

## **A Method for Pattern Selection in Web Framework Design**

*Pak Song Ho, Ri Il Nam*

**Abstract** We studied a method for selecting rational software design pattern for the framework development to web application. In the realm of software development the modularity and reusability of software are rising because of huge consumption of cost for the maintenance and repair rather than for software development. In the software development, framework not only helps raising the quality of products and production rate but actualizes and extends the functions according to the specific features of targets. Because framework determines software architecture, it helps developers not only reduce the time of development but also develop, deliver and use it with ease. Thus, to design framework correctly is a crucial problem essential for software development and this requires experience and knowledge of many developers.

**Key words** framework design, design pattern, hierarchical analysis method, hierarchical analysis model, hybrid-analytic network process

### **Introduction**

The great leader Comrade **Kim Jong Il** said as follows.

**“By developing our science and technology to world standards as soon as possible, the intellectuals should make a great contribution to increasing production rapidly and developing the economy.”**(“KIM JONG IL SELECTED WORKS” Vol. 10 P.196)

We should intensify study on the development of web application so as to put the production and business activities of factories and enterprises in all fields of the national economy on the world-level IT basis as soon as possible.

Known in recent development of the web framework are only limited methods [1, 3] such as one for selecting patterns for the decision of architecture and implementation of components in comparison with already analyzed functional requirements and domain of pattern's problem solving. And the other one [2, 6] is to select seized patterns on the basis of development experiences. There are no other methods than these. Thus there arise the following problems.

First, it is impossible to select correct corresponding patterns based on the domain of pattern's problem solving when the developer sets the domain of framework too large and when it is changed [6].

Next when the developer is greenhorn and does not understand the pattern fully, it is difficult for him to make correct selection. And he might lose much time since it needs more time to study and acquire much experience.

For that reason it presents itself as an urgent task to clarify from fresh angle the scientific pattern setting methods in consideration of the patterns and their co-relationship for the right methodology for the implementation of software components including framework.

## 1. Hierarchical Analysis Model and Pattern Selection Algorithm

### 1.1. Definition of hierarchical analysis model for the pattern selection

Analysis hierarchical process (AHP) is one of the most intellectual multi-target optimization. It divides the elements affecting target making depending on the subordinate relationship among the strata. It is helpful to deciding rational methods by defining the relative weight[7].

Here we create comparison matrix between elements and make relative weight with value equivalent to the highest inherent datum a weight vector by using eigen vector method.

Because our weight vector does not exactly coincide with actual value in general, there are some advanced methods. These method are AHM(Attribute Hierarchy Model) and ANP(Analytic Network Process), H-ANP(Hybrid-Analytic Network Process)[7].

My paper newly proposes pattern selection method with the use of H-ANP for the selection of pattern in web framework development.

We made new hierarchical analysis model and showed relations between valuation items and each element with the pattern selection as an ultimate goal.

Requirement of hierarchical analysis model is as follows:

- In each layer, the relations between elements have to be equal. The lower layer is subordinate to the higher layer and these relations of dependence can not but are partial.
- Relations between each layer and each element have to be well-poised intuitively.
- Valuation items are criterion. The number of items of lower layer in relation with those of lower layer should be 7, 9 at best.

For example, valuation items[4, 5] of pattern selection for presentation tier are control for invocation coming to web page, combination of processing component according to the content of invocation and access for data processing according to result of invocation.

If we concretize 3 items of pattern selection in presentation, the following can be possible:

Item 1: It's pre-processing or post-processing of your requests.

Item 2: It's adding log records, debugging, or some other behavior to be completed for each request.

Item 3: It's centralizing control for request handling.

Item 4: It's whether to implement your controller as a servlet or JSP.

Item 5: It's whether to implement your Helper components as JavaBeans or Custom tags.

Item 6: It's creating a generic command interface for delegating processing from a controller to helper components.

Item 7: It's how to partition your View and Model.

Item 8: It's where to encapsulate View Management and Navigation logic.

Item 9: It's reducing coupling between presentation tier and business tier.

Item 10: It's controlling client access to a certain View or sub-View.

Item 11: It's controlling duplicate form submissions.

Item 12: It's partitioning Data Access Code.

Next, because proposals are design patterns, we determine pattern relations through one to one comparison based on resolution domain and function analysis of every pattern.

