Implementation of Executive Information System on Client/Server Architecture Controlled by Role Based Access Control Mechanisms

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Abstract

The Organisations are implementing Executive Information Systems (EISs) to handle increasing amounts of money which are being invested. Because they need to use an effective EIS in order to achieve competitive advantage in markets. And EISs improve the quality of management in organization by providing visual reports. However, EISs development projects incur risks. As a consequence, the eventual success of this kind of systems is affected by various factors especially during the use of the system. Therefore the proposed system is to develop an EIS on client/server architecture. Furthermore to overcome the problems faced during the use of the system due to the security risks, Role Based Access Control (RBAC) mechanism is used to regulate the access right of the authorized users. That means users with different roles can access to the system with different permissions. This system will implement an EIS for dental clinic on client/server system controlled by RBAC using Microsoft SQL Server 2005 DBMS.

1. Introduction

Executive Information Systems (EISs) are computerized information systems designed to be operated directly by senior executive managers without the need of intermediaries'. They aim to provide fast and easy access to information from a variety of sources, both internal and external to the organisation. They are easily customizable and can be tailored to the needs and preferences of the individual executive using it. Since the trend of senior management having direct access to computers has grown and EISs have become a significant area of business computing. An indication of this significance, are the increasing amounts of money invested by organizations in EISs development projects and the subsequent operation of these systems. EISs are gradually becoming an affordable option for a larger number of organizations. [7] This paper presents the development of an EIS using Role based access control mechanism. Therefore, this EIS is implemented on client/server architecture using Asp.net 2.0(C# programming language) and Microsoft SQL Server 2005 DBMS.

2. Executive Information system

An Executive Information System (EIS) is a type of management information system intended to facilitate and support the information and decision-making needs of senior executives by providing easy access to both internal and external information relevant to meeting the strategic goals of the organisation. [10] It help an executive spot a problem, an opportunity, or a trend. EIS is easy to use and easy to tailor to the preferences of individual users. It also permits the user to “drill down” into the detailed data. EIS should make it easy to track the critical success factors of the enterprise, that is, the few vital indicators of the firm’s performance. It is commonly considered as a specialized form of a Decision Support System (DSS). Management Information system consists of DSS, expert systems and executive information systems. [5]

The main objective of EIS is to provide in real time information to the high-level or strategic management. Executives have to manage and manipulate very large sets of data. Executives can have a customized view that extracts information from disparate sources and summarizes it into meaningful indicators. The executive is an authorized person in the organisation such as chief executive officer, marketing directors. They are in higher on the organization scale. They need to have access to “high quality’’ information .In an organisation, executives’ role is to create the future (short term and long term).To assist executives in making effective decisions, EIS can be applied.EIS provides an

approach to sales forecasting, which can allow the executive to compare sales forecast with past sales.EIS helps executives problem, an opportunity or a trend in seconds. EISs are becoming an important tool of top level control in many organisations. [8]

2.1 Developing EIS

The earliest approach was the introduction of Management Information Systems (MIS). These systems were operated by systems professionals and were used to generate regular, pre defined, reports containing information about the organization. A later attempt to assist managers in their jobs is the utilization of Decision Support Systems (DSS). These provided assistance with specific decision making tasks.

However, despite the superiority of both of these approaches over non-computerized systems, and their relative success with lower and middle management, they failed to provide the necessary support to executive managers in organisations. They have responsibility and are accountable for the results of their actions, to either other executives (higher on the organisational scale) or to the owners of the organisation. A prominent characteristic of the executive's role is the making of decisions. This refers to evaluating possible courses of action and selecting and initiating one of them. In order to take effective decisions, executives need to have access to 'high quality' information. Such information needs to be relevant to the variables affecting the outcome of the decision, accurate, timely and up to date. Moreover it needs to be accessed easily and presented in a format that makes it easily understood.

