Architecting for Next Generation Business Applications

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Abstract: - The current generation business applications are restricted by the limitations in technology, and are unable to easily provide powerful enterprise features for developing next generation business applications that need rich user interfaces and support for development of large solutions. Microsoft’s Vista platform and WinFX API address this requirement. A Loan Management application, prototype of a next generation business application, is built using the WinFX API. The application demonstrates rich user interfaces working with business logic components exposed as services. It also illustrates separation of business logic components from workflow and data access components. This application, thus, shares an architecture and design that can be used for building future business applications.

Key-Words: - Loan Management System (LMS), Service Oriented Architecture (SOA), Next Generation Business Application

1 Introduction

Six years into the new millennium, it is time business applications utilized the advancement in technology for improved user experience at lower developer costs. In addition, the requirements of customers include enterprise-level features like integration and interoperability in the proposed solutions. All these drive the need for next generation business applications that are built on a set of core fundamentals. These fundamentals include a solid operating platform, open standards, supporting frameworks and tools. One such emerging platform that suits this need is Microsoft Vista with its system services layer WinFX.

This paper discusses the details of business challenges, how Vista helps solve these challenges showcasing a prototypical implementation of a Loan Management System as the business application. It also discusses the detailed solution architecture and implementation methodology used in arriving at the solution.

2 Business Applications – Then and Now

2.1 Business Applications - Challenges

Capabilities of current generation business applications are limited to what the current technologies can offer, such as limited UI capabilities and closed standards. Rich user interfaces often need unconventional models for development as cited in [1]. Also, seeking rich user experience only means several disadvantages such as increased project costs and time, investments into closed technologies, resource scarcity, complex development processes, etc.

Secondly, application integration has been a challenge due to many reasons, some of which are discussed in [3].
2.2 Platform Support for NextGen Business Applications

The next generation business applications need to possess the following key features to handle these challenges.

- Technology platform that is reliable, secure and manageable
- Ease in development and deployment of applications
- Rich, intuitive and spatial UI as exemplified in [2]
- Alignment to open technology standards such as XML
- Alignment to open architectural standards such as SOA
- Provide a host of frameworks and tools that support the proposed concepts

3 Emerging Platform – VISTA

3.1 Suitability of VISTA for Next Generation Business Applications

Windows Vista is an Operating System platform that is not limited to providing desktop services, but includes enterprise features [5] such as

a) Security through user account protection, split security tokens, code access security, etc.

b) Reliability and manageability through new APIs that help predict and diagnose problems

c) User experience features integrated into the platform with WinFX

d) Ease in deployment with enhancements to ClickOnce deployment strategy

e) Use of XML as the standard for most of its components and supporting the same for applications built on top of them

f) SOA support integrated into the communication layer of WinFX

g) Support for development of applications using many of these features through its development system, Visual Studio and its extensions

3.2 Architectural Considerations for VISTA

More than what was covered above, Vista comes with three primary “foundations” for implementing business applications, namely WPF, WCF and WF.

WinFX is the set of managed APIs provided by Microsoft that lays a strong focus on improving user experience through rich, flexible and dynamic user interface mechanisms such as rich user controls, animations, 3-D effects, vector graphics, etc. through Windows Presentation Foundation (WPF) framework, support for contemporary development practices, such as Service Oriented Architecture (SOA) and building distributed applications through Windows Communication Foundation (WCF) framework and implementation of workflow inside the application through Windows Workflow Foundation (WF) framework.

Windows Presentation Foundation (WPF) provides a unified presentation subsystem for 2D/3D drawing, document printing and rendering, speech synthesis and recognition. It makes use of the hardware/Graphical Processing Unit (GPU) to provide vector-based, hardware accelerated, resolution independent UI.

From a programmatic perspective, eXtensible Application Mark-up Language (XAML) provides declarative style to design UI, separate it from code that developers alone could manage.

Windows Communication Foundation (WCF) is the conglomeration of all the pre-existing communication technologies on Windows platform to a framework for service-oriented architecture. It provides mechanisms for defining addresses, bindings and contracts of component services and supports interoperability with WCF and non-WCF clients that include older Windows and other platforms.
Windows Workflow Foundation (WF) is a framework for building workflow within an application context. It includes both system and human workflows. It provides features for long-running workflows, runtime access, graphical and code-based authoring. As per [4], workflow plays a key role in large-scale distributed applications and becomes a part of tightly integrated architectures.

VISTA platform in general and WinFX in particular provide a platform and API that help develop rich business applications using open technologies.

3.3 VISTA – A Comparative Study

VISTA is an Operating System platform with a unique set of frameworks not available from other platform vendors. While Java platform has tremendous support in terms of frameworks, the model and philosophy are quite different for presenting a comparison.

However, WPF can be compared with Macromedia Flash [8]. WPF takes advantage of the hardware for graphics rendering because of its tight coupling with the Operating System. While Flash has very good programming and 3-D support, WPF supports a declarative programming model which does not exist in Flash. WPF’s programming model also helps in bringing object-orientation to UIs natively. Further details on the comparison of the two frameworks are available at [9].

Apart from Workflow Foundation, BizTalk is another product available from Microsoft for implementing workflow in current generation applications. The key differentiators of WF from BizTalk, besides carrying platform support, include simpler implementation, tighter integration with business logic, and omitted overhead of Business Process Monitoring capabilities of BizTalk. A detailed comparison of the features of WF and BizTalk can be found at [10].

Similarly, WCF is light and derives platform support which is not available in many other SOA tools and frameworks.

