

Spring Framework: A Companion to JavaEE

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Abstract

This paper present the ideas of the Spring framework which is widely used in making enterprise applications .Considering the present situation where applications are developed using the traditional EJB model, Spring framework insists that ordinary java beans can be used with slight modifications. This framework can be used with J2EE to make it easier to develop application. This paper presents the architecture overview of spring along with the features of the framework that have made the framework useful. The integration of various frameworks for an E-commerce system has also been discussed in this paper. The Spring MVC framework is also discussed. This paper also proposes architecture for a website based on Spring, Hibernate and struts framework.

Keywords- Spring, IoC, AOP, E-commerce, MVC

1 INTRODUCTION

In today's world, with the advent of information technology and communication media many of the organizations use frameworks for making the development of applications easier. The business nowadays demands web applications so it is very important to take care of the architecture. Framework can be thought of as a set of functions helping the developers in creating the applications. The Spring Framework is an application framework that helps to customize applications. Even though JavaEE is widely

used, it has some limitations such as reusability of code is less, heavy development burden [1],[5].Spring framework when used with JavaEE makes the development easier. Spring is a layered architecture so whenever an E-commerce system is developed using spring it has clear

separation of the layers. Because of its layered architecture it allows users to select about which of its components users can use.

2 RELATED WORK

2.1 Architecture of Spring

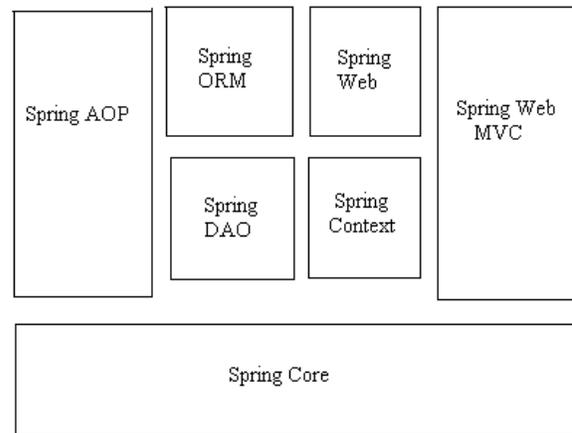


Fig 1 Architecture of Spring Framework

The architecture of spring has seven modules. The modules are as follows [2]:

- The core container
- Spring context
- Spring AOP

- Spring DAO
- Spring ORM
- Spring Web Module
- Spring MVC framework

2.2 Features of spring framework

Spring is a free, open source framework that offers a lot of functions to programmers. It was created by Rod Johnson and Juergen Hoeller. The most important features are the Inversion of Control, Aspect oriented programming and Spring MVC. Spring has its own MVC framework that can be used with other frameworks. The Aspect oriented programming, IoC and MVC are the important features.

Aspect oriented Programming: With the help of AOP the various concerns present in a system can be separated easily. In spring aspects are joined together with the help of spring xml file and coding is well modularized [10].

Example: consider the example of library system
 The various types of services such as student service, librarian, and staff need the functionality provided by Logging, Security, and Transaction modules. The normal system for this would be as follows [6]:

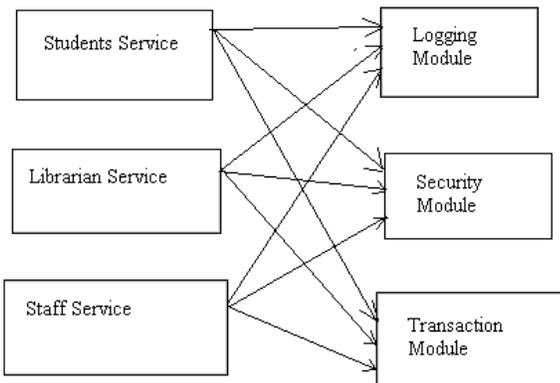


Fig 2 Normal System without AOP

The same system with the help of AOP can be drawn as follows: All the three functionalities are provided to all the three services [6].

Inversion of Control: In the IoC instead of an application calling the framework, it is the framework that calls the components specified by the application. The dependencies are injected dynamically at run time.