The term 'Executive Information Systems' was introduced in 1982 to describe the kind of systems a few senior corporate officers were using on a regular basis to access information they needed. They deliver information of both soft and hard nature. This information is presented in a format that can be easily accessed and most readily interpreted. This is usually achieved by the utilization of multiple modes of accessing data and the use of Graphical User Interfaces (GUIs). [9]

2.2 The Five Categories of EIS Benefits

They are five categories of EIS benefits and they are explained in the following:

1. Information
   - More Timely information
   - Faster access to information
   - More accurate information
   - More relevant information
   - More concise information
2. Environmental Scanning
   - Better access to soft Information
   - Improved access to external information
   - Better environmental scanning
   - More competitive information
3. Improving Executives' Effectiveness
   - Improved communication
   - Improved executive performance
   - Save executive time
   - Improved Presentation Of Data
4. Meeting Strategic Objectives
   - Increased span of control
   - Improved planning
   - Improved decision making
   - Better Problem Understanding
5. Economy
   - Cost savings
   - Less paper
   - Greater responsiveness to changing customer needs [8]

3. Related Work

A set of related papers to ours are [7], [8] and [9]. In [7] describes the development frameworks for EIS. The development framework is helpful in organizing a complex subject, identifying the relationships between the parts and the areas where further developments will be required. The purpose of these frameworks is to identify features useful in identifying elements of EISs development and usage that influence the success of these systems. Paper [8] implements the Executive Information System for Sales Forecasting using OLAP. EISs use a new type of technology and several techniques for extracting, transforming, processing and presenting data in order to provide strategic information. The purpose is to presents the architecture of Executive Information System and also the main technologies (Warehouse &OLAP) used for designing and building an EIS. Paper [9] presents Executive Information system: a framework for development and their use. To ensure a minimal risk of failure, it is needed to be aware of the various factors that could potentially affect the success of the system. The most effective way to gain such awareness is by having a structured approach to facilitate the study of these factors. This paper is provided by the construction of a suitable development framework for the classification of relevant issues.

4. Client/Server Systems

The term server applies to any program that offers a service that can be reached over a network. A server accepts a request over the network, performs its service, and returns the result to the requester. An executing program becomes a client when it sends a request to a server and waits for a response. Servers can perform simple or complex tasks. For example, a time-of-day server merely returns the current time whenever a client sends the server a packet. A web server receives request from a browser to fetch a copy of a Web page; the server obtains a copy of the file for the page and returns it to the browser. The advantage of implementing servers as application programs is that they can execute on any computing system that supports TCP/IP communication. [4]

The client/server communication is designed to support the roles and message exchanges in typical client-server interactions. In the normal case, request reply communication is synchronous because the client process blocks until the reply arrives from the server. It can also be reliable because the reply communication is an alternative that may be useful in situations where clients can afford to retrieve replies later. [2]

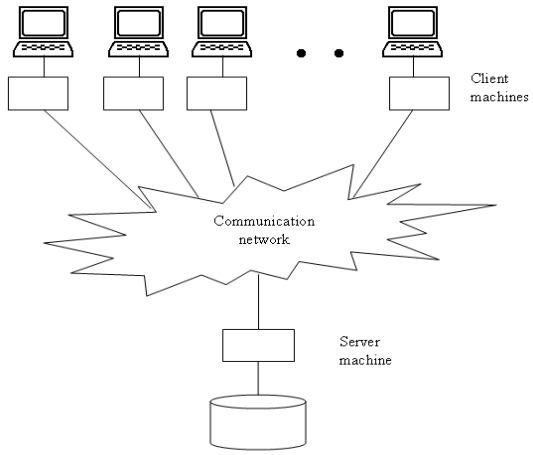

Figure 1: An example of client/server system

As shown in figure1, the client is the application (frontend) and the server is the DBMS (backend). A client/server system can be thought of as a distributed system in which all requests originate at one site and all processing is performed at another. More precisely a client/server system is a distributed system in which some sites are client sites and some are server sites, all data resides at the server sites, all applications execute at the client sites and full location independence is not provided.

