide various services such as advertising, providing information about the business, buying and selling, booking, searching, and transferring confidential information. Customers look in the account pages to access the above services. Figure 1 illustrates a set of pages in an account.
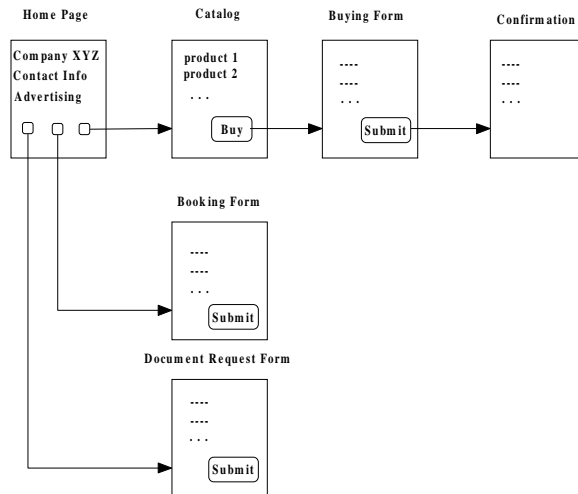

Figure 1. A Set of Web Pages in An Account

Next, we discuss each type of service that may be offered by an account.

Advertising

This feature is simply to store, arrange and display information. An account holder should be able to edit the content of information that he/she wants to include in the Web sites. The information could be an introduction about the business, contact information, press conferences, special offers, a map showing how to get to the company, and so on. These data are not limited to text but can be images, sounds, multimedia, or animations to further enhance the appearance of the Web sites and to attract more customers to come back. In addition, we use databases to store documents and hyperlinks instead of flat files. This makes hyperlink management much easier and faster and reduces complexity. Consequently, we want to build a set of automated tools for hypertext management.

Databases are also useful since they can contain other data management tools to support data maintenance such as check-in and check-out. Databases can also be extended to contain other persistent data that may be used to augment the Web pages in various ways. For example, a history list could be implemented to record when Web pages were changed. Databases can also be used to generate data within a Web page. For example, tabular data such as names, addresses and URLs can be stored in a single location in a database, but might be used in multiple locations in a set of Web pages.

Selling

This feature is probably the one of most interest to small business. It is vital to have a complete and secure method for selling things on-line. (Cain 1995) We provide a catalog of products or services offered by the account holder. An item in the catalog should include

fields such as name, description, image and price. To help customers find what they want easily we have designed some searching capabilities. Customers can search items by name, price, description, or any combination of those. Customers can select items and add them to their baskets (or shopping carts) when browsing through the catalog. The catalog itself and searching capabilities are naturally augmented with the mature database technologies.

When finished shopping, customers will have to fill in order forms and make their payments as with current commercial sites. This information is then transferred back to the Community Network servers using SSL technology. (Luotonen 1998; MacGregor et al 1996; Yeager 1996) Once the servers receive the order, a confirmation (similar to a receipt) is sent back to the customer for future reference purposes.

Security

Note that for selling we do not need the customers to identify themselves in order to establish a secure selling channel. (Shaffer and Simon 1995; Stallings 1995) Only the account holder has to do so because customers want to make sure that the account holder is who they claimed to be. Customers are typically very skeptical about giving out their credit card numbers, and they do not want those numbers to go to the wrong place. Each account holder should have a digital certificate, the Internet equivalent form of a passport, to identify his/her entity. A digital certificate has two keys, a *public* one and a *private* one. The public key is listed in on-line directory services similar to the yellow pages version of the phone book, while the private key is stored in the account holder's account. When a secure selling channel needs to be established (i.e. when the customers click to the form pages), the following steps happen:
1. The Web browser generates a *session key*.
2. The Web browser retrieves the account holder's *public key* from a directory service.
3. The Web browser encrypts the *session key* using the account holder's *public key* and sends it to the server.
4. The server (acting for the account holder) uses the account holder's *private key* to decrypt the message and obtain the *session key.*
5. Two parties now can communicate securely by encrypting their messages (symmetric key cryptography) using the *session key*.

Account Holder Notification

Now the orders (together with the credit card numbers) are already in the Community Network servers, but the account holder does not have any sales information yet. We provide three options for the account holder to get the orders. The account holder must choose one of the three

options at the time the account is set up, but he/she can change the option anytime. The options are:
1. Encrypt the orders using the account holder's *public key* and then send them via secure email.
2. Send a notification email to the account holder, and provide a view-order capability via the Web. This requires the account holder to authenticate himself with the system. The authentication mechanism is discussed in the Account Access section of this paper.
3. This option is similar to option 2., but the view-order is limited only to the order parts. No credit card numbers appear in the view. The Community Network acts as a middleman to take care of the financial transaction with this option and later credits the account holder's checking account. This option was proposed because many small businesses do not want to be involved in the financial transaction process. By subscribing to this option, the account holder frees himself/herself from money matters and can concentrate on producing and delivering goods and services to customers.

Booking Appointments and Reservations

There is a design dilemma for this feature. Ideally we would like to implement the whole booking system accessible via the Web for the account holder and customers. Customers are capable of making their own reservations, while account holders are allowed to update the booking capacities, states, and so on. However this approach encounters some serious difficulties. For example, if the server is somehow shutdown for a few hours, the business will not be able to do any booking. When the system is up again, the booking system must be reinitialized to update all reservation states. Any delay in reinitializing the system can cause erroneous functionality. Concurrency is also another big issue that needs to be controlled when multiple parties try to access the system.

