

## Design of Hospital Beds Center Management Information System based on HIS

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**Abstract:** Hospital information system(HIS) has been considered as one of the most important branch of the Medical Informatics by international academia community, with the essence of integrating all the hospital departments into a large information network to make the whole hospital system run better. Aiming at "difficult to be hospitalized" issues in our country, our research has designed and realized a set of safe, stable and easy-to-handle beds resource management information system according to this article HIS functional specifications. The Bed Management Information System was developed by the hospital information department, using PowerBuilder, the MVC model and the Oracle database to make the system run normally. This system has realized the bed resource management of hospitalized patients, and achieve interdisciplinary treatment for different department according to the system information, which reduce the average hospitalized stay of patients effectively.

### 1. Introduction

In the highly developed medical information environment, how to make full use of information technology to optimize the hospital's internal business processes and management processes has to be the important task for each hospital<sup>[1]</sup>. HIS has been considered as one of the most important branch of the Medical Informatics by international academia community, with the essence of integrating all the hospital departments into a large information network to make the whole hospital system run better. Nowadays, people's needs for health care are no longer limited to treatment, but also for prevention of disease and improvement of health process. Thus, the proportion of hospitalized patients has been increased year by year in recent years, while the patients put forward higher requirements on conditions, environment, physicians and nurses. So how to reduce the average hospitalized stay of patients as well as improve the bed turnover by doing a reasonable and scientific management of bed resource is an urgent problem to be solved.

Many Japanese hospital started using HIS to deal information in 1980s with the rapid development and large scale<sup>[2]</sup>. They put forward the concept of HER (Electronic Health Records), which combine the EMR (Electronic Medical Records) with CPOE (Computerized Physician order entry) closely. And it means the Japanese government pays the increasingly attention on the spread of computerized method, such as Telemedicine<sup>[3]</sup>.

In our country, it has become an essential infrastructure for the operation of the hospital management business because of the widespread establishment of HIS in many advanced hospital<sup>[4]</sup>.

<sup>5]</sup>.However, literatures on hospital bed information management is extremely limited.How to combine the bed management with computerized method perfectly is still to be a problem.

## **2. The Key Technologies**

### **2.1. HIS**

Professor Morris. F. Collen raised the HIS with the concept of using computer and communication equipment to collect, store and process the hospital information in 1988<sup>[6]</sup>. We consider the HIS as the software system that can achieve the hospital information management for all aspect by computer in our research.The function of HIS can divided into transaction management and information services. As to transaction management, it can realize the Outpatient management, hospitalized management, medicine management, economy management and integrated information management while information services mainly used for medical,scientific research and education.

### **2.2. PowerBuilder**

Started to be used in 1991 and had a peak of about 100,000 users,PowerBuilder is an integrated development environment developed by SAP. It's native data processing object is called a data window that can create, edit, and display data from a database. The object provides the programmer with tools to specify and control the appearance and behavior of the user interface, and also provides a simplified access to the contents of the database. To a certain extent, the data window allows the programmer to consider different vendors between different database management systems. Users can use multiple presentation styles to display data that can be connected to various data sources<sup>[7]</sup>.

### **2.3. MVC**

MVC is the abbreviation of "Model-View-Controller", MVC application program is always composed of these three parts. Event causes Controller to change Model or View, or both. As long as the Controller changes the Models data or properties, all Views dependent on it will be automatically updated. Similarly, as long as the Controller changed the View, View will get the data from the potential of Model to refresh themselves<sup>[8]</sup>. View is on behalf of the user interface, for Web applications, it can be summarized as the HTML interface, but it is possible be XHTML, XML and Applet<sup>[9]</sup>. With the complexity and scalability of the application, the processing of the interface also becomes a challenge. An application may contain a lot of different views, the MVC design pattern for view processing is limited to data acquisition and processing on the view, as well as the user's request, but don't cover the business process on the view. Then, Business process will be handled by Model. Model is the process of business process / state and the development of business rules. The design of business model is something of the core of MVC. MVC design pattern tells us that if we want extract the application of the model according a certain rule, the level of extraction is very important, which can be design basis for judging whether the developer is excellent .The controller can be understood as receiving requests from the user, then match the model with the view, and complete the user's request together.

