Study on construction of information service platform for pharmaceutical enterprises based on virtual cloud environment

Wu Zhiyi and Mao Xiaohong

Guangdong Institute of Science and Technology, Zhuhai, Guangdong

_____

ABSTRACT

The pharmaceutical information service is important for pharmaceutical enterprises to promote the development of pharmaceutical enterprises, and then the application of virtual cloud technology on it is studied in depth. Firstly, the basic theories of virtualization technology and cloud computing technology are introduced. Secondly, construction meaning of information service platform of pharmaceutical enterprises are discussed. Then the system architecture for information service platform of pharmaceutical enterprises is designed. Then the architecture of cloud computing and optimal algorithm are put forward. Finally, the simulation is carried out, and effectiveness of this plat is verified.

Key words: pharmaceutical information service; pharmaceutical enterprises; cloud computing; virtualization technology
_____

In recent years, there are about 5000 pharmaceutical enterprises in China; the annual output value is 4500 billion yuan, and the annual sales is about 3500 billion yuan, and the annual growth rate is 16.6%, it is one of the fastest growing industries in China. However, the characteristic of pharmaceutical enterprises in China is "big and not strong", the structural contradiction in developing procession of pharmaceutical industry is more prominent. Although the number of pharmaceutical enterprises is more, the scale of them is little. The pharmaceutical enterprise is the stage of developing quickly and low level, therefore the requirement for the pharmaceutical information service is different from the foreign pharmaceutical industry, the actual investigation should be carried out for the pharmaceutical enterprises in China, then the actual information service status of pharmaceutical enterprises in China can be obtained, therefore it is necessary to construct the information service platform for pharmaceutical enterprises to promote the development of pharmaceutical enterprises, then the developing environment of pharmaceutical enterprises can be improved, the application and transformation of critical techniques can be promoted, and the optimal set of society resources can be obtained [1].

The information service platform of pharmaceutical enterprises is the legal entity which provides the information search, personnel training, market exploitation, technology innovation, management consultancy, regulations and standards, device sharing for local pharmaceutical enterprises based on the opening and resources sharing principles. In order to construct the effective information service platform, the advanced technology should be applied. The emergence of massive data for pharmaceutical enterprises make the traditional computer management mode be replaced, the virtual cloud environment can ensure the storage and calculation of massive data, which offers the effective tool for establishing information service platform of pharmaceutical enterprises. The cloud computing center with high reliability and high automation can help the pharmaceutical enterprises visit all kinds of application and information based on cloud, the link of maintaining the computer hardware can be removed [2].

INTRODUCTION

The virtualization technology and cloud computing technology can offer the support for constructing the

information service platform of pharmaceutical enterprises. The virtualization technology can operate based on the virtual computer environment. The virtualization technology is a new means that is higher than the hyper-threading technology and simulation software with virtual effect, it is best technology, uses fewer resources, and has higher efficiency. Based on the virtualization technology of CPU, the single CPU can simulate parallel of many CPUs at the same time, then a single platform can run many operation systems at the same time, many application programmers can run dependently and can not affect each other [3].

The cloud computing technology is the basic frame that delivers the computing resources according to the requirement and paid subscriptions according to the use. The cloud computing technology combines the virtual technology, services manage automation technology and standardization technology, it can serve the basic frames such as server, network, storage space and so on. It can also support the application platform and software on computer of remote "cloud". The current "cloud" technology concludes public cloud, private cloud and mixed cloud. The public cloud can serve the big company, and also serve the construction of big local public information service platform; it can visit the computing resources with proper price quickly. Because the provider of public cloud can mange the hardware, software and the supporting basic frame, therefore the pharmaceutical enterprises need not buy them. The private cloud mainly serve the single company, it can also serve the construction of medium and small local public information service platform. The pharmaceutical enterprises can control every business line, customize of authorization group, and apply relative service resources. The mixed cloud is put forward based on private cloud; the pharmaceutical enterprises applying the private cloud can develop as the workload, private cloud and public cloud of managing across multiple data centers, then the mixed cloud is put forward.

Meaning of information service platform of pharmaceutical enterprises
The information service platform of pharmaceutical enterprises has the following characteristics:
(1) Publicity
The publicity require that the public information service platform of pharmaceutical enterprises keep market-oriented, construct the resource sharing mechanism, and make use of all kinds of service resources effectively, offer public general benefit service, and offer the good condition for the development of medium and small pharmaceutical enterprises [4].

