

# Design of Electronic Medical Record System Based on Cloud Computing Technology

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## **Abstract**

*According to current status and problems of electronic medical records management system, it combines with the current the latest information technology, cloud computing, and it explores the solution of electronic medical records management system and puts forward the new ideas and methods; Based on the literature and information on cloud computing technology, we summarize the cloud computing theory, architecture, application model, etc. and select the appropriate application platform for the electronic medical records; Based on the Google cloud computing technology, it focus on Google cloud computing platform Google App Engine and its solution Plan, it makes the research of collaborative electronic medical record system based on Google App Engine.*

**Keywords:** *electronic medical record, cloud computing, technology, design*

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## **1. Introduction**

Electronic medical records are developed with management of computer, and emerging of CD-ROM and IC card application and also with globalization of the Internet. The Electronic medical records is inevitable in the field of information technology and network technology, it is the trend of modern hospital medical records management. The preliminary application of the electronic medical records in clinical and it can greatly improve the working efficiency of the hospital and medical quality, but this is only the start of the application of the electronic medical records [1-5]. According to the current study, the electronic medical records deal should have two aspects of the functions:

a. Doctors, patients, or other authorized person, can know about an individual's health data or related information, and in any case the information is complete, accurate, timely, and we can get the exact definition, maximum detailed, accurate and comprehensive information.

b. The electronic medical record can make the initiative judgments according to their own mastery of the information and knowledge, when the individual state of health are need to be adjusted, it make a timely, accurate analysis, and give out the optimal scheme and implementation plan. It is called as the ideal electronic medical records because functions looks like simple, but have deep meaning, it total functions can not be fully realized in dozens of years.

The definition of electronic medical records is that, it is established by medical department it is saved and used through electronic way. The electronic medical record is focused on outpatient and hospitalized patients (or objects), it is the integration system of clinical diagnosis and treatment of information data. It is the complete recorded of the process of medical institutions and detailed clinical information.

## **2. Cloud Computing Technology**

What is cloud computing, cloud computing is a new kind of calculation model; the calculation model is a new stage after host, personal computer and the Internet [6-8]. It is integration product of grid computing, distributed computing, parallel computing and virtualization technology, the traditional development of computer technology and network technology. It distributes the calculation the task to a large number of computer or remote server

pool, so it can make all kinds of application system according to the need for computing power, storage space and all kinds of software services.

Cloud computing can make the effective utilization of resources, the traditional operation model of IT industry is focused on the unity of data center operation pattern, cloud computing make traditional software become more convenient [7-10].

Developers can quickly make innovation, do not need to think too much of hardware investment and operations. Such as when we develop a web site, you can according to the calculation of the data center, and allocate bandwidth and storage resources, and don't need to worry about too much input of resources or under-funded. In addition, the large amount of calculation task can be quickly handled through large data centers, 1000 units calculate 1 hour is the same to the effect of 1 unit calculates 1000 hours, but the former method is more rapidly. Cloud computing on IT resources can provide large flexibility, it can be thought as the change mode of the IT industry.

### **3. Analysis of Medical Record System**

#### **3.1. Overall Data Flow**

Data flow diagram is a tool for comprehensive describe of information system logic model, it abstracts the data, it describes the context information and the actual process through the graph form way.

Module includes information system, personal office, and administrative management and so on. The system has the management platform module, in the paper; the overall data flow diagram reflects the relation of collaborative medical records platform between each subsystems and the relationship between the subsystem and other business systems.

#### **3.2. Overall Function Structure**

The overall function of medical records system mainly includes the application system, application platform and interface, which are shown as in Figure 1.

##### **(1) Application System**

Application system is mainly implemented by JSP, servlet, Javabean. It can be divided into specific function layer and the pipe system, the level of the two small bedding layers. Specific function layer includes article system, personal office, administrative management and other functions, and so on.

System management including the hierarchical permission management, module management, management, log management page. System management can provide the basis for application layer, interface, permissions and integration.

##### **(2) Application Foundation Platform**

Application platform is the foundation of the whole application system; it can also be divided into two small levels. The core business logic layer includes providing industry, business process management control of the workflow engine, provide the management of the business processing form engine and provide business processing data management data source interface. User management includes the unit organization, user information, group management interface, and unified user management. At the same time, when a user logs in, it can provide the mechanism of CA system combining with the third party.

