Research on Dynamic Software Architecture of Self-adaptive Web System

CaiFeng Cao , YaoZu Luo

School of Computer   Wuyi University   Jiangmen 529020, China

cfcao@126.com

Keywords: D-ADL; Dynamic software architecture; Web application system

Abstract. With the development of Web application, users hope Web application system can provide with high quality services for them. Thus,we have proposed a self-adaptive Web system and its three-tier architecture. Then, we have designed dynamic software architecture for it.The DSA has been applied to the development of autonomous learning platform system.

Introduction

The research about DSA is mainly focused on dynamic evolution, the language of describing SA dynamic evolution and its execution tools. The research is mainly on therory. DSA application is in the stage of exploration. In view of Web system being widely applied as well as its adaptive performance shortfalls,this paper tries to solve the problem of Web system's weak adaption from the aspect of software architecture. We have discussed the dynamic software architecture of Web system, used the D-ADL to describe Web system,which lays the foundation for the implementation of self-adaptive Web system.

Architecture of Self-adaptive Web Application System

Chen and David proposed an three-layer adaptive SA framework in [1], which can be divided into task layer, model layer and operation layer. In this paper, based on the hierarchical model, we proposed the architecture of self-adaptive Web system, which can meet the self-adaptive demand of web page and function in the current network environment.

The architecture of self-adaptive web application system consists of user layer, self-adaptive layer and service layer . The three-tier architecture is showed as Fig. 1.

User layer is the man-machine interactive interface, being used to describe user requirements, and triggering the adaptive event. User terminal interacts with the Web application system through browser.The system can obtain the target needs according to different user terminal browser request ,which corresponds to different user demands.Different user demands correspond to different system services. When user demand changes, it only needs to modify the mapping relationship between service and demand, which can realize the effect of dynamic self-adaption.

Self-adaptive layer is the core layer of the whole self-adaptive Web application system .It includes three modules, environmental monitoring, decision analysis and dynamic configuration. The layer collects information of status attribute from user layer and system service layer, does demand analysis and executes self-adaption strategy for them.

System service layer subdivides the function of Web application system into multiple components corresponding to different services.It can do many operations based on self-adaption strategy of self-adaption layer, such as dynamic loading or deleting components, so as to meet the needs of terminal users.
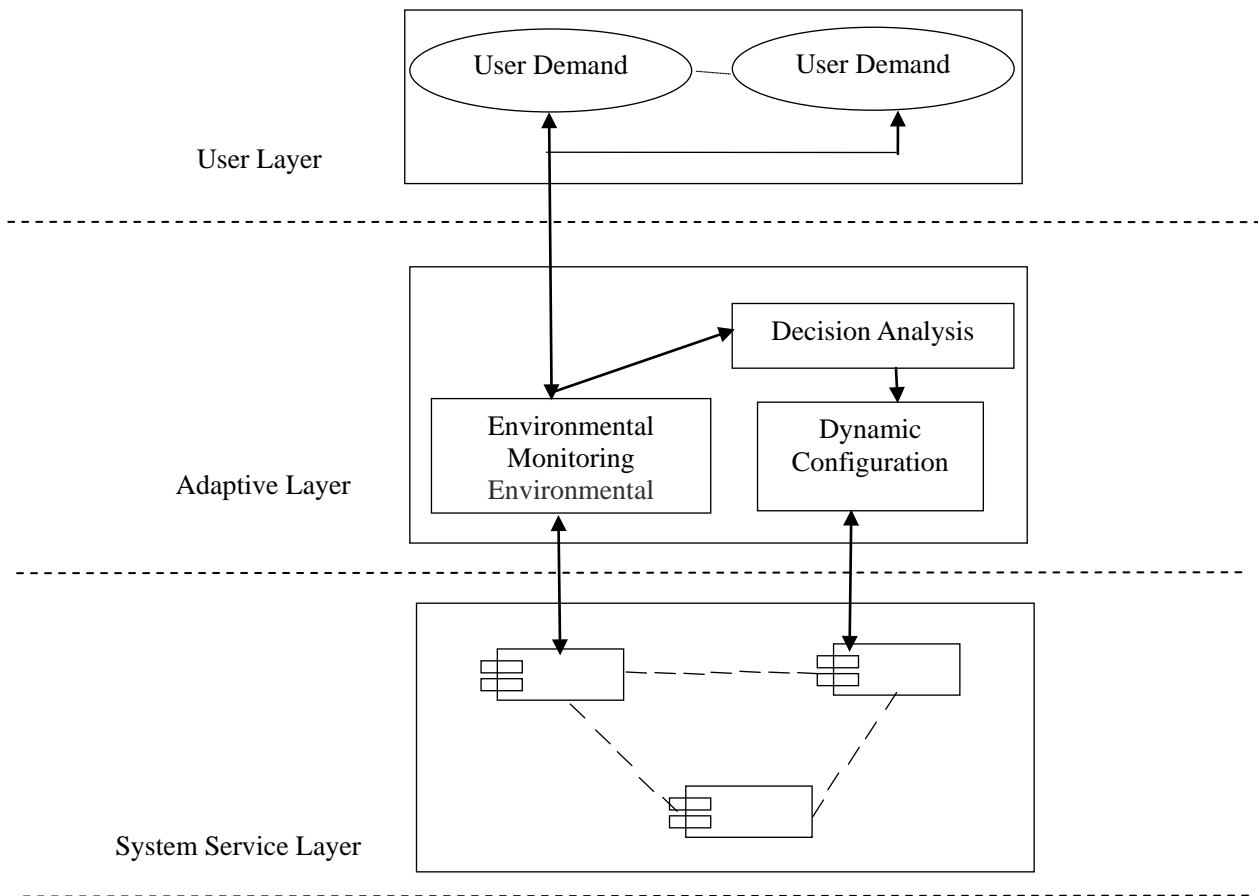
Fig.1. The architecture of aelf-adaptive Web application system

