DEVELOPMENT OF AN E-COMMERCE WEB APPLICATION

USING .NET TECHNOLOGY

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The information revolution came in the early 1990s with the advent of the World Wide Web. In the early days of the web, the use of websites was very limited. With the passage of time, new technologies were developed which provided unlimited convenience to the internet users in performing day to day tasks. One of the areas that evolved significantly with the commercialization of e-commerce applications was the way companies did business. Big and small companies moved towards exploring new techniques of doing business, and created e-commerce websites for selling their products and services online.

The web applications developed in the early years of the web posed many problems that made the user experience cumbersome and complicated. Some of other problems faced by the website users were the weak security methodology, inaccessibility for the disabled, tedious coding methodology, and lack of administrative features. To
improve on the flaws that existed in earlier websites, Microsoft introduced a new technology called .NET which included many new enhancements and features that were missing from the older technologies, such as providing advance security through encryption, built-in control for faster website development, server-side scripting, and compiled execution for better performance. Also, the seamless integration of the e-commerce websites developed using .NET with web services further simplified and expanded the ways in which such e-commerce websites interoperated with other businesses.

This project demonstrates the new features present in the Microsoft’s .NET technology and also emphasizes the importance of web services in the development of e-commerce websites. This is shown by developing an e-commerce bookstore web application in which payments are processed by using PayPal’s all-in-one payment processing service. This bookstore application provides its users with advanced security features, easy website accessibility and navigation, built-in controls for rapid development, reporting services, and web analytic solution for accurately measuring web statistics. A conclusion is presented showing how this bookstore application can be extended in functionality to reach more customers and for enhanced user experience.
CHAPTER I

INTRODUCTION

Overview

The world has become a virtual shopping mall with the increase in popularity of the Internet. More and more people around the world now have easy access to the Internet and continue to learn how to put its immense ability to use. One of the biggest advantages of the Internet has been the enormous popularity of using it to shop. Websites such as eBay and Amazon have become household names for Internet users. As the popularity of e-commerce solutions continues to grow with more and more people relying on the internet to process their transactions, so do the concerns which make many customers wary of doing business on the internet. Apart from costs or convenience, people seek website accessibility, more security, better selection and ease of use. Similarly, business owners are looking for better administrative capabilities as well. There have been tremendous advancements in this area, but much is possible. In addition, there is a huge opportunity for providing these innovations to small business owners who do not have deep pockets to spend on millions on research and development.

Background

In various conversations with family and friends who own small online businesses, one issue that was common throughout was that even though their businesses
had aesthetically pleasing websites, the owners had to invest significant time and effort for administrative functions. These functions include creating and editing users, adding and deleting roles, manually generating business reports and accurately measuring number of website visitors. Also, a common concern was the importance of data integrity and online security.

One of the experiences almost every student has experienced is the long lines at the school bookstore at the beginning of every semester. In today’s times, when students are constantly juggling education, jobs and domestic responsibilities, this waste of time can potentially be avoided. Furthermore, my user experience while using the CSU, Chico bookstore’s website exposed several flaws in its web application. These problems actually present an opportunity to rectify the issues and turn the user experience into a pleasant one.

The concerns and problems that I have experienced personally and through my social circle fueled the desire to come up with a solution that addresses them all. My master’s project presented a platform and an opportunity to demonstrate a working model of my solution. I intend to account for administrative requirements like report generation, web analytics tool, role management and membership services. It will have a robust data backup solution and address the security concerns as well. Also, such a website will reduce overhead costs and the workload of the bookstore staff as well.

Purpose of the Project

The purpose of this project is to build an e-commerce bookstore web application that includes a full-featured administration backend. This application will
focus on areas where a typical bookstore website (CSU, Chico’s in our case) can be improved. This web application will offer its customers enhanced security, website accessibility, administrative capabilities and simplified user experience. On the other hand, the administration backend will have features for automating order-maintenance, handling order-related customer inquiries, inventory-management tasks and analyzing web-statistics. This project will also incorporate web services for processing payments instead of storing information locally in the bookstore database. In addition, the project will analyze the interaction of the website with various subsystems such as shipment vendors, suppliers and certification-authority vendors that play a critical part in making the online purchase process seamless for the customer.