### **2.4. Oracle Database**

Oracle database, often called Oracle RDBMS or Oracle,is a object relational database management system and produced and sold by Oracle Corporation.It keep tracks of data storage in

computer as well as SYSTEM tablespace. The SYSTEM tablespace contains data dictionaries (default) metrics and clusters, where the data dictionary is contained by a specialized collection table that contains information about all user objects in the database<sup>[10]</sup>.

### 3. System Requirement Analysis

#### 3.1. The overall requirement analysis

It is important to establish a normative, safe and stable, simple bed resource management system based on the demand of patients, users and leaderships in hospital. The overall requirement analysis was shown in figure 1.

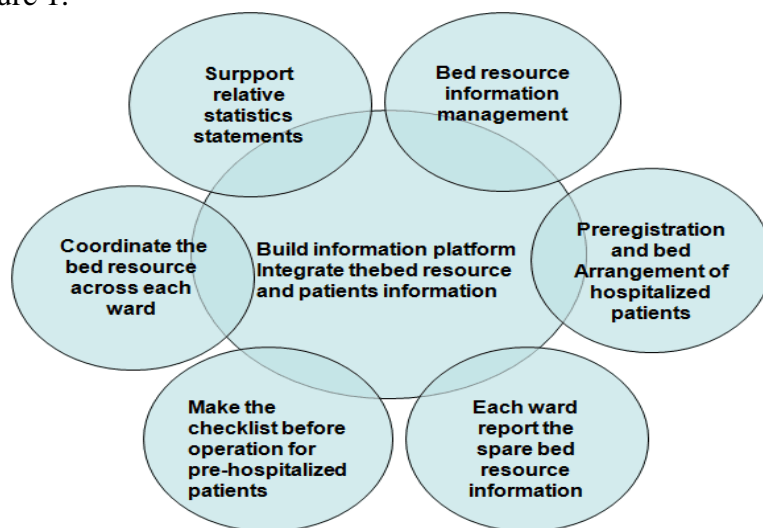


Figure 1: Beds Center Management Information System overall requirement analysis.

#### 3.2. The functional requirement analysis

The functional requirement analysis including the following 5 aspects:

- 1) Bed appointment management;
- 2) Bed report management;
- 3) The overall bed list in department;
- 4) Appointment and transfer between different department;
- 5) System settings.

#### 3.3. The non-functional requirement analysis

The non-functional requirement analysis can be divided into 4 aspects:

- 1) Accuracy and timeliness in system processing
- 2) Safety of system
- 3) Scalability of system

4) Maintainability of system

### 3.4. Feasibility Analysis

The feasibility analysis contains business feasibility analysis and technical feasibility analysis.

### 4. System Intergrated Design

The overall structure of hospital management information system is divided into the execution environment layer, data layer, application support layer, business logic layer and presentation layer. At the same time, the information system also abides by the relevant policies and regulations, professional standards as well as the security support and system operation and maintenance support in the construction process. The overall system structure shows in diagram 2. In the overall system structure, our research mainly design and implementate Hospital Beds Center Management, whose main task is to allocate, replace beds for patients while evacuate beds when patients are transferred or discharged. Details were showed in figure 2.