##### **(3) Interface to Access**

System can provide the external scan input and auxiliary project for office (SMS, fax, email) and also can provide interfaces for a visit.

### **3.3. Medical Record System**

#### **3.3.1. The Address to Deal with**

Medical record management system main implement the rapid flow in unit interior and accelerate the process, and improve the efficiency, realize the automation of information processing. Main function includes the collaborative user management, authentication, authorization, and grade of form control, rights management and workflow control data interaction and other basic norms and function. It not only can support the realization of the application layer of various business functions, and also can provide the collaborative platform and the third party system application with the open interface, but also it can provide extended

support for future possible new business.

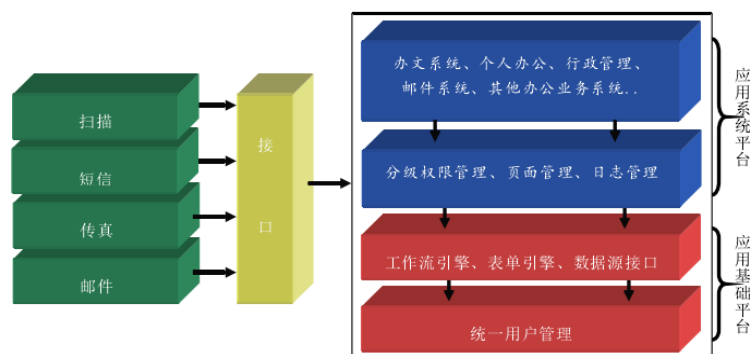


Figure 1. System whole Function Structure

Based on the above considerations, we adopt Google's GAE cloud computing platform and information release management platform software products, and some other excellent third-party applications software products as the foundation to build the cloud computing platform together. The design and development of cloud computing platform should safe, advanced, practical, stable, open and easy management principles, Google mature GAE platform architecture is used to design and development, its specific route is as follows:

a) Multi-layer Architecture

Multi-layer system structure is adopted in system construction, the presentation layer, the core information logic layer, information logic layer should be separated reasonably, so as to guarantee system scalability, and improve business systems integration.

b) Management of the WEB interface

System adopts the complete structure, both front desk and background management operation, the web browser is adopted ensure easy operation of the system and its friendly interface.

c) Openness of Mature Technology

System architecture is based on specification, on the one hand, because the architecture is based on the J2EE specification, the architecture is stable and efficient; On the other hand, it also has good openness, the system is able to run at all kind of operating system platform, such as UNIX, Linux, and Windows NT / 2008 Server platform. System nuclear Cardiac function module is realized through the EJB implementation, which is to ensure the stability and efficiency of the system under the condition of large load operation.

d) The Relational Database

The system adopts the Oracle relational database. The system can also support other mainstream relational database, including SQL Server, Sybase, Infomix, etc. thus it can ensure the system has a better openness.

e) The Common Development Tools

In the development of system, the use of common development tools is adopted (Eclipse), in order to avoid the compatibility problems.

f) Advanced Interactive Online Application Technology

System development adopts advanced technology for WEB application development, including, JavaScript, HTML, DHTML, XML, etc.

g) Automatically Publish Information Flow

The medical record system can make full use of the Internet technology; and realize the classification of information, information collection and centralized management of information.

At the same time, combined with various demands for the use of medical record system, it putS forward the general design principle is as follows:

a) Advanced

Advanced technology is adopted in this system and system structure is based on J2EE specification.

**b) Practical**

The design of the system application function is to meet the need of medical record. At the same time, the system adopts advanced interactive technology, such as DHTML and JavaScript, XML, and using graphics GUI design, guarantee system is easy to be operated.

**c) Openness**

System adopts open construction technology, which in line with the technology of the J2EE specification, the core module adopts EJB2.0 standard which makes the system able to cross platform running on various operating system platform. In the application server platforms, the system adopts pure Java technology.

**d) Standard**

Design and development of system adopts the national standard, the standard of the software industry and the corresponding interface standards. With an open type of TCP/IP network protocol, the open data can be achieved between different applications based on XML format.