(2) Connection
The connection require that the construction of information service platform of medium and small pharmaceutical enterprises should collect and assign all kinds of components based on open mind and market approach, make the innovation ability of information service platform in pharmaceutical industry be strongest. The service level of pharmaceutical enterprises is highest.

(3) Openness
The openness requires that the information service platform of the medium and small pharmaceutical enterprises execute the mechanism for the survival of the fittest. At the same time the resource benefit of devices and equipments of public information service platform, the enterprises in pharmaceutical industry can be permitted to sue all kinds of resources in platform.

(4) Directionality
The directionality require that the construction of information service platform of medium and small pharmaceutical enterprises should have the clear development goals, construction and planning, and have the clear service object and task of public relation, and have clear rules and regulations and guarantee mechanism

(5) Service
The service characteristics require that the construction of information service platform of medium and small pharmaceutical enterprises should be carried out based on principle "Government support platform, platform serve enterprises, enterprises independent innovation", it can offer many kinds of services for society, and help the medium and small pharmaceutical enterprises solve the difficulty during the developing procession of them, and offer decision-making consultation for government.

The information service platform of medium and small pharmaceutical enterprises is constructed through using information technology and integrating the all kinds of resources in pharmaceutical industry, such as production factor, human, technology, management, and market. The platform is fully functional, and has simple operation, which has the basic supporting system for offering the all kinds of public information service and technology support for pharmaceutical enterprises. The information service platform can solve the general demands of pharmaceutical enterprises, and improve the managing level of enterprises, and open communication channels, and improve the market competitiveness of pharmaceutical enterprises [5].

_____

Design of the system architecture for information service platform of pharmaceutical enterprises
The four layer system structure design is applied in the construction of information service platform of pharmaceutical enterprises. The system concludes application layer, computing resources layer, and data resources layer, and the wireless is used to link the three layers. The system can offer data of pharmaceutical enterprises, and computing of data and other services. The customer layer is the interface window with the user, the remote data and data computing can offer the user. The whole system is shown in figure 1.
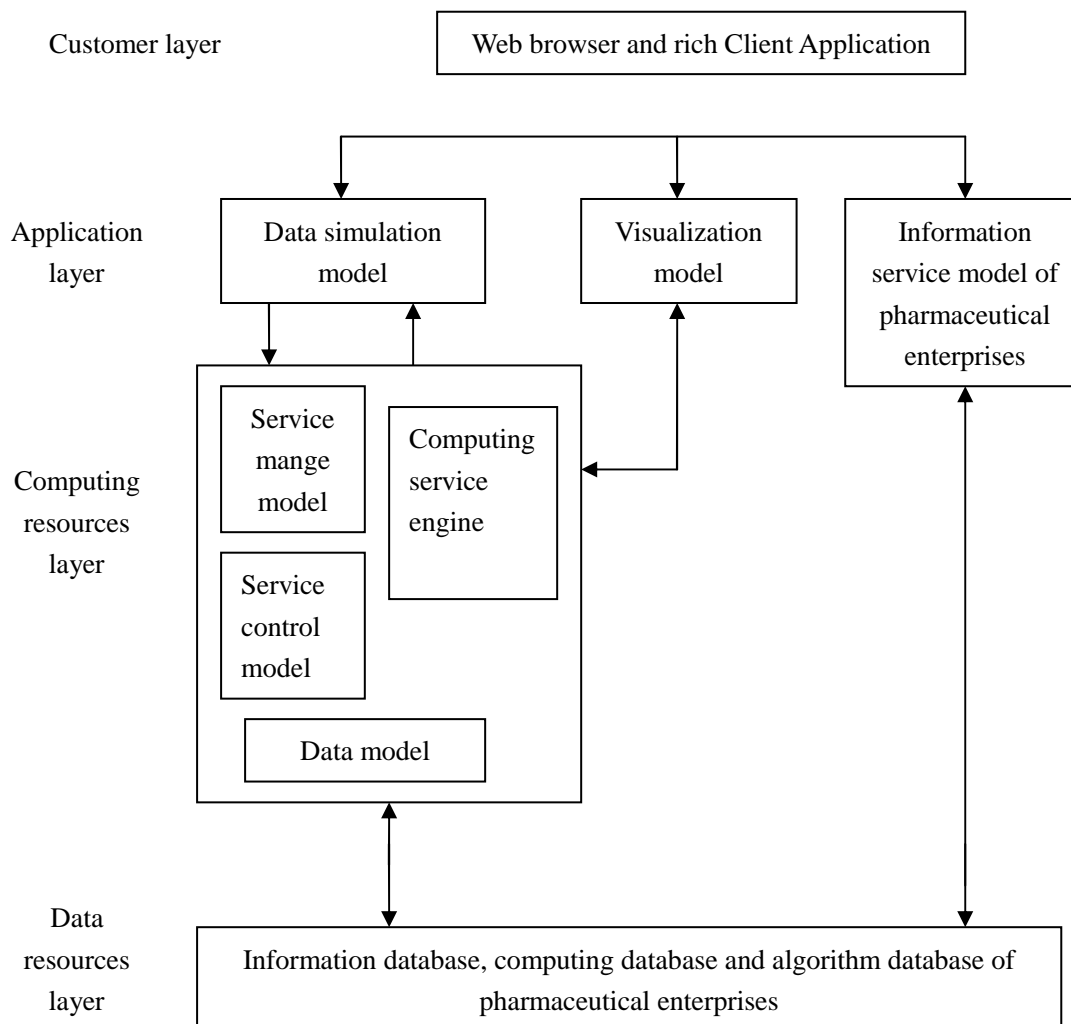