Several variations on the basic theme are possible: several clients might be able to share the same server (indeed, this is the normal case) and a single client might be able to access several servers. This latter possibility divides in turn into two cases:

a. The client is limited to accessing just one server at a time – i.e., each individual database request must be directed to just one server; it is not possible, within a single request, to combine data from different servers. Furthermore, the user has to know which particular server stores which pieces of data.

b. The client can access many servers simultaneously – i.e., a single database request can combine data from several servers, which means that the servers look to the client as if they were really just one server, and the user does not have to know which servers store which pieces of data. [3]

4.1 Client/Server Application Programming

The client/server approach does have certain implications for application programming. In a client/server system, it is more important than ever that the application programmer "*not just use the server like access method*" and write record-level code. Instead, as much functionality as possible should be bundled up into set-level request- for otherwise performance will suffer, because of the number of messages involved. The number of messages between client and server can be reduced still further if the system provides some kind of stored procedure mechanism. A stored procedure is basically a precompiled program that is *stored at the server site* (and is known to the server). It is invoked from the client by a remote procedure call (RPC). [3]

One stored procedures can be shared by many clients. Optimization can be done at the time the stored procedure is created instead of at run time. Stored procedures can provide better security. For example, a given user might be authorized to invoke a given procedure but not to operate directly on the data accessed by that procedure. [3]

5. Role Based Access Control

Role-based access control (RBAC) is a technology that is attracting a great deal of attention, particularly for commercial applications, because of its

potential for reducing the complexity and cost of security administration in large networked applications. Under RBAC, security administration is greatly simplified by using roles, hierarchies, and constraints to organize privileges. RBAC reduces costs within an organisation, because it takes into account that employees change much more frequently than the duties within positions. Under RBAC, if, for example, an employee moves within an organisation, only his or her role assignment is changed. Accordingly, it is unnecessary to revoke his or her existing privileges and assign a completely new set of privileges. [6]

RBAC can be configured to support a wide variety of access control policies, including traditional discretionary access control (DAC) and mandatory access control (MAC), as well as organisation-specific policies. Recently, RBAC has also been found to be a natural access control facility for workflow management systems. The concept and design of RBAC make it perfectly suited to a wide variety of application and system software environments, for both stand-alone and distributed deployments. It provides a safe and effective way to manage access to an organisation's information, while reducing administration costs and minimizing errors. [6]

5.1 Role Based Access Control Mechanisms

The appeal of RBAC is its inherent representation of real-world access-control processes. In many situations, people perform day-to-day functions based on the role in the organisations to which they belong, within a community of people, or in society at large. A role is a higher-level concept that can be better understood as opposed to individual access rights or operations. Roles are compatible with the hierarchical organisations found in real, such as those in an enterprise. Roles can be easily mapped onto an already hierarchical structure of an organisation. Higher-level roles are automatically granted the roles associated with lower level organisational entities. It is for these reasons RBAC is being touted as the generalized form of access-control models. [1]

The underlying **RBAC** foundations are permissions are assigned to roles, users are assigned to roles, and access decisions are based on users being members of applicable roles. [1]

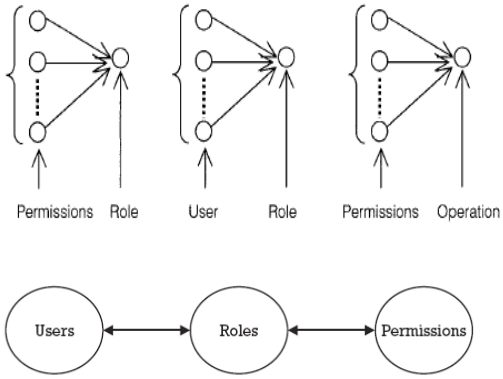

Figure 2: Relations between Permissions, Roles and User

In figure 2, users are assigned to roles in a many to many relationships. A single role can be assumed by multiple users, while each user can be assigned to multiple roles. Permissions are assigned to roles in a many-to-many relationship. A single permission can be assigned to multiple roles. In turn, a single role can be designated to contain multiple permissions. [1]

6. Overview of the Proposed System

In this paper, we develop an EIS system for a dental clinic, with 3 branches and have been provided for necessary financial and branch information. Users of the system are clinic owner, managers of the three branches, receptionists and dentists. Since there are various kinds (roles) of users will use our EIS system, some security control mechanism must be regulated. Therefore Role Based Access Control mechanism has chosen to control access right of each user.