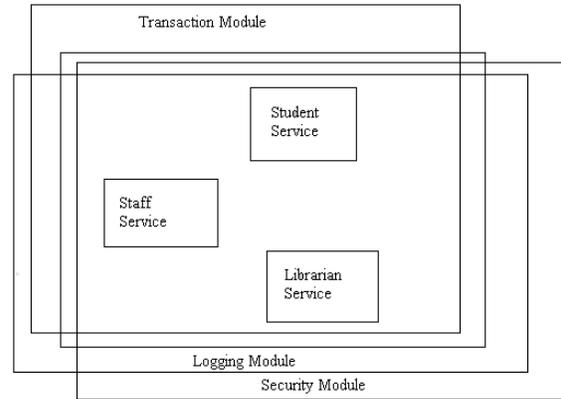


Fig 3 Approach using AOP

2.3 Spring mvc model

The Spring Framework provides its own MVC model. The major components of Spring MVC are as follows [3]:

- DispatcherServlet- It receives the request transferred to it by web.xml file.
- Controller- It handles the request and is created by user. They are objects that can respond to the actions a user takes like form filling or clicking a link.
- View- It can be thought of as a way of representing the output to the end users.
- ModelAndView- Whenever a request come it's the job of ModelAndView to associate the view to the particular request. It is created by controller and when it executes it returns data and name of view.
- ViewResolver- It tries to resolve the view based on output given by ModelAndView and select the output media.
- HandlerMapping- Whenever DispatcherServlet receives incoming requests it associates the request to individual controllers with the help of this component.

The MVC model of Spring can be shown as below [6]:

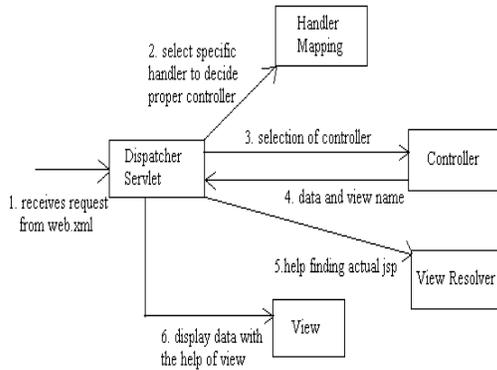


Fig 4 Handling of request using Spring MVC

2.4 Spring and xml

XML stands for Extensible Markup Language. XML is widely used in most of the frameworks for handling of the configuration information. The information stored in xml files can be modified and the change can be seen throughout the application. With the help of xml files process of development can be simplified and time can be saved. There are three types of xml files:

- web.xml file
- applicationContext.xml file
- DispatcherServlet.xml file

web.xml:

Whenever a request is initiated by a user the web.xml file receives this request and forwards it to DispatcherServlet which is being specified in the web.xml file. The web.xml file specifies the xml version number and name of DispatcherServlet [3].

The DispatcherServlet can be configured as shown:

```
<servlet>
  <servlet-name>dispatcher</servlet-name><servlet-class>
  org.springframework.web.servlet.DispatcherServlet</servlet-class>
  <load-on-startup>1</load-on-startup>
</servlet>
```

This indicates that name of the servlet is “dispatcher” and load-on-startup 1 indicates that it should be the first to execute when called.

The type of URLs that can be handled by the DispatcherServlet can be shown using <url-pattern> element.

```
<servlet-mapping>
  <servlet-name>dispatcher</servlet-name>
  <url-pattern>/send/*</url-pattern>
</servlet-mapping>
```

The configuration files can be loaded using the most commonly used context loader called as ‘ContextLoaderListener’ as shown below:

```
<listener>
<listener-
Class>org.springframework.web.context.ContextLoaderLis
tener</listener-Class>
</listener>
```

ApplicationContext.xml:

It is responsible for handling the flow of events. Whenever applications are developed in a J2EE environment this xml file needs to be included [3].

```
<bean id="superClass" class="packageName.SuperClass"
/>
<bean id="subClass" class="packageName.SubClass">
</bean>
<property name="superClass" ref="superClass"/>
</beans>
```

This file loads the bean of SuperClass.java and SubClass.java.

DispatcherServlet.xml:

Whenever a request is received by web.xml file it has the name of the Servlet that is responsible for handling the request in the <servlet> element. The DispatcherServlet is responsible of handling the request. It specifies the view resolver, beans, handlers and their mapping [3].

```
<bean id="viewResolver"
class="org.springframework.web.servlet.view.InternalReso
urceViewResolver">
  <property name="prefix">
  <value>/WEB-INF/views/</value></property>
  <property name="suffix"><value>.jsp</value></property>
</bean>
<bean id="urlMapping"
class="org.springframework.web.servlet.handler.SimpleUr
lHandlerMapping">
  <property name="mappings">
  <props><prop key = "/*">dispatchController</prop>
```

```

</props>
</property>
</bean>
<bean id="dispatchController" class="
packagename.DispatchController"></bean>
</beans>
    
```

2.5 E-Commerce System Using Spring and other frameworks

Spring framework can be used with many other frameworks for making of an E-commerce application such as struts and hibernate.