As a result we only provide a notification service to the account holder when there is a booking. We leave the account holder the responsibility to arrange bookings and contact back to the customers if such a reservation is not possible. The obvious disadvantage with this approach is that customers won't know instantly if their bookings are accepted.

Transferring confidential information

As with the **Booking** feature, we provide a notification service to the account holder when there is a request to retrieve confidential information such as medical records, credit ratings, personal financial portfolios, and so on. Typically, a customer who wants to use such a service should first register with the account holder to verify his identity due to the importance and confidentiality of these documents. Also the customer should have a digital

certificate so that documents sent to him can be encrypted using his *public key.* Then, only the customer can decrypt the documents since he has the *private key.* Digital certificates are distributed by many Certificate Authorities (CAs) such as RSA, VeriSign, VISA, Master, and enTrust. These certificates can be used for many purposes other than just sending and receiving confidential documents. The price for digital certificates is quite affordable. For example, VeriSign charges $14.95 US for an individual digital certificate.

Searching

By storing documents and hyperlinks in the databases rather than flat files, we can use available advanced indexing and searching techniques. This allows searching for Web pages according to contents, keywords, categories, items, locations, and many more criteria.

Account Access

Account access is a mechanism that allows the account holder to login, initialize, view, and make any necessary changes in the account. An account holder should have a digital certificate installed in his Web browser to access his account pages. This is to ensure the security of the account. In addition, a simple userid and password scheme is also used to safeguard the situation where the business has many employees but only certain personnel are entitled to access the system. Note that the userid and password scheme alone would not be sufficient. Attackers can easily write a script to break this scheme due to its availability in the Web. Therefore, the digital certificate is to prevent advanced attackers, while the userid and password prevent low-tech attackers. The latter are often ordinary employees who may have access to the computer with the digital certificate installed.

An account holder is able to login to his account, as shown in Figure 2. He can view, edit or delete any pending orders, booking requests, document requests, or advertising information in his account.

Figure 2. Account Access Pages
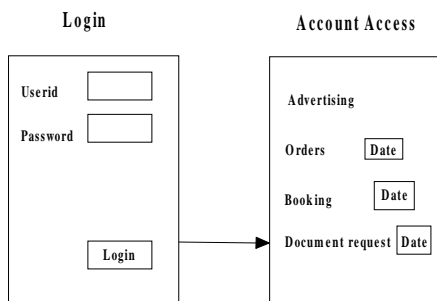
Account generating program

The account generating program is a program used to create new accounts. Once a business registers with the Community Network and provides all the necessary information, the account will be automatically generated. This program is a script written either in Perl or C/C++. The look-and-feel of this program interface is shown in Figure 3.

Figure 3. Account Setup Pages
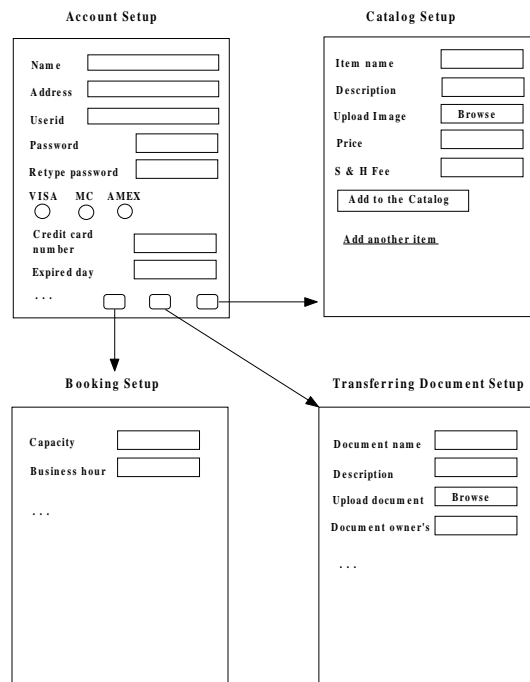
Technology

As discussed earlier, we use SQL databases to store documents, hyperlinks, and catalogs. The tagged texts are a mixture of HTML, SGML, and XML to better provide the desired appearances, which are not all supported by HTML. SSL is running in the servers to perform authentication and handle secure communications. Our scripts, which follow CGI standards, are written in Perl and C/C++.

For authentication and secure email purposes, we adopted a Public Key Infrastructure (PKI) product from enTrust Inc. This PKI encompasses a set of digital certificates together with a certificate management structure. These digital certificates are compatible with popular email programs such as Microsoft Outlook and Outlook Express, Qualcomm Eudora, and Netscape Messenger.

Conclusions

This paper has presented a flexible, working model for e-commerce implementations that will be of interest to any small business considering this technology. It provided an overview of the various features that can be offered, and gave some insight into the different challenges and how they are approached from an implementation point of view. There is also a concise explanation of the use of encryption technology for secured transactions.

We have developed a template for small business electronic commerce sites. The prototype implementation will be working shortly, so that we can test the suitability of this model for a number of businesses.

Future Work

Important issues that need to be resolved include the following:
How to distribute the digital certificates for the account holders?
How to make sure that the account holder is who he claims to be?
How to distribute the digital certificates for the customers who want to receive confidential information online?
Who will assume liability if things go wrong? For example, what if a business takes the customers' money but does not deliver the services as promised?

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