Figure 1 System architecture diagram for information service platform of pharmaceutical enterprises

(1) Data resources layer
Because the data of pharmaceutical enterprises is huge, and there are a lot of duplicate data, then the system architecture of information database is designed based on hierarchical data storage, and a part of data joint is integrated based on internet and united platform. The data resources layer applies two layer architectures, which are logic resources layer and basic data layer, the data resources layer can offer united data call specifications for customer and system by means of virtual data joint. The customer can search and call the data from database through virtual data interface independently. The central database in this layer permits single data table distribute different data joint, and balance of performance can be ensured. The background data can be added in this layer dynamically, and the extension online can be supported, and the normal services of system can not be affected. Logic resources layer can response the requirement of customer, and issue data requirement to basic data layer, and complete the data procession combining with central database, then the feedback data can be integrated [6].

(2) Computing resources layer
The computing resources layer can offer data simulation service for different pharmaceutical enterprises based on virtual technology, service can carry out calculation based on virtual machine with different simulation software according to the requirement of pharmaceutical enterprises. The corresponding software concludes MATLAB, SPSS,

and so on. The construction of computing resources layer can avoid the resources waste because of repetitive construction.

（3）Application service layer
The application service layer concludes Web service and visualization model. Web service is the interactive portal between the client layer and background, the task of it is to run the service, response the task required by client. At the same time it can offer the information for a certain pharmaceutical enterprise. Web service software based on Apache service technology occupies the highest ratio, which runs on Unix, Windows, Linux and other system platform, it has the characteristics of free of charge, supporting the cross-platform application, and high transferability. The visualization service can show the dynamic changes of information of pharmaceutical enterprises, which offer effective basis for evaluating and analyzing the development situation of pharmaceutical enterprises.

(4) Customer layer
The customer layer is the interactive portal between the information platform and pharmaceutical enterprises, which concludes Web client and other application interfaces. Web client is Flex application programmer based on Flash player, which can show the information of pharmaceutical enterprises as figure, data table and text, and offer the visualization interface for customer to manage the data [7].