Proposed Solution

This project tries to address the above-mentioned problems with these solutions:

- Security: One of the needs for improvement I noticed in the CSU, Chico website was the lack of security, especially for password encryption. To solve this for online transactions, this project will include the advanced security features that will store the customer information in a secured way in the bookstore database, encrypt confidential information, like passwords and credit card numbers, and provide a secure environment for online transactions.

- All-in-one Payment Processing Service: Another area in which I found the CSU, Chico website lacking was the policy of storing the customer’s credit card information in their own database. This is considered a security risk. To solve this problem, this project
will use PayPal’s all-in-one payment processing service that stores a customer’s credit card information without having to risk storing the same information in the bookstore database that might pose legal issues as well.

- Accessibility: The project will follow the California state accessibility standards to make the website accessible for people with disabilities. This feature is missing from the CSU, Chico bookstore website.

- Web Analytics: Another problem faced by many websites is the inability to accurately measure web statistics. This project will implement an advanced solution for calculating the exact number of bookstore website visitors, navigational patterns of customers and the time spent by the visitors on the bookstore website.

- Reporting Services: Another common problem seen in bookstore websites is the inability to generate reports quickly for business audits or monitoring business trends. The project will address this problem by enabling generation of customized reports quickly with advanced administrative features.

- Rapid Development and Administration: One of the problems that developers faced during development of CSU, Chico bookstore website was the code development phase took a lot of time. This project will solve the problem by choosing a technology that uses built-in controls for rapid development and administration.
CHAPTER II

REVIEW OF LITERATURE

Review History of Web Development
Technologies

Information revolution came in the early 1990s with the emergence of World Wide Web. The Internet provided the underlying infrastructure on which the web was built and through which it could function. Even though the web has changed dramatically since 1990s, the core components of the web still remain the same. These three building blocks are HTTP (HyperText Transfer Protocol) for exchanging information across internet, URL (Universal Resource Locator) for addressing resources, and HTML (HyperText Markup Language) which is its markup language [19].

One of the first common web programming models that evolved in the early 1990s was Common Gateway Interface (CGI). CGI programs connected any service or information resource that needed access through the web with the web server. Some of the common early languages used were the C, C++, Perl, and Unix shell [19]. Information used to be gathered and submitted through a static HTML web form.

With the advent of .NET technology from Microsoft in the 1990s, most of the limitations of older web technologies were eliminated through features like built-in controls, compiled code instead of interpreted code, server-side scripting, etc. Not only that, Microsoft revolutionized the development and administration of web applications
with the introduction of ASP.NET 2.0 which included more advanced features such as built-in server controls, membership and role management services, improved security, etc. This technology provided support to all browsers, improved security, and reduced response time for database queries [2].

Project Requirements and Preferred Technologies

The following requirements were gathered for the bookstore web application. After reviewing the differences and benefits of the available technology options, a recommendation for the technology was made for each of the requirements.

1. The Bookstore web application should provide a secure environment for online transactions and for securely storing customer’s confidential information.

   Based on the above requirements, an analysis of two popular technologies ASP.NET 2.0 and PHP was done. ASP.NET 2.0 was recommended as the best technology to meet the above requirement.

   Although both web technologies are equally suitable for implementing SSL cryptography technique, ASP.NET 2.0 also provides built-in server controls such as login controls that encrypt a user’s credentials using one-way hash technique. Also, ASP.NET 2.0 login controls require users to input strong passwords by default. Unlike ASP.NET 2.0, PHP does not have built-in security controls that are easy to implement [2], [14].

2. The Bookstore web application should maintain a consistent look across the entire website and any shareable elements such as header, footer and sidebar should be centrally managed.
To meet this requirement, ASP.NET 2.0 was proposed as the preferred technology over PHP 5 because ASP.NET 2.0 includes a new addition to page framework called Master Page that provides a consistent look and feel for common pages across the website. For such shareable pages, changes done in certain elements such as header, footer and sidebar can be easily managed from Master Page. Unlike ASP.NET 2.0, there is no concept of Master Pages available in PHP 5 that defines the consistent look and feel of the web site and that eliminates the tedious work of making changes in every web page for the common elements [2], [14].