We construct tiers for design pattern selection by considering setting valuation items and relations. Its modeling is as Fig. 1:

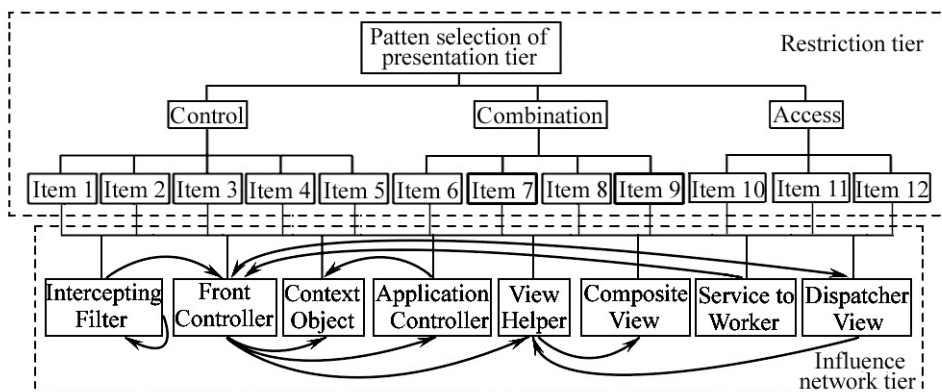


Fig. 1. Hierarchical analysis model for presentation tier pattern selection

## 1.2. Pattern selection algorithm

In proposed model of tier analysis, final target is presentation pattern selection and valuation items set control, combination and access. And details of every valuation item are 12 altogether, result is 8 design patterns.

Because relations between design patterns are inter-connection, model of tier analysis consists of restriction tier and influence network tier, and H-ANP is used in pattern selection.

Proposed pattern selection algorithm in paper is newly made according to hierarchical analysis model of Fig. 1 to reduce complexity of computations of H-ANP algorithm and increase accuracy.

First, weight of every item in restriction tier is calculated by using AHM.

Make matrix for judgment of one to one comparison  $A = \{a_{ij}\}$  for valuation of every layer.

$a_{ij}$ : degree of importance items for target achievement.

Calculate matrix for attribute judgment  $\mu$  by using attribute measure for judgment.

$$\mu = (\mu_{ij})_{n \times n}, \quad i, j = 1, 2, \dots, n$$

Calculate relative attribute weight of item  $i$ .

$$\omega_i = \frac{2}{n(n-1)} \cdot \sum_{j=1}^n \mu_{ij}$$

Second, weight of every item in influence network tier is calculated

Calculate influence rate of patterns by the method of level value.

Calculate degree of directive contribution of patterns for every item by using AHM.

Calculate degree of grey relations for patterns.

Calculate coefficient of association between influence rates with degree of grey relations by using appraisal method of weight by expert.

Calculate indirect influence rate of patterns for each item in restriction tier by using average weight based on coefficient of association.

Calculate total influence of patterns for restriction tier by annexing influence which each pattern exerts to the other. Calculate degree of total contribution by multiplying degree of directive contribution with total influence. Degree of total contribution is weight of every pattern for target implementation.

### 1.3. Pattern selection result of J2EE design patterns

By valuation conditions of item 2, item 3, item 4, item 6 from pattern selection algorithm, if we calculate the degree of total contribution of implementation patterns for presentation tier in J2EE design patterns, the table 1 is the result.

Table 1. The degree of total influence and of total contribution

Items	The degree of total influence	The degree of total contribution
IF	2.875	0.536
FC	3.616	1.598
CO	2.292	0.552
AC	2.562	0.69
VH	2.188	0.702
CV	2.086	0.396
SW	2.392	0.392
DV	2.766	0.636

In the result, we selected FC(FrontController) pattern of which weight value is the highest.

That is why; we changed valuation items from problems of presentation tier. Then we selected the patterns which are as table 2.

Table 2. The patterns for implementation components of presentation tier

Components	Patterns
Interception	Intercepting Filter
Request Dispatcher	Front Controller, Dispatcher
Request execution	Command
View creation	View Helper
View preparator	Composite View

For implementation patterns, we implemented Intercepting Filter pattern as an example.

If we used the rational standard filter method, then implementation packages of intercepting filter pattern will be like table 3.

Table 3. The implementation packages of intercepting filter pattern

Packages	Descriptions
MultipartEncodeFilter	Intercepting for encoding
DebuggingFilter	Intercepting for debug
SessionFilter	Intercepting for Session
DecoratorFilter	Intercepting for decoration
MultipartFormData	Intercepting for multipart formdata
FilterChain	Intercepting execution manager
Intercepting-Descriptor.xml	Intercepting evolution descriptor
FilterManager	Intercepting kernel manager

As a result, the basic class diagram of implementation suggestion framework is as Fig. 2.