Struts framework: This framework divides web system into three layers: Model, View and Controller. Model consists of JavaBeans, EJB; View consists of JSP files; Controller is carried out by Actions [4].

The architecture of struts can be shown as below [2]:

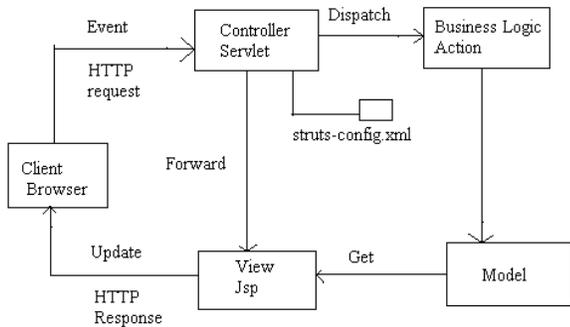


Fig 5 Implementation of Struts

The structure of Hibernate can be shown as below [2]:

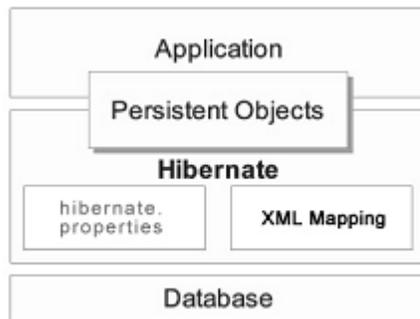


Fig 6 Structure of Hibernate

Hibernate framework: This framework reduces the complexity and difficulty while manipulating the JDBC

and SQL data. It maps Java classes to database tables efficiently. It is mainly associated with databases [3],[4].

Integration of Struts, Spring and Hibernate

Struts, Spring and Hibernate frameworks can be combined together to make an efficient E-commerce applications. The struts framework with an efficient MVC can help in developing the presentation tier. The Spring framework can help in handling the business logic. The Hibernate framework can help in handling the data present in the system and help in storing and retrieving the data to and from database respectively.

The architecture based on integration of above frameworks can be shown as below [1]:

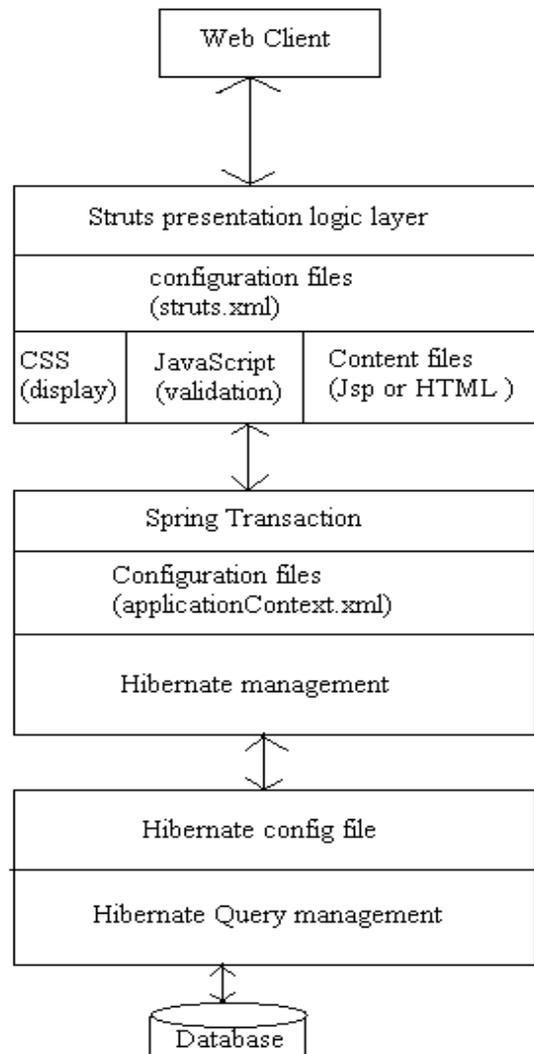


Fig 7 Architecture based on spring, struts and hibernate

A. Web presentation layer

The web presentation layer is been handled by the struts framework. It is responsible for handling requests and forwarding the response back to client. It provides with the views that can be provided to the users such as Jsp, HTML documents.