3. The Bookstore web application should use a web technology that has a high performance rate.

In this day and age, customers seek a high performance user experience that provides an optimal use of their precious time. In light of this requirement, ASP.NET 2.0 was recommended as the technology of choice because it has a better performance rate as compared to PHP. ASP.NET runs in an environment that is fully compiled. This compilation process includes the compilation of C# code into Microsoft Intermediate Language (MSIL), and then it converts the Intermediate Language (IL) into low-level machine code [1]. Unlike ASP.NET, PHP is an interpreted language and takes a performance hit since it needs to interpret code line-by-line [1], [14].

4. The Bookstore application should be developed using an Integrated Development Environment (IDE).

This requirement was incorporated keeping the development phase in mind, and ASP.NET 2.0 came out to be the best technology in this case as well. ASP.NET 2.0 applications use Visual Studio 2005 Integrated Development Environment (IDE) that
offers tools to developers for handling various tasks, such as built-in controls for rapid development, debugging support, IntelliSense capabilities and multi-language support. On the other hand, although PHP 5 does have support for Integrated Development Environments that come with development and debugging capabilities, it lacks multi-language support and IntelliSense capabilities which are available in Visual Studio 2005 IDE [2], [14].

5. The Bookstore application should have a reliable support plan.

Although Microsoft products are expensive as compared to the technologies that support PHP, they are more reliable with support being available around the clock. This enables quicker turn-around times for handling any exigent circumstances related to their products. On the other hand, PHP is an open source (free) language with a wide community of users around the globe who provide support, but it lacks reliable and prompt support that is absolutely necessary to avoid adverse impact to today’s businesses. Therefore, Microsoft’s ASP.NET 2.0 is a preferred choice that meets this requirement [14].

6. The Bookstore application should use a secure and reliable web server.

For this requirement, the Apache server was compared with the IIS server. IIS 6.0 was the better choice to satisfy this requirement because it is closely integrated with the operating system and receives the same security and authentication services present within Windows. Besides this, IIS also offers high reliability as it can compartmentalize applications and provide dedicated memory and space for execution. On the other hand, Apache’s server is comparatively isolated, although some modules do offer security and
authentication services. In addition, Apache web server is not very reliable as it still suffers from application isolation and memory issues [16], [24].

7. The Bookstore web application should use an all-in-one payment processing solution that can be easily integrated within the bookstore website.

To meet this requirement, integration of PayPal’s SOAP API with ASP.NET was preferred over PayPal’s PHP integration. To integrate PayPal’s all-in-one payment processing service, ASP.NET technology seemed a better fit because it seamlessly integrates with PayPal’s SOAP API and offers enhanced security since data is transferred by SOAP API. The integration becomes easy because files can be referred in the project, and methods are readily available from the objects in the reference files. Besides this, SOAP API integration with ASP.NET is preferred because around the clock support is available if required. Unlike SOAP API integration with ASP.NET, PHP integration is cumbersome, and reliable support is not available around the clock [25].

8. The Bookstore web application should implement a fully relational database management system solution that is cost effective, highly reliable, scalable and manageable. It should include business intelligence capabilities that can be integrated with the web technology solution of the Bookstore web application.

Based on the above requirements, three of the most popular database management system solutions, Oracle 11g, MS SQL Server 2005, and MySQL 5 were analyzed. MS SQL Server 2005 emerged as the best database management system solution to meet our requirements compared to the other two for the following reasons [3], [11], [13], [17]:
The MS SQL Server 2005 is a very cost effective RDBMS solution that is easy to learn, extremely reliable, scalable, has reporting services capabilities, and Visual Studio 2005 is tightly integrated within the server.

Oracle 11g is an RDMS solution that is very reliable, secure and manageable. However, in comparison to MS SQL Server 2005, Oracle 11g is a very costly solution that has a shallow learning curve for the developers and administrators.

MySQL 5 is an open source solution. Hence, it is very cost-effective, but it suffers from other serious limitations. For example, it lacks reliable support. It is not fully relational, lacks reporting solution and is relatively harder to maintain.