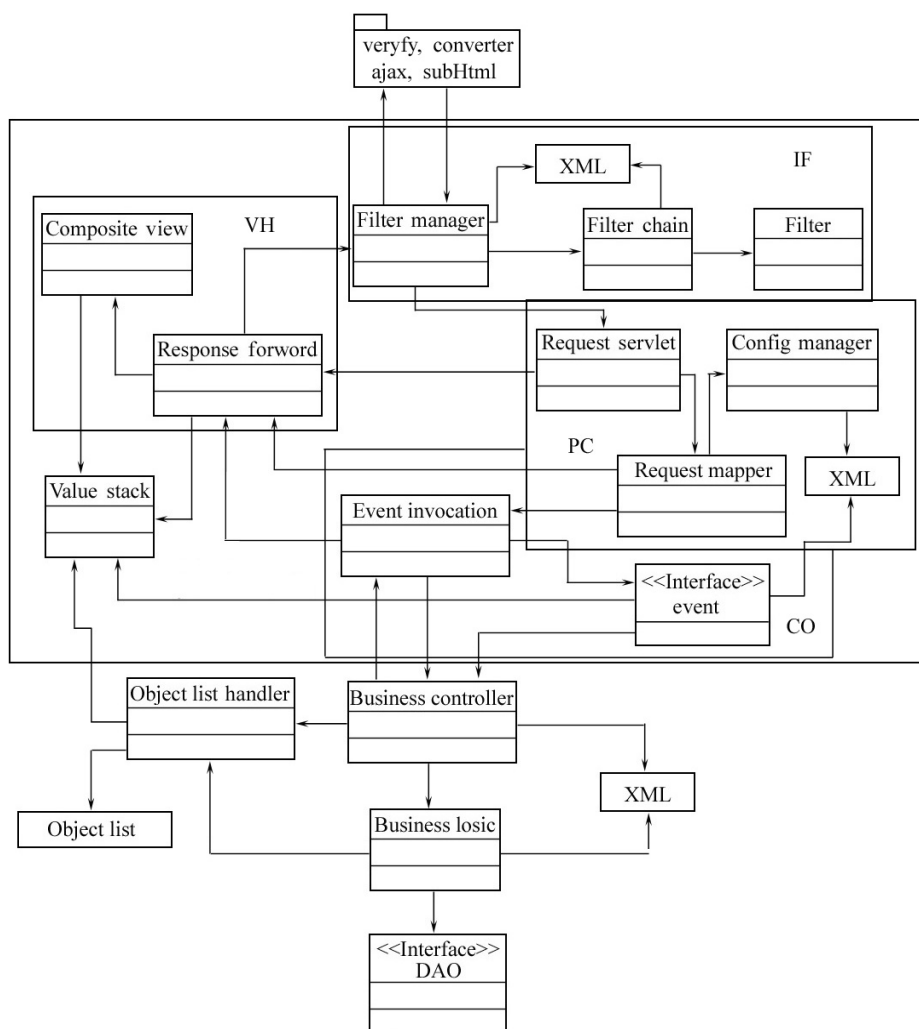


Fig. 2. Class diagram of suggested framework

## 2. Characteristics of Comparison and Evaluate of Suggested Framework

First, comparison between Struts framework [4, 5] and suggested method is as follows.

Table 4. Comparison between Struts and suggested framework in development valuation

Character	Struts	suggestion
method for pattern selection	Experience or domain comparison	H-ANP
Selected design pattern	5	10
Implemented core package	6	11
Development cost	1 923.7	1 387.2

Second, comparison between Struts, JFF and common character for reusability is as follows.

Table 5. Comparison of reusability of frameworks

Character	Struts	JFF	Suggestion
MVC	Incarnation	Incarnation	Incarnation
Construct tier	Presentation tier	Presentation tier, business tier, data integration tier	Client tier, presentation tier, business tier, data integration tier
Using tag	Using custom tag	No define	Using custom tag
Asynchronous communication	Supporting Ajax	No define	Supporting Ajax
Verify input value	Supporting Validation framework	No define	Verify client
Auto development tool	Supporting 1.x	No define	No define

Third, it is to evaluate performance of suggested framework by developing business program for device management.

Test condition: device registration page, 20 simultaneous users, 25 requests from each. The result is shown in table 6.

Table 6. Comparison between Struts and suggestion

Character	Struts(2.0.1)	Suggestion
Development package	6	3
Error pursuit rate	98%	94%
Verify speed of input value	20~70ms	5~10ms
Response time(database creating)	40~100ms	30~90ms
Response time(database reading)	50~120ms	40~70ms

## Conclusion

The paper is oriented to implementing a method for pattern selection by using intellectual hierarchy analysis, which is of importance in designing and implementing framework for the development of web application by means of designing pattern of software.

In recent, analytic network process of hierarchy analysis represents the highest intelligence and it implements feasibly the element selection to meet the purposes, with due consideration into the combination and relations between the elements in the formed hierarchy.

If it selects the most reasonable pattern and implements framework by the hierarchy analysis, it can lift the quality of framework, extend functions and easily develop application software and at the same time reduce the cycle of development.

Thus, implementing the framework for development of web application by selecting J2EE design pattern of H-ANP method can raise the efficiency of technology and economy.

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