Architecture of cloud computing and optimal algorithm
The architecture of cloud environment is shown in figure 2. The cloud terminal is connected with the background cluster server based on Network Load Balancing), the cloud control management cluster server is responsible for management dispatching of virtual resources, and the cloud virtual desktop cluster server is responsible for simulation of end user system interface. The cloud storage cluster server is responsible for storing the database, information and virtual hard disk of pharmaceutical enterprises.
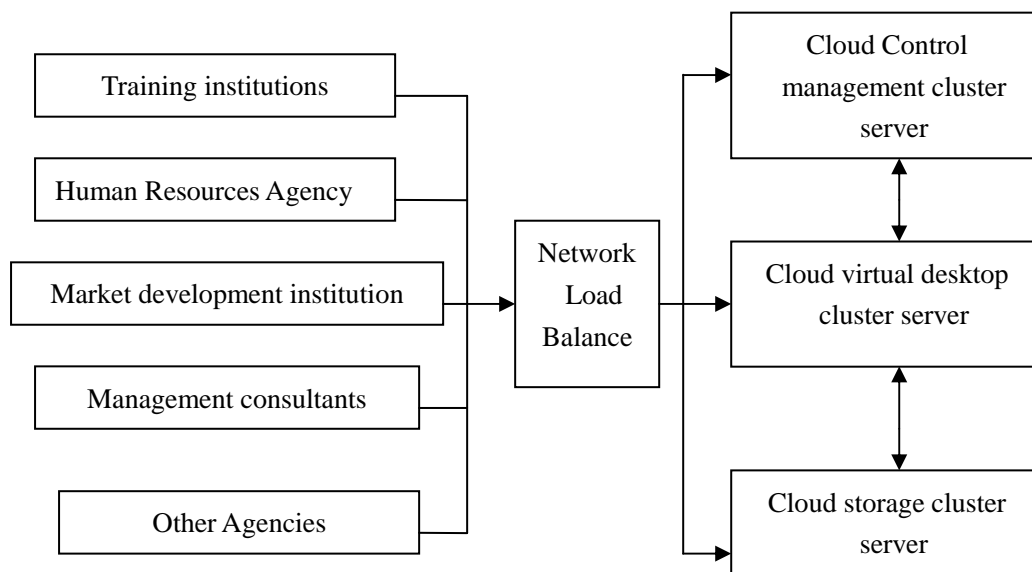

Figure 2 Architecture of cloud computing

Network Load Balancing should count the attribute information of background server, and measure comprehensive ability of processing tasks. The cloud background cluster server is made up of n servers, the excessive load of a server is defined as L_i ($i = 1,2,\cdots,n$), there are three affecting factors for the server, which are utilization of CPU (U_{cpu}), the share of memory (U_{mem}), occupancy rate of wireless broadband (U_{wire}), the three factors name as excessive load factors, and the following expression can be obtained [8]:

$$L_i = w_1 U_{cpu} + w_2 U_{mem} + w_3 U_{net} \tag{1}$$

where w_1, w_2 and w_3 are weight value.

Cloud computing have many characteristics, such as super large scale computing center, abstract concepts of resources "cloud", high general and extensibility, low cost. Therefore pharmaceutical enterprises put forward higher

requirement for resources maintenance and management of cloud background, resource sharing should be reasonable, and the utilization of resources should be effective and reliable. It is necessary to confirm the strategy of achieving the excessive load balancing for cloud computing controller. In order to achieve this object, the ant colony algorithm is applied in it.

(1) The basic theory of ant colony algorithm

The basic theory of ant colony algorithm can be described according to the traveling salesman problem, and the corresponding algorithm is listed as follows:

When the condition $t = 0$ is satisfied, the original operation is carried out, and every ant is put on different city, and the pheromones concentration on different route $edge(i, j)$ can be set. The beginning city of different ant is assigned to the first element in corresponding tabu table.

Then the maximum probability that the different ant crawl from city i to city j, and the corresponding calculation formula is expressed as follows:

$$p_{ij}^k(t) = \begin{cases} \dfrac{[\tau_{ij}(t)]^\alpha \cdot [\eta_{ij}]^\beta}{\sum\limits_{k \in allowed_k}[\tau_{ij}(t)]^\alpha \cdot [\eta_{ij}]^\beta}, j \in allowed_k \\ 0, other \end{cases} \tag{2}$$

where, $allowed_k = \{n - tabu_k\}$, α and β denotes the importance of pheromone concentration and visibility to probability $p_{ij}^k(t)$.

After n iteration operation, all ants complete a entire travel, therefore tabu table corresponding to all ants has been filled, the L_k (total distance gone by k th ant when it complete the travel in turn) of k th ant is calculated, the $\Delta\tau_{ij}^k$ should be amended, and the corresponding amending formula is expressed as follows:

When k th ant passes by route $edge(i, j)$ in $[t, t+n]$:

$$\Delta\tau_{ij}^k = \frac{Q}{L_k} \tag{3}$$

In other cases:
$$\Delta\tau_{ij}^k = 0 \tag{4}$$

where, $\Delta\tau_{ij}^k$ denotes the number of pheromones per unit length released in the route $edge(i, j)$ by k th ant in time interval $[t, t+n]$, Q denotes the constant.

Then the shortest route that is found by all ants is stored, and tabu table of different ant is emptied.