Technology Chosen

Based on the analysis of the requirements, a review of the current technologies and the preferred solution for each, the following tools and technologies were chosen to satisfy the project requirements for the development of e-commerce bookstore web application:

- Microsoft ASP.NET Framework: ASP.NET 2.0 was selected as the programming framework for this project as it comes with many new features such as built-in server controls, a simple programming model, flexibility of choosing amongst various languages, easy deployment, and a powerful security mechanism [1], [2], [7].

- Programming Language: C# was selected as the programming language for this project as C# is programming language supported by Microsoft’s .NET framework and by Visual Studio 2005 IDE [8].
• Database Management System: The MS SQL server 2005 was selected as the relational database management solution for this project because of its tight integration with Visual Studio 2005 and Microsoft .NET Framework. This streamlines the development and debugging of data-driven applications [6], [11], [15].

• Web Server: Internet Information Server (IIS) 6.0 was selected as the web server for this project as IIS offers various features such as high reliability, strong security and great performance rate to the web application infrastructure [24]. Moreover, since MS Windows platform is used for the project development, IIS integrates seamlessly with Windows and hence a good fit for the web server selection.

• Integrated Development Environment (IDE): Microsoft’s Visual Studio 2005 was chosen as an IDE for this project because of its support of the Microsoft programming language, C#, and data markup languages such as HTML and Cascading Style Sheets (CSS) that will be used in this project. This development framework is going to be used for developing, documenting, running, and debugging programs written in various languages such as HTML (Hyper Text Markup Language), CSS (Cascading Style Sheet), and C# [2], [5], [8], [29].
CHAPTER III

DESIGN AND IMPLEMENTATION OF
THE PROJECT

Project Development Stage Overview

Once the scope of the project and the optimal technology for its implementation was established, as discussed in the previous chapters, the focus shifted to the development stage of the project. An overview of the development stages of the bookstore web application is illustrated in Figure 1 and Figure 2.

The first phase in the design of the bookstore and the administration websites is the identification of various use-case scenarios this web application needs to support. This individual use-case scenario tied together form an overall design for the web application and is illustrated in Figure 8. Once the overall design for the web application took shape, the next phase was to design a detailed model for the bookstore database. The design of the database was based on the project requirements and features the project needed to support. It involved identifying relationships among bookstore tables, and normalizing the redundant data. After the design of the database was established, the project moves to the implementation phase. During implementation, the Bookstore and the Administration websites were implemented using ASP.NET 2.0 technology and MS SQL Server 2005, a relational database management system. A number of key features were incorporated in the web application such as integrating PayPal’s payment processing service, deploying
Fig. 1. Project development stages of the Bookstore website.
Reporting Services, configuring Urchin 5 and setting up Secure Socket Layer (SSL).

Once the implementation was completed, the focus shifted to system testing to verify the proper functionality of the web application across all subsystems on the platform.

**Overall System Design**

The architecture of the Bookstore web application consisted of six different subsystems. Each of these subsystems had a significant role to play in the development of
the bookstore and the administration websites. A brief description of the bookstore application subsystems is given below:

- The bookstore subsystem: The bookstore subsystem was the front end interface with the customers and it primarily interacted with the administration subsystem and the payment processing subsystem. The primary interface to the bookstore subsystem was the customer who initiates a transaction. The bookstore subsystem, in turn, interacted with the payment processing subsystem to verify the credit card information of the bookstore customer.

- The shipment subsystem: This subsystem interacted with the bookstore subsystem to ship the placed order to the provided shipment address by using the selected shipment method. It also provided the bookstore subsystem with shipment tracking information associated with that order.

- The supplier subsystem: This subsystem interacted with the administration subsystem to place orders to one or more suppliers and to update bookstore inventory. Once an order was received, this subsystem was also responsible for payments to the supplier. Such payments were handled directly by the administrator.

- The administration subsystem: This subsystem interacted with the bookstore subsystem, shipment subsystem, supplier subsystem and certification authority subsystem. This was due to the fact that the administrator of the bookstore could change the order status, update the shipment methods, make payments to the supplier and update the product and category information on the bookstore website. The administration subsystem also handled direct customer requests related to their orders, such as updating
the order status, changing customer’s shipment and billing information, and updating shipment status. This subsystem also provided administrator/business owners with various sales and order reports.