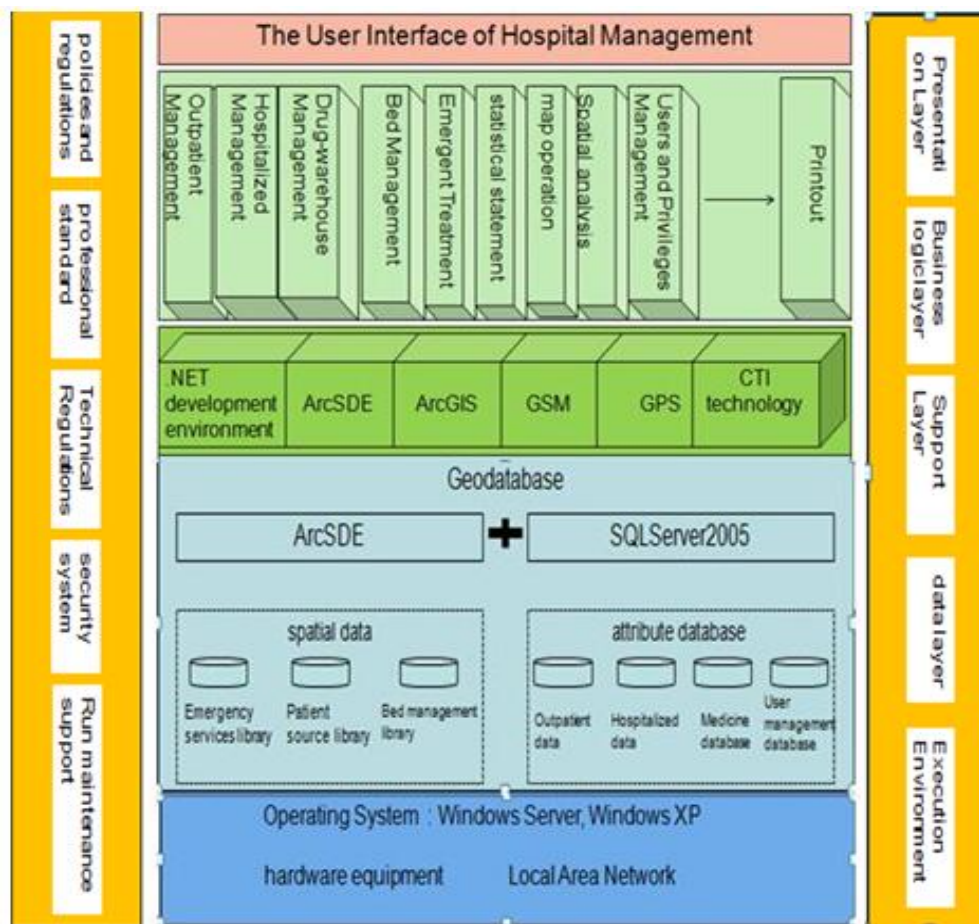


Figure 2. The integrated system structure.

## 5. System Module Implementation

### 5.1. Bed reservation management module implementation

This module can realize the following functions:

- 1) Reserved record;
- 2) Scheduled record;
- 3) Canceled Records;
- 4) Hospitalized Records.

### 5.2. Bed report management

### 5.3. List of bed in ward

- 1) The whole bed information of hospital;
- 2) The emergency bed list.

### 5.4. Appointment transfer branch management

### 5.5. System settings

## 6. System Test

### 6.1. Functional test

The test testers are composed of developers who are responsible for developing the corresponding modules, and then perform the functional tests overlapping after performing unit tests.

### 6.2. Pressure test

Our research chose 5 bed number in the waed as examples to perform the pressure test. The result showed in table 1.

Table 1. Operation Response Time Test

<b>Bed Number</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>T4</b>	<b>T5</b>
<b>Test 1 (ms)</b>	3165	7652	2647	8664	9314
<b>Test 2 (ms)</b>	6464	2456	3654	3246	6723
<b>Test 3 (ms)</b>	3464	3665	6794	7321	1546
<b>Test 4 (ms)</b>	9841	6546	3264	6846	1646
<b>Test 5 (ms)</b>	8732	2648	2156	8633	6467
<b>Average Time (ms)</b>	6333	4593	3703	6942	4899

## 7. Conclusion

The overall architecture and function flow of the system are analyzed and introduced in detail by using the overall system architecture diagram and the bed center function flow chart in this paper. We also present the three-tier structure of presentation layer, business logic layer and data layer respectively in details. According to the HIS function requirement as well as combining the intrinsic HIS preferably, our research has designed and realized a set of safe, stable and easy-to-handle beds resource management information system aiming at the problems of “difficult to be hospitalized”, which provide the hospital beds centralized management with comprehensive information solutions<sup>[11]</sup>. Although the hospital's bed management mode was optimized and the average length of hospital stay was reduced, the problem of hospitalization was relieved to a great extent<sup>[12]</sup>. However, how to protect the quality of patients under the premise of the quality of care, making the average hospital stay in patients with a more reasonable arrangement, still need a better communication between hospital management and patient, to complete a more perfect bed management.

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