4 Solution Overview

Loan Management System (LMS) addresses the problem domain similar to most business applications that provide self-service application with workflow. The primary use cases of LMS are Registration, Login, Loan Application Request/Approval and Status Request.

Register: Provides a self-service mechanism for general users to register themselves with the system.

Login: Provides mechanism for registered users to authenticate themselves to apply for loans and check on the status of their requests.

Apply for Loan: Provides authenticated users, a mechanism to apply for loans.

View Status: Helps loan applicants track the status of a loan request.

The application is developed using n-tier architecture. It presents UI using simple controls and images rendering rich user experience such as 3-D space and effects. It also aligns to SOA using WCF and supports workflow using WF.

5 Solution Architecture

The Loan Management System is a web-based, .NET application developed using WinFX API.

The Presentation layer consists of a set of UI components developed using Windows Presentation Foundation, UI Process components to navigate between the screens and uses Service Interface pattern to invoke the WinFX service.

The user of the application uses the browser to initiate the application. The presentation layer forwards the request to the WinFX service over HTTP. The WinFX Service acts as the service interface for the service components implementing the business logic and instantiating the workflow. The service components and workflow library use the data access façade to access the database components.

The data access layer consists of data access façade and data access components. The data access components encapsulate access to the SQL Server 2005 database.
6 Implementation Details

The main objective of the application is to showcase next generation business applications. WPF capabilities can be exploited to create user interfaces that provide immersive user experience and mimic real life scenarios. WCF provides communication services and is used to encapsulate existing business layer which integrates the workflow logic using WF.

This section gives an overview of how the prototype was built, explaining the modules and covers the detailed implementation specifics of the application

WinFX consists of three fundamental frameworks:
- Windows Presentation Foundation (WPF) is “a user interface subsystem and API based on XML, .NET, and vector graphics, which makes use of 3D computer graphics hardware and Direct3D technologies” [7].
- Windows Communication Foundation (WCF) is “a service-oriented messaging system which allows programs to interoperate locally or remotely similar to web services” [7].
- Windows Workflow Foundation (WF) “allows task automation and integrated transactions using workflows” [7].

6.1 Presentation Layer

To provide a great user experience the prototype was built using WPF as it provides mechanisms to model and display 2-D and 3-D objects such as cubes, rectangles, etc and apply patterns and light properties on them for user interface design.

Some of the objects were created using ZAM 3D and MS Expression Interactive Designer, WinFX 2006 CTP and imported as XAML files into WinFX development environment. Animation was provided for in-screen navigation. Many of these UI features were not possible in earlier technologies.

The screens present 3-D space in the form of halls and walkways. These are created by showing 2-D rectangles/images with simple patterns in perspective view. Some of the UI elements are created by converting simple 2-D rectangles/images into 3-D image objects (in Interactive Designer) and attaching event handlers.

Storyboards provide for in-screen navigation. The end images mimic real life setup such as walkways and reception desk. Menus are provided with the help of text controls, converted into images and aligned in 3-D to appear in the form of table-top placard.

The event handlers that need to show screens for user input are implemented using 2-D forms and controls provided in WPF. Once a form data is entered and submitted, the form object with the associated controls is converted into a 3-D image and the submission process is animated through a storyboard.

The screen navigation is implemented using structured navigation. A navigation hub class is created which holds the sequence of navigation paths. The order in which pages are displayed is determined at run time. The structured navigation is based on objects called “page functions.” The advantage of using structured navigation is that the data can be transferred between pages using page function object and there is no need to keep track of previous page as the sequence is stored in stack which is easily accessible.

6.1.1 Service Interface Component

Presentation flow starts with form objects calling service interface object passing the request parameters to it. This service interface object uses a proxy of the WinFX service, which is created by svcutil.exe utility. This service utility creates MyService.cs file and updates App.config file with appropriate code for calling the service layer.

The service interface packages the request parameters of calling object into request object in the format defined by the proxy. This service interface invokes the WinFX service methods using proxy by passing the request object as parameter.

6.2 Business Layer

6.2.1 WinFX Service Module

WinFX Service Module developed using Windows Communication Foundation works as Business Layer.

The service interface from the presentation layer calls methods of the WinFX service by passing serialized request object as a parameter. Depending on the functionality, the service methods of the service component call Data Access Façade, and/or start the workflow runtime
and initialize the workflow in the LMS Workflow Library component. The calls to workflow are handled asynchronously by the event handlers provided by the service component.

Based on the response from Data Access Façade, the response object is serialized and sent back to presentation layer.

6.2.2 Workflow Module
Workflow is developed by visual modeling of the activities in VS 2005 extensions for Windows Workflow Foundation.

The workflow is designed for automated loan processing. The request object from the presentation layer is passed as a parameter to the workflow. At runtime, the workflow decides whether to approve, reject or keep the request status as pending based on certain pre-defined criteria.

The workflow component directly updates the database appropriately.

6.3 Data Access Layer
The LMS Data Access Layer is divided into Data Access Façade and Data Access Components. The Data Access Façade identifies the corresponding Data Access Component and invokes the corresponding DAC for database operations. Data access components use persistence framework of ADO.NET to access the database stored procedures that encapsulate the data modification logic. The application configuration file is used to store the connection string. The response is gathered into the response object and sent back to the business layer.

7 Conclusion
The next generation business applications will have significant demands from users in providing rich and intuitive user interfaces, seamless integration with business functionality implemented in several applications and sophisticated workflow. Platforms will need to provide the necessary capabilities such as those found in the emerging platform Microsoft VISTA and WinFX API The Loan Management prototype discussed in this paper shared an application architecture and design that can be used as a basis for developing next generation business applications.

References