- The certification authority subsystem: The certification authority subsystem verified and authenticated the certificate owner information. The bookstore web application used self-signed certificates to encrypt the communication channel between the client and the server and to confirm the authenticity of the bookstore website to the customer by using this self-signed certificate.

- The payment processing subsystem: The payment processing subsystem interacted with the bookstore website subsystem. When the customer placed an order on the bookstore website, this subsystem verified the customer’s credit card information in a secure environment. The bookstore web application used PayPal’s payment processing services to process payments in real-time.

The various subsystems used in the development of this e-commerce bookstore web application are illustrated in Figure 3.

Design and Implementation of the Bookstore Website

This stage begins with identifying key scenarios that would be encountered by the Bookstore website users.

Bookstore Website Use Cases

**Scenario 1: User visits the bookstore website home page.** The URL of the Bookstore website directs the user to view the home page or an error message is displayed. This scenario is shown in Figure 4.
Fig. 3. General System Design.

Fig. 4. Use-Case: User visits Bookstore home.
Scenario 2: User selects specific items. The home page contains various items under categories such as gifts, graduation items or clothing. A user selects a particular category and then selects a desired item under that category. The user can also select the desired items by entering the full name or partial name of that item in the search box. This is illustrated in Figure 5.

![Fig. 5. Use-Case: User selects specific items.](image)

Scenario 3: User checks out the selected items. A user adds selected items to the shopping cart and goes to the checkout page. A new user has the option to create a new account while the an existing user enters his login information. A new user has to provide personal information, including address and credit card information before he is authenticated. For an existing user, the address and credit card information is auto-filled but allowed to be modified, if required. This is shown in Figure 6.

At this stage, the user can either cancel the order to go back to the home page or the user can go to the order confirmation page after credit card information is verified.
Fig. 6. Use-Case: User enters login and shipment information.

by PayPal. An email is sent directly to the user containing the order confirmation information. In case, the customer’s credit card information is not verified, then the customer is asked to input valid credit card information. This scenario is depicted in Figure 7.

Fig. 7. Use-Case: User either places the order or cancels the order.
Overall Diagram

The use-case scenarios described above are tied together to work as a complete system and shown in a flowchart in Figure 8.

Fig. 8. User Interface Flowchart of Bookstore website.
GUI Design

The next project stage development was to design the interface of the bookstore website. A brief description of the bookstore screen shots is given below:

1. Bookstore Home: This screen is the home page of the bookstore website.
2. Graduation Items: This screen is displayed when a user selects a sub-menu option of graduation items.
3. Item Description: This screen is viewed by the user to review the item description of a selected item.
4. Shopping cart: This screen is viewed by the user when items are added to the shopping cart.
5. Shipment information: This screen is viewed by the user when shipment information is entered for the ordered items.
6. Credit card information: This screen is viewed by the user when credit card information is entered to submit payment for the ordered items.
7. Order confirmation: This screen is displayed when a user successfully makes payment for the ordered items.

Some of the key screen shots that were created for the bookstore website are given in Figure 9 and Figure 10.

Design and Implementation of the Bookstore Administration Website

This phase involves identifying all potential scenarios that can be encountered by the bookstore administration website’s users.
**Bookstore Administration Website**

**Use-Cases**

**Scenario 1: Administrator creates a new account.** The administrator of the bookstore website inputs information into the assigned fields to create an account for a new user. The administrator ensures the user’s information is unique and compliant to the new-user checks implemented. This scenario is shown in Figure 11.

**Scenario 2: User manages customer order information.** The bookstore staff members perform various functions in managing information related to their customer’s orders such as updating ordered items, modifying shipment method, canceling orders, and issuing refunds. Additionally, the bookstore staff can view the order information.
Fig. 10. Review order information.

corresponding to the specific order by using the search and sort functionality. This scenario is shown in Figure 12.

Scenario 3: User manages customer’s information. The bookstore administration staff manages information related to the bookstore customers such as editing customer’s billing and shipment information, activating and inactivating user accounts. A user can sort customer information by a customer’s last name, email, city and can search by customer’s name, address and city.