Design of Self-adaptive Layer

Self-adaptive layer is introduced to web system.It has three modules, environmental monitoring, decision analysis and dynamic configuration

Environmental monitoring module. With the popularization of iPhone, Android and other intelligent mobile phone and 4G mobile communication technology, terminal equipments accessing Web application system exist diversification, and their configuration is also different. User experience of Web system is very important. Environmental monitoring module extracts information of User-Agent according to HTTP request from different user terminal browser, and sends the data to decision module . Decision module analyzes them. At the same time, it monitors the network environment that the system is running all the time , to decide whether the network happens abnormal action.

Decision analysis module. The module judges terminal type based on the header information which has received User-Agent. If it is a mobile terminal,the module does the explanation of terminal equipment in the WURFL (Wireless Universal Resource File). Thus, the system can obtain the detail information of terminal equipment , such as the operating system, the size of the screen, video support condition and other information. At last, according to the information, it gives the strategy that adapts this terminal browser page which was called. If it is a PC terminal, the module gives the strategy that adapts PC terminal page.

Dynamic configuration module. Based on the strategy of decision analysis module the dynamic configuration module adjusts function structure and implements adaptation operation, such as delete, add or replace function component according to the user terminal configuration. What's more, it transmits the information to different system service according to different request content and calls

the offline cache according to the network situation. Finally, it returns the information to the user terminal browser by combining into a dynamic page.

Description of Dynamic Software Architecture

At the completion of the analysis and design of self-adaptive Web system architecture and the adaptive layer, we will present the description of dynamic software architecture of the system, which will provide blueprint for system development.