B. Business Logic Layer

The business logic layer is been handled by the spring framework. The main features of this framework being IoC and AOP are used for handling the business logic. It also handles the interaction with the Hibernate persistence layer with the help of its DAO component.

C. Data Persistence layer

The data persistence layer is handled using the hibernate framework. This framework makes connectivity of data easier instead of using the tedious JDBC connection error handling mechanisms. This layer is called by business logic layer. This layer handles interaction with the database to retrieve and store data.

b) Business layer:

The business layer is also called as business Logic, functional Process Logic, Business Rules and all are kept in a separate layer. In this layer we typically define classes, functions, procedures, properties. The business layer can be handled using spring framework because it has various features such as Aspect Oriented Programming and dependency injection.

c) Data Access layer:

The data access layer is used for connectivity with the database. It handles the creation of databases. It also handles database related coding.

The general architecture for the three tier can be as follows:

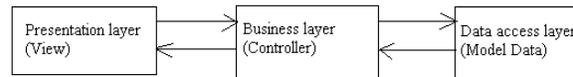


Fig 8 General 3-Tier architecture

The proposed architecture for the website consisting of the three layers is as follows:

3 PROPOSED SYSTEM

The above Spring framework which is having a multitier architecture can be used with many other frameworks such as Struts which can be used for web presentation layer. It can also be easily integrated with Hibernate which is a powerful database connectivity layer. Although spring has its own MVC it can use the presentation tier of Struts.

The proposed system here can be considered here with the help of a website such as that of a Shopping Cart where user requests items and buys items. It generally has three layer i.e. presentation layer, business layer and database layer.

a) Presentation layer:

The Presentation Tier or User Interface is the portion the user sees when they open a web page in the browser. It is what is presented to the user on the client side within their web browser. It is responsible for handling requests and forwarding the response back to client. It provides with the views that can be provided to the users such as Jsp, HTML documents. The presentation layer can be done using either spring mvc or struts.

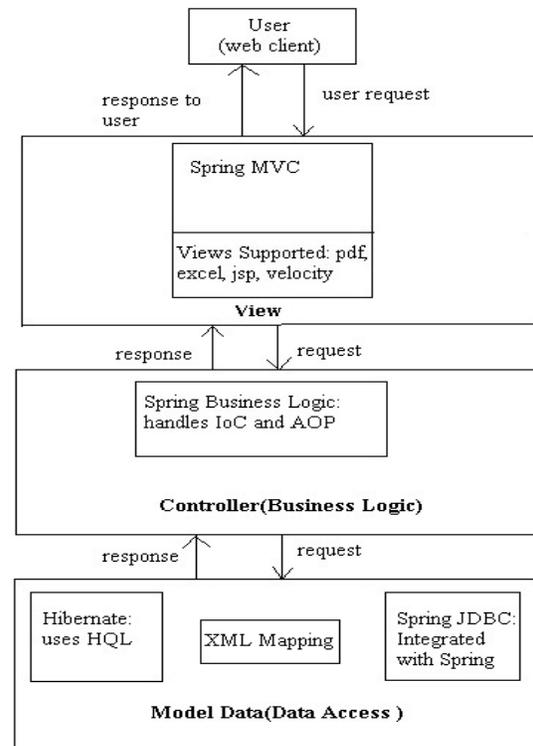


Fig 9 Proposed System

The above architecture can be explained as follows in terms of model, view and controller.

a) View- Presentation Layer

The View basically means how the results will be displayed to the users. There can be various views supported by different web frameworks.

The website can be developed using the following frameworks: Spring MVC, Struts.

Benefits of Struts MVC are as follows-

1. Centralized File-Based Configuration- The mapping to be done is in XML configuration file. This allows loose coupling changes can be made by editing a single file.
2. Form Field Validation- Struts provide strong validation that is in built.

Even though Struts is used for web presentation layer there are many other contenders for it such as Spring's own MVC, Stripes, Wicket. But Struts has its own limitations which can be stated as follows:

- 1) Testing is difficult in Struts as compared to Spring MVC.
- 2) Struts 1 supports less number of views as compared to Spring MVC.
- 3) Documentation is not properly organized so difficulty arises for developers.

Benefits of Spring MVC over Struts are as follows-

- 1) Spring MVC uses interfaces which avoid concrete inheritance between action and form objects.
- 2) Using Spring IoC testing of objects becomes easy.

Although Spring MVC has its own added advantages it also comes with some limitations such-

- 1) Spring MVC requires extensive XML configuration files which can become tedious.