Customer accounts can be inactivated if valid customer information is not provided when the account is created. This scenario is shown in Figure 13.
Scenario 4: User manages shipment information. The administration’s website staff members manage information related to the bookstore shipment vendors such as listing, adding and updating shipment methods, shipment rates, and shipment order status. Besides this, staff members are able to activate or inactivate specific shipment methods according to their store needs. This scenario is shown by Figure 14.

Scenario 5: User manages category information. The administration website staff members manage information related to product categories such as sorting, listing, updating, and adding the product categories. Subcategories are also added under the
Fig. 12. Use-Case: User manages order information.

Fig. 13. Use-Case: User maintains customer information.
parent categories. These categories and subcategories can be edited, activated and inactivated, when required. This scenario is shown in Figure 15.

**Scenario 6: User maintains product information.** The bookstore administration website staff members maintain information related to the bookstore products such as listing and updating existing products and adding new products. A user can inactivate specific products that will result in the product being invisible to the bookstore web site users. Besides searching products by product phrase or supplier, products can be sorted by product ID, product name or product price. This scenario is shown in Figure 16.

**Scenario 7: User maintains supplier information.** The bookstore administration website staff members maintain information related to the bookstore suppliers such as listing and updating existing suppliers and adding new suppliers. Supplier-ordered items are added to the bookstore database, and these items can also be updated or deleted. These supplier orders are managed by tracking information such as supplier order status, date received, check amount and check date. In addition, the suppliers are managed by the search and sort capabilities using information such as supplier name, city and state. This scenario is shown in Figure 17.

**Scenario 8: Administrator manages report information.** The bookstore administrator can measure accurate web statistics related to the bookstore website by using a web analytics tool called Urchin 5. Some of the key reports offered by this software are session graphs and page views graph, directory drilldown, and entry and exit pages. Additionally, the administrator can look at sales data by viewing order and sales reports to accurately assess the monetary and inventory information related to bookstore products on a monthly, quarterly or a yearly basis. This scenario is shown in Figure 18.
GUI Design

The next stage in the project development was to design the interface of the bookstore administration website. A brief description of the bookstore administration screen shots is given below:

1. Create Account: This screen is displayed when an administrator needs to create an account for bookstore administration website users.

2. Customer Management: This screen is displayed when a customer’s information needs to be changed, such as name, phone number, and email.

3. Customer Order Maintenance: This screen is displayed when a customer’s order information needs to be modified. For example, changing order status, updating ordered items and updating shipment tracking information.
4. Category Maintenance: This screen is displayed to the user when category information needs to be updated, such as adding a new category, adding a new sub-category, listing and updating sub-category information.

5. Reports: This screen is displayed to the user when web statistical information is needed regarding bookstore customers. This screen is also displayed when users need information related to their customer’s orders and sales.

Some of the key screen shots that were created for the bookstore administration website are given in Figure 19 and Figure 20.

Database Design

MS SQL Server 2005 was chosen as the database system for this bookstore application. To demonstrate the project, a sample database was created by populating the
tables with the sample data. Setting up the database involved designing the database schema and creating tables. Figure 21 and Figure 22 show the database diagrams of the bookstore application and depict the relationship among these schema tables [6], [15]. The following is a brief description of the key schema tables.

1. ‘tblCustomers’ Table: The ‘tblCustomers’ table contains the customer’s personal information such as customer’s shipment address and login information. Any customer’s account can also be activated or deactivated depending on the duration of inactivity. The database information specific to the customer’s account is handled by the customer_status_code column in ‘tblCustomers’ table.

2. ‘tblOrders’ Table: The ‘tblOrders’ table stores order-related information such as order identity number, order status, order date, grand total and sales tax. This order
identity number is handled by the order_id column in ‘tblOrders’ table. It is provided to the customer upon order confirmation and can be used to inquire or update order information.

3. ‘tblOrderItems’ Table: The table ‘tblOrderItems’ contains items that are added to the shopping cart, such as price of the ordered items, quantities ordered and status of the ordered items. It is worth noting that the ordered items information is always stored in the database, irrespective of the order status because it is used for business analysis, auditing and reporting.

4. ‘tblProducts’ Table: This table contains product-related information such as product name, product price, product description, and quantity on-hand. The available quantity information is handled by the product_available column in ‘tblProducts’ table.
This product quantity is adjusted automatically based on the status of the order such as paid and cancelled.