Dynamic-ADL is put forward by the domestic scholar Chang Yun Li, which is based on high order multiple type PI calculus ADL. In D-ADL, component, connector and architecture style is defined as the abstract type of high order multiple type PI calculus; system behavior is modeled as process; the interaction point of components and connectors is defined as a channel. It separates the dynamic behavior of system from the computational behavior, which is convenient to understand, write, and modify the changing logic of the system. Using high order multiple type PI calculus as the behavior semantic basis, D-ADL describes the dynamic characteristics of the system, and allows the components, connectors and configuration to change, which making the SA can be analyzed automatically. The dynamic software architecture of self-adaptive Web application system is shown in Fig. 2.
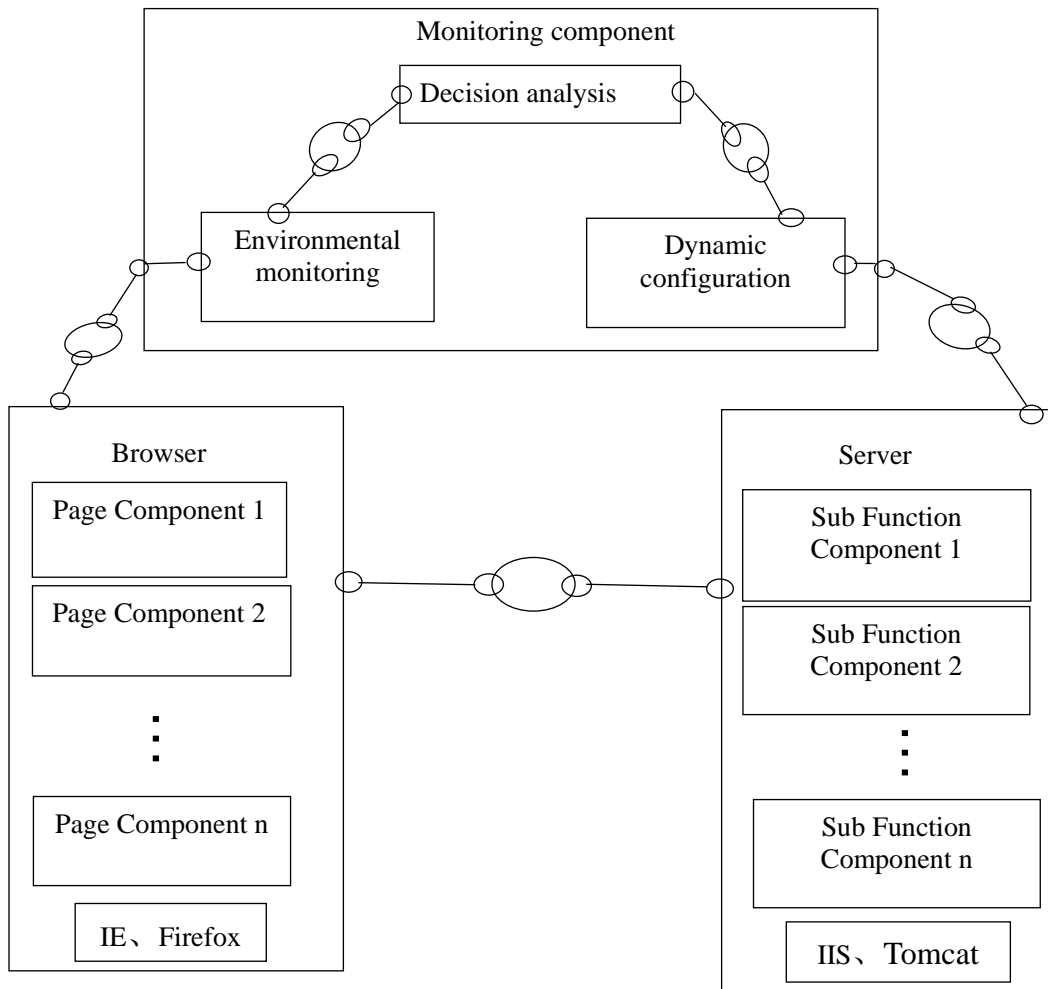

Fig. 2.   The dynamic software architecture of Web application

In the dynamic software architecture of the Web application system, there are various kinds of components and connectors. The components are divided into browser component, control component and server component. Browser component containes page components, Internet explorer, Firefox basic components. Page components mainly do rendering, layout and display to the returned HTML or XHTML source data. Monitoring component realizes self-adaptive function.

It includes environmental monitoring, decision analysis and dynamic configuration. Server component includes base component such as IIS or Tomcat , and sub function components of Web application system. Connectors not only represent a simple interactive operation such as a procedure call, but also represent complex interaction such as HTTP protocol, database using protocol, network security protocol etc. . The browser component through HTTP protocol connector makes a request to the server component. Then monitoring component gets client configuration and produces an adaptive strategy.The server component forwards it to the different subfunction components according to the different request, and then returns related data to the the browser component. The page components do rendering, layout and display the returned data. At the same time, aiming at different browser components requests, the server component can also provide adaptive function and page.

Conclusion

Base on dynamic software architecture, this paper puts forword an adaptive Web application system with three layers architecture. Then it analyzes the principle of adaptive layer and its effect in the adaptive Web system. Finally uses D-ADL to describe dynamic software architecture of self-adaptive Web system, which provides good technical conditions and theoretical support for the design and implementation of the autonomous learning platform system that we will develop.

References

[1]Cheng SW, David G, Bradley S. Software Architecture Based Adaptive for Pervasive Systems.2005.http://www-2.cs.cmu.edu/afs/cs/project/able/ftp/arch-arcs02/arcs-final.pdf.

[2] ChangYun-Li, GanSheng-Li, PinJie-He. A formal dynamic architecture description language [J]. Journal of software, 2006, 17 (6):1349-1359.

[3]Qian Mu-Li. The software architecture design [M]. Beijing: TsingHua university press, 2008.

[4] Qing Guo, Chun Cao, Xiao Xing-Ma. Based on software architecture of Web adaptive application [J]. microcomputer system, 2011, 32 (8) : 1575-1580.

[5]Hong Mei, Huang Gang, Haiyan-Zhao. A software architecture centric Internetware development method[J]. China series E (Information Science), 2006, 36 (10):1100-1126.

[6] Qiong Li,Ying Jiang. Dynamic software architecture research review [J]. Computer application research 2009, 26 (6).

[7] Bo Yu, Huai Min-Wang, Dian Xi-Shi, etc. A component model supporting software trustworthiness evolution [J]. Journal of software, 2011, 22 (1):17-27.