- 2) Spring MVC doesn't support AJAX-Asynchronous JavaScript which is a newer trend in developing an web application.

The main functions of the presentation layer are as follows-

- 1) It is responsible for validating, collecting and displaying the data by using various views to the users such as collecting the quantity of shopping item from user, displaying the price either in graphical manner or pie chart.
- 2) It forwards the request to the business layer and also collects response from the business layer and displays it to the user.

b) Controller- Business Layer

The controller is responsible for handling the business logic and handles business logic. In this layer we can define classes and define procedures to be written in java.

The website can be handled with the help of Spring AOP and IoC which helps in handling business logic and business data.

The Spring framework acts as a good contender for the middle tier because of its Aspect Oriented Programming and Inversion Of Control.

The main functions of Spring framework while making it use for developing a website are as follows:

- 1) The Spring framework provides its own MVC so there is no need to use any other MVC. Developers may sometime feel more comfortable with some other framework such as Struts so Spring should easily get integrated with such frameworks.
- 2) The Spring framework has the main functionality as Inversion of Control and Aspect Oriented Programming which can be efficiently used to handle the business objects.

This layer should be able to access the data from data access layer.

c) Model data- Data access Layer

The website which is being stated will have some data to be displayed to the user which can be stored in a database. The user gives request to the application about various information such as list of shopping items, their prices, their available quantities. In order to access the database the Spring framework provides its own JDBC connectivity module which can be used to access the database.

The Spring framework can also be easily integrated with other ORM tool such as Hibernate, iBATIS.

The ORM tool is a tool that performs mapping from Object to relational tables. Hibernate is one such ORM tool.

The spring framework has its DAO module which can be helpful to connect any ORM tool.

The Hibernate ORM tool can be easily integrated with spring with the help of XML mapping. The spring framework when used with Hibernate for data access and Struts for Web presentation can help in developing web application in an efficient manner.

4 DISCUSSION

The Spring framework has its own mvc model. Struts framework which is used for presentation tier also has mvc model. But there are some differences between the two with regards to the mvc model. The differences can be explained as follows[17]:

- 1) The Spring mvc supports more number of views than that of the struts1 such as struts1 only supports JSP and Tiles, but spring mvc supports Velocity, pdf, excel in addition to Jsp and Tiles.
- 2) Spring mvc is well organized as compared to struts.
- 3) Struts framework has been around for long time, so it is easy for use as compared to Spring because documentation of spring has to be read before using it.
- 4) Spring mvc web tier are typically easier to test than Struts web tiers due to avoidance of forced concrete inheritance and explicit dependence of controllers on the dispatcher servlet.
- 5) With the help of spring mvc all tiers can be used, but struts can only be used for web tier.

The above differences between struts web tier and spring mvc can be thought of as very little when comparison is done between struts 2 and spring. But both of them are very much same with the advent of changes from struts 1 to struts 2.

The Spring framework has its own JDBC module for data access but it can be compared with Hibernate based on how connection is done between database and application.

JDBC vs Hibernate

- 1) Using JDBC developer has to write code to map object into relational tables, Hibernate does this thing using the xml files so need for developers to write the code to map java classes to database tables.
- 2) Scalability of Hibernate is very good for high performance applications as compared to JDBC.

5 ARCHITECTURAL BENEFITS OF SPRING

There are many architectural benefits of Spring framework. They can be described as follows [3]:

- Spring Framework can be effectively used with other frameworks such as struts, hibernate.
- Spring provides easy access to database by using hibernate framework and avoiding the handling of error mechanism.
- Applications developed using this framework depends on few APIs.
- Due to its Inversion of Control feature the amount of time needed for testing the code is less.
- Because Spring is a layered architecture users can select which of its components can be used.
- The Spring Web MVC framework is robust, flexible and well designed for rapidly developing web applications.

- Spring Web MVC provides controllers so that handling of many requests from user interface becomes easier.
- Spring Framework can work effectively with J2EE for developing applications in an effective manner.

6 CONCLUSIONS

Spring is a powerful framework for building enterprise applications. It can also be easily integrated with struts and hibernate frameworks for developing efficient enterprise applications thereby reducing the coupling and clear separation of layers. Due to its lightweight feature it is easy to use. Simple web server such as Tomcat can also be used during integration of spring with other frameworks. Considering the present scenario wherein there is struts2 framework that can be used for web tier spring framework can be used effectively for all the three tiers to build an efficient enterprise application. The Spring framework can be easily integrated with any ORM tool such as Hibernate with the help of XML mapping and also with iBATIS.

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