5. ‘tblShipments’ Table: The table ‘tblShipments’ contains shipment information about the ordered items such as date of shipment, tracking number, etc. The tracking number information is stored in the database in the shipment_tracking_number column within ‘tblShipments’ table. This tracking number information is provided by the shipment carrier. It can be used by the bookstore customers to track the status of their shipments.

6. ‘tblCreditCardPayments’ Table: Information related to the customer’s PayPal transaction, such as PayPal’s transaction identity, transaction date and amount are
Fig. 19. Customer management.

A unique transaction identity is given to the customer at the time of order confirmation which can be used by PayPal for resolving any payment disputes.

7. ‘aspnet_Roles’ Table: The ‘aspnet_Roles’ table contains information about a unique record that corresponds to a unique role as shown in Figure 48. In ASP.NET 2.0 role management service, a record is inserted in the ‘aspnet_Roles’ table when a new role is added to this table [1], [2].

8. ‘aspnet_Membership’ Table: In the ASP.NET 2.0 membership database schema shown in Figure 48, ‘aspnet_membership’ table is used for storing membership data using a defined data schema. It is worth noting that user passwords that are stored in this table are not in a readable format because they are hashed by default [1], [2].
9. ‘aspnet_Users’ Table: In the ASP.NET 2.0 role management database schema illustrated in Figure 48, ‘aspnet_Users’ table contains user-related information such as user name and last activity date. This table associates the user names to a unique application in the ‘aspnet_Applications’ table [1], [2].

Implementation of Key Features

1. Fast development and enhanced security: One of the key features of this project was to eliminate tedious coding and to create the bookstore web application quickly. ASP.NET 2.0 includes new server controls such as grid view control and login controls that contain built-in capabilities for accomplishing numerous commonly-used tasks. The Grid View control was used in accomplishing tasks such as sorting, auto formatting,
Fig. 21. Database Schema for bookstore application.
Fig. 22. Database Schema of ASP.NET 2.0 Membership and Role Management Services.

ing, editing and deleting without writing any code. It saved a significant amount of
time during the web application’s development. Similarly, the built-in login controls such
as login view, password recovery and create user wizard streamlined the task of
implementing membership and role management services and resulted in quicker
development of the web application. In addition, these login controls were also used in
enhancing the security of the Bookstore web application as they stored customers' confidential information such as user password and security answer using the one-way hash technique [1], [2].

2. Integrated PayPal’s Payment Processing Service: For this project, PayPal’s all-in-one payment processing solution called Website Payment Pro was used. This provided an all-in-one payment processing service and allowed bookstore owners to accept credit cards on the bookstore website. PayPal’s Website Payment Pro service combined the payment gateway and the merchant account in a single relationship, and it helped bookstore owners avoid the expense of various payment providers [26]. In addition, the bookstore customers did not require direction to a different website for payment services since their credit card information was processed on the bookstore website itself in the background.

Some of the key steps for setting up PayPal’s Website Payment Pro service on the bookstore website were [25]:

- Created a PayPal Business account
- Applied for Website Payment Pro account and accepted the billing agreement
- Downloaded the API credentials to pass to the bookstore website
- Integrated PayPal in bookstore website using PayPal’s Direct Payment API
• Used PayPal’s Sandbox environment to test integration by passing transactions to PayPal

3. SQL Server 2005 Reporting Services: One of the key features of the bookstore web application was the implementation of MS SQL Server 2005 Reporting Services for creating order and sales reports for the bookstore administration staff. Microsoft’s Reporting Services is a part of Microsoft SQL Server 2005. The report life cycle consists of report development, management and report delivery. During the report development, a report wizard was used for setting up the reports and arranging their layout for formatting the data. The processing of these reports was carried out by evaluating the expressions and replacing their corresponding values [3]. The implementation of Reporting Services was done based on a number of benefits it could potentially provide to the bookstore staff, such as tabular report layouts, web based reports and enhanced interactivity through sub reports. The Reporting Services also provided administration capabilities through Report Manager, which was used for managing and delivering reports [3], [27]. One of the reports created for the bookstore administration website is shown in Figure 23.