The data exchange meets the international standards of WFMC workflow engine technology, makes the system joint with subordinate units.

**e) Scalability and Connectivity**

System adopts the modular design of the structure, the "soft bus" pluggable deployment, can support distributed operation, and also can provide a good secondary development extension according to the needs of business development for the adjustment of system function and the matching network.

The expansion of the hardware is aim for higher efficiency. System is connected through standard JDBC of database, Oracle support, Sybase, SQL Server, Informix, the large a relational database system, they conform to the openness of the J2EE specification system.

**f) Stability**

System chooses the mainstream operating system according to the actual environment and the need, it also uses TCP/IP protocol network in the communication, the application of the Oracle database in to guarantee the stability of the system.

**g) Security**

The design of system security system can build perfect application security system. Such as in the identity authentication, access control, data confidentiality, data integrity and security audit management.

**4. Whole System Architecture****4.1. Platform Architecture of Medical Record**

Collaborative platform of the medical record including the user interface, application system, application platform, application server and data Library, operating system, hardware, network and so on multiple levels.

**4.2. Cloud Platform Architecture**

The cloud computing architecture model consists of three layers, respectively, they are infrastructure, platform, service layer, application service layer, As shown in Figure 2.

The first layer of the infrastructure is the service layer, also called hardware as a service [7], it includes host, storage, network and its hardware equipment, through the virtualization integration technology, the formation of a whole, at the same time through the cloud management flat units, it can provide basic services such as data storage, backup and running environment. This layer of resources can realize the effective monitoring, combined with virtualization technology, and through to the service model extraction, it provides the function of the automated deployment, this layer is the key in the cloud architecture.

The second layer of the platform is the service layer, and it mainly provides a unified platform system software support services, includes unified identity authentication service, security service, access control service, the workflow engine, development and testing services, etc.

This layer is different from the past traditional way of platform; the platform service will satisfy the deployment of cloud architecture type, through virtualization, the cluster, load balancing technology such as state of cloud services according to need at any time.

On the third floor, it is also the most layer of software, it provides electronic government affairs services. A lot of application system belongs to this category. The extension and management of email, communications, and office applications system can be realized under the cloud architecture.



Figure 2. Cloud Reference Architecture

**4.2.1. The Initialization Configuration**

In the first step, log the GAE web site, <http://appengine.google.com>, enter the Gmail email address and password, Then click the "Create an Application" button, start to create cloud computing applications and web sites based on GAE. It is as shown in Figure 3.

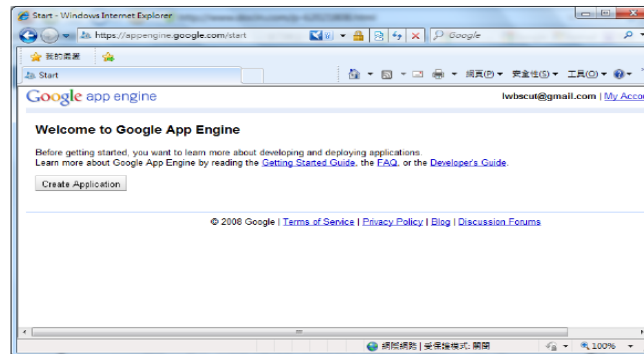


Figure 3. Platform of the GAE

**4.2.2. Message Authentication**

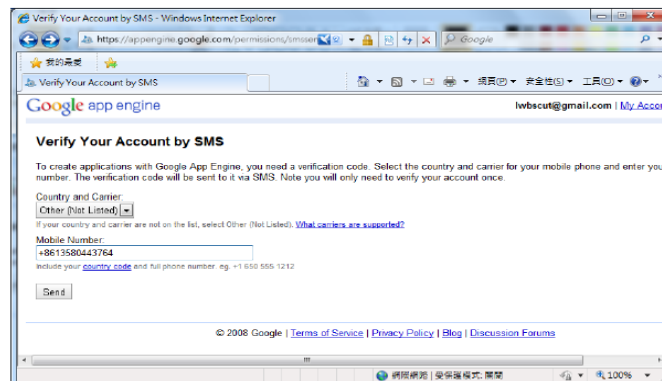


Figure 4. Message Authentication Platform

As shown in Figure 4, after filling in the "Mobile Number" Mobile phone Number, click the "Send" button, the GAE will send text message to mobile phones with the password. After inputting eight codes, it will go into the web site home page.