The above operation is repeated continuously, and the operation is over the algorithm achieve the condition of convergence, then the ant group can find a optimal travel route that can be satisfied with requirement.

(2) Improved ant colony algorithm

The ant colony algorithm is easy to fall into local optimum, in order to avoid this disadvantage; the genetic algorithm is introduced into iteration of standard iteration, to improve the efficient of resources discovery, resources assignment, task movement and production for cloud computing service. The calculation method of probability under cloud computation according to the current resources information is expressed as follows.

When $j, k \in$ current cloud computing resources, the following expression is obtained:

$$p_{ik}^{k}(t) = \frac{[\tau_j(t)]^{\alpha} \cdot [\eta_i]^{\beta}}{\sum [\tau_k(t)]^{\alpha}[\eta_k]^{\beta}} \tag{5}$$

In other cases:

$$p_{ik}^{k}(t) = 0 \tag{6}$$

where $\tau_j(t)$ denotes the strength of resources pheromones in t, the natural attribute of resources is defined by η_i, $\eta_i = \tau_i(0)$.

The task object under cloud computing environment is to assign M tasks to N resources, and the shortest mean execution time for task on resources is calculated based on the improved ant colony algorithm, and the optimal of system resources is completed, that is to calculate the minimum value of the following function:

$$\min F(m_i) = \frac{\sum_i m_i f_i(m_i)}{M}, \quad i = 1,2,\cdots,N \tag{7}$$

where M denotes total amount of the task that is offered to cloud computing environment by a certain data section, $M = \sum_i m_i$, m_i denotes the number of tasks assigned on resource i.

RESULTS AND DISCUSSION

In order to verify the effectiveness of information service platform of pharmaceutical enterprises based on improved ant colony algorithm, the simulation is carried out. The task parameter of cloud computing is set as 45, and the $\alpha = 1$, $\beta = 2$, and the iteration times are chosen as 250, and the crossing probability is 0.75, the mutation probability is 0.25, the traditional ant colony algorithm and improved ant colony algorithm are used in the simulation, and the corresponding results are shown in table 1.

Table 1 Simulation results of information service platform for pharmaceutical enterprises based on virtual cloud environment

Algorithm	Mean value	Optimal value	Times of finding the optimal solutions
Traditional ant colony algorithm	518.843	516.357	8
Improved ant colony algorithm	518.596	516.357	17

As seen from table 1, the traditional ant colony algorithm finds the optimal solutions 8 times, and the improved ant colony algorithm finds the optimal solutions 8 times, the optimization ability improves 35%. At the same time, the running time of improved ant colony algorithm is quicker than that of traditional ant colony algorithm; the running efficiency of improved ant colony algorithm is higher.

CONCLUSION

With the development of pharmaceutical industry, the information service platform of pharmaceutical enterprises should be constructed quickly, then the pharmaceutical industry can be developed quickly. The good information service platform of pharmaceutical enterprises can make enterprises win the market, which can form an effective, comprehensive information system. The information resources construction level can be improved. The information service platform based on virtual cloud environment applies cloud computing technology, virtual technology and network technology, the improved ant colony algorithm is applied in this information service platform, the running effective of system can be improved based on the simulation results.

REFERENCES

[1] Y Xiang, Y Cao. *Shanghai Medical & Pharmaceutical Journal*, **2013**, 3(1), 32-33.

[2] HY Song, RJ Zhang. *Journal of Chemical and Pharmaceutical Research*, **2014**, 6(1), 389-393.

[3] C Gallo, F Malatacca, A Frat*ello. International Journal of Web Portals*, **2013**, 5(2), 12-25.

[4] ZB Pang, LR Zheng, JZ Tian. Enterprise Information Systems, **2013**, 12(4), 30-35.

[5] H Dadfar, JJ Dahlgaard, S Brege. *Total Quality Management & Business Excellence*, **2013**, 24(7-8), 819-834.

[6] LH Wei. *Applied Mechanics and Materials*, **2013**, 321-324(1), 2524-2527.

[7] T Tunsaringkarn, J Suwansaksri, A Rungsiyothin. *Journal of Chemical and Pharmaceutical Research*, **2014**, 6(1), 507-511.

[8] X Zhao, ZM Zhang, BH Zhang. *Journal of Chemical and Pharmaceutical Research*, **2013**, 5(9), 549-554.