4. Web Analytics Service: Another key feature of the bookstore web application was to provide the bookstore administrators with the capability of accurately measuring web statistics of the bookstore visitors. Urchin 5, web analytic software was chosen for this purpose because it comes with features such as built-in date-range controls, flexibility of scheduling reports, ease of use and enhanced security hooks. The implementation involved installing and configuring the software to specific bookstore business requirements. The main configuration steps were setting up the profile, setting up log
sources, choosing scheduling options, assigning report permissions, and direct report linking. To keep an accurate count of the bookstore website visitors, it was configured using the ‘User-Agent’ visitor tracking method [27].

5. Secure Socket Layer (SSL) deployment: Another key feature of the bookstore web application was setting up the Secure Socket Layer (SSL) on the bookstore and administration websites for data authentication and data encryption purposes. The set up process involved downloading the Internet Information Services (IIS) 6.0 Resource Kit and installing the self-signed certificate. Additionally, some of the key steps for implementation of the Secure Socket Layer were configuration of the default website properties (port value: 443) by allowing communication over a secure channel using 128-bit encryption [24].
System Testing

All the components of the bookstore web application were moved from the development server to the test server for system testing. During system testing, project files and databases were placed together to ensure that the integrated web application works as expected by the bookstore users. In bookstore system testing, various areas of the application were tested for accessibility, browser compatibility and layout consistency [4], [21], [22].

Once the system testing was successfully performed, the administrator transferred the project files to a virtual directory and deployed the application on a production server to “Go Live” with the bookstore website [1].
CHAPTER IV

CONCLUSION

Summary

The purpose of this project was to explore the features offered by various web development technologies and to look into various components that make a successful e-commerce website.

The work performed during the course of this project has revealed new perspectives on the creation and workings of an e-commerce website:

1. The numbers of e-commerce websites are going to expand continuously at an ever-increasing rate.

2. Security will play a significant role in the success of e-commerce websites. In the near future, ASP.NET 2.0 security is going to become a benchmark for newer web development technologies.

3. In the future most e-commerce websites are going to commit themselves to an all-in-one payment processing service such as PayPal. PayPal payment processing service has the potential to be used by most websites due to its ease of integration and for easily collaborating payment gateway services with the merchant account.

4. Finally, collaboration between various software vendors and web services is going to play a key role in ensuring seamless integration during the implementation of an e-commerce website.
Problems Encountered

Some of the problems that were faced during the development of this project are:

- The scope of the project was broadened, which resulted in more effort incorporating additional features than initially estimated. In addition, the project report also needed continuous revision based on the evolving project scope, which required additional time.

- Although ASP.NET 2.0 built-in controls require less coding and contain built-in functional components, programmatically, it lacks the flexibility to manipulate such controls for performing desired tasks as compared to non built-in controls.

- The system became non-recoverable for unknown reasons and displayed a fatal error message. Due to this problem, the system had to be reimaged, and the project files had to be recovered by using a hard disk recovery utility.

- The SQL Server 2005 displayed an error message when an attempt was made to connect to an instance of Microsoft SQL Server 2005. Remote connections for SQL Server 2005 were enabled using the Configuration Tools of MS SQL Server 2005. MS SQL SERVER service was then restarted to resolve the problem.

Future Work/Improvements

This project implements the essential features for the workings of an e-commerce website. Beyond the implemented features, numerous enhancements can be made for the benefit of the customers, employees, and business administration. The following are possible future enhancements for this project:
1. An alternate web analytics solution called Google Analytics can be integrated to provide additional reports about website visitor demographics and visitors navigational patterns which are not currently offered by Urchin 5, the employed web analytics tool [26], [28].

2. To save time and for speedier checkout processing, the implementation of PayPal’s Express Checkout would be an easy solution. PayPal’s Express Checkout solution allows customers to use their existing PayPal accounts to make online transactions [25].

3. Advanced reports that can potentially enable the auditors to research the balance sheet of the company should be created to calculate bookstore revenue and profits made monthly, quarterly or annually.

4. A disaster recovery plan for mirroring the primary server and database from catastrophic failures should be implemented [11].
REFERENCES
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