### 4.3.3. Create Cloud Computing Application Website

The website of appspot.com for the suffix as shown in Figure 5. Input the name of the website and the corresponding program name casystem-cloud, the page will show that success creating of "Application Registered Successfully".

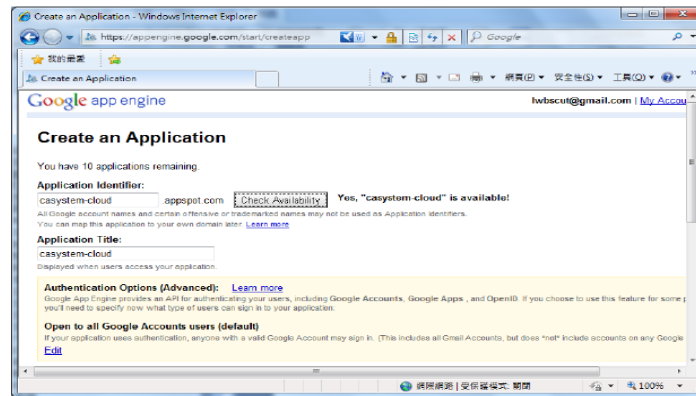


Figure 5. Application Program of the Cloud Computer

## 4.4. The Workflow Engine

### 4.4.1. General Class Diagram

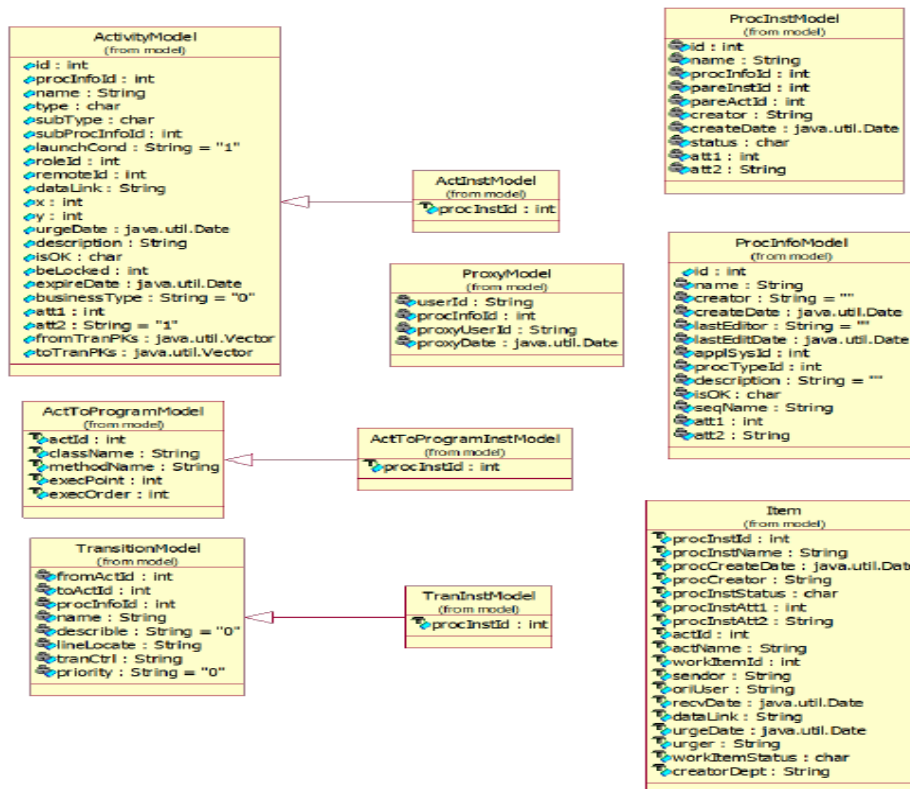


Figure 6. General Class Diagram

The Activity Model is according to the class of node information, mainly used in the definition of the node properties and settings; Item class is mainly used to store a user work Item, including the specific work items and user attributes; Proclnst Model is mainly used for depositing process instance, including the process instance attribute and the method of getting the information; ProclInfo Model class is mainly used in storage process definition, including the properties of the process and the process definition method; Proxy Model class is mainly used for user authorization process information, including the authorized users and the authorized user's attribute, and the method of authorized user role; Role Model class is mainly used to store character information, including the role of attributes and acquire the method of character attributes, as shown in Figure 6.

In this system, the users in different process can be selectively to different people, of course, it can also be licensed to the same person.

#### 4.4.2. Set of Authorization

Authorization set is mainly to realize the authorization from one person to others, after the authorization, the authorized person can handle the process instance. The authorization file can only be carried out in accordance with the template.

Authorization cannot accomplish the document of authorization. The name of the authorized person is currently logged user; the agent should be selected from the user module, start time of choose refers to the authorized effective starting time, end time refers to termination time of authorization.

In the authorization of the system, the first step is get the authorization from the agent library EJBUtil according to the user needs as well as the need to deal with the process instance and create proxy1 agent. Then according to the user identifier and the work item status, query the work items collection of work items, then through the loop statements, it enumerates every work item according to the properties and process instance attributes of work item. If the work item is owned to current user, it will authorize to the proxy user. If it's not current job items, the authorization will not be performed.

## 5. Conclusion

In the paper, the following several aspects of work has been done.

a) According to current status and problems of electronic medical records management system construction standards, it combines with the current the latest information technology, cloud computing, explore the solution of electronic medical records management system and put forward the new ideas and methods;

b) Based on the literature and information on cloud computing technology, summarize the cloud computing theory, architecture, application model, etc. select the appropriate application platform for the research practice;

c) Based on the Google cloud computing technology, it focus on Google cloud computing platform Google App Engine and its solution Plan, it makes the research of collaborative electronic medical record system based on Google App Engine.

d) Combined with hospital construction demand, it proposes the electronic medical record system based on Google App Engine architecture, and presents the design and realization of the core concrete module.

e) The collaborative electronic medical record system implementation experience and problems of cloud are summarized; it makes the accumulation of experience for large-scale electronic medical record system and mechanism construction of cloud computer.

## References

- [1] Berthold J, Saleh AAM, Blair L, et al. *Optical Networking: Past, Present, and Future*. Light wave Technol. 2008; 26(9): 1104-1118.
- [2] Figuerola S, Garcia J, Sanchez A, et al. *The network service plane: An approach for inter-domain network reservations*. In Transparent Optical Networks. ICTON 2008. 10th Anniversary International Conference on. 2008: 13 -15.
- [3] Abosi C, Nejabati R, Simeonidou D. *A service plane architecture for future optical Internet*. In Optical Network Design and Modeling. ONDM 2009. International Conference on. 2009: 1-6.

- [4] Wuxue Jiang, Jing Zhang, Junhuai Li, Hui Hu. An Improved Resource Query and Location Algorithm Based on Cloud Computing. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(10): 6166-6172.
- [5] Xia Hu, Min Zhou. Research on the Information Security Problems in Cloud Calculation's Environment. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(12): 7316-7323.
- [6] Sun Qiong, Min Liu, Shiming Pang. Cloud Computing Application of Personal Information's Security in Network Sales-channels. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(12): 7331-7338.
- [7] Jing Liu, Xing Guo Luo, Bai Nan Li, Xing Ming Zhang, Fan Zhang. An Intelligent Job Scheduling System for Web Service in Cloud Computing. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(6): 2956-2961.
- [8] Hong Sun, Shi-ping Chen, Li-ping Xu, Ying-ying Chen. Base-on Cloud Computing A new type of distributed application server system design. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2012; 10(7): 1800-1807.
- [9] YANG Zhexi, XUE Huacheng. Informatization Expectation with Cloud Computing in China. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2012; 10(4): 876-882.
- [10] Hong Sun, Shi-ping Chen, Chen Jin, Kai Guo. Research and Simulation of Task Scheduling Algorithm in Cloud Computing. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(11): 6664-6672.