The outputs of the project are chart and graph diagrams of branch competitive analysis, month-by-month revenue analysis, dentist-by-dentist revenue analysis and Variance analysis of each branch.

All these outputs have to be seen only by owner not by other users of different roles. And other information related to the clinic will also provide to the users with respective roles. As a consequence, it is easy for upper-level executives to use and extensive computer experience is not required in operations. And it provides timely delivery of summary information by charts for better understanding by executives. Moreover, it filters data for management for efficient decision making process. Mainly, executive improves in tracking information.

The input data will be collected from each branch of the dental clinics such as: daily revenue by branch and by dentist, expenses, wages, taxes, dentist commission, bills and Cost of drugs and materials, petty cash and technician fees.

Some of the input data are collected and entered to the system by branch managers where RBAC controls each branch manager's access right. Other input data are to be entered by receptionist in which RBAC discriminate the access right between managers and receptionist. The input data from three branches are stored in head office's database by communication and sharing. As above, dentists also have their own authorities to access the database. This means that users with different roles can access to the system with different permissions.

Since the system use client/server architecture, the distinct machine (computers in each branch) can be connected together into a communications network, such as the Internet and the data are stored in the server (computer in head office). All the client machines' data access is ahead to the server through **RPC (remote procedure call).**

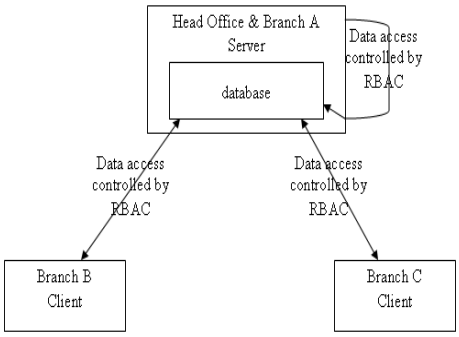

Figure 3: overall system design on client/server system

As shown in figure 3, the proposed EIS system is developed on client server architecture and controlled by RBAC. All of the input data from the client reside at the server's database. And the output execute at the client site.

7. Design of the System

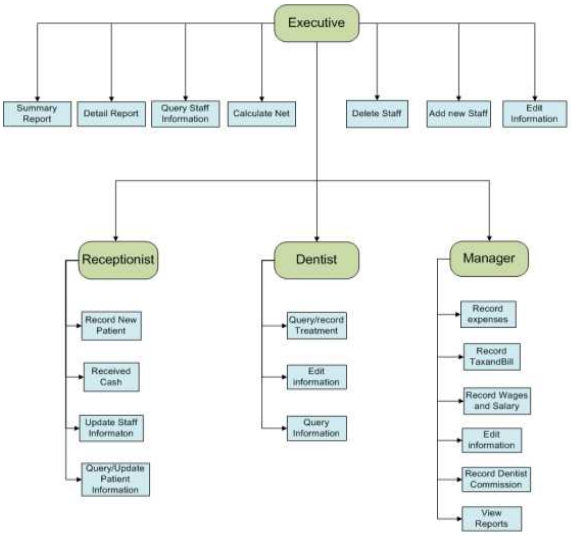

Figure 4 : Module diagram of the proposed system

Figure 4 represents the modules which different on the roles of the users. Therefore, users can perform the system's processes according their roles. There are four kinds of user in the system and there are four roles for above users. In the executive level, executive can compare by viewing the detail report and summary report about the cash which are implemented with graphical displayed. Then executive can also check and query the staff information such as executive in the orgainsation, managers, dentists, receptionists and assistances. Executive can view the comparison of the income and expenses of the branches and executive can also view the income of each dentist from same branch or different branches.These information are shown in table form and on by graphs. Moreover, executive can add ,delete or edit the staff informations according to the executive role and permission. At the manager level, managers have to enter and save earnings and spendings within the organization such as expenses, tax and bill , wages and salary and dentist commissions. And manager also can view the respective reports which he had made and then edit such information. For the receptionist role, receptionists can record and query the patient information. Besides receptionists can edit the respective information according to their role and receive the treatment charges which are defined by dentist. At the dentist level, dentist can record and view patient's treatment history. And dentist can also query and edit some information according to their roles. The charges of treatment are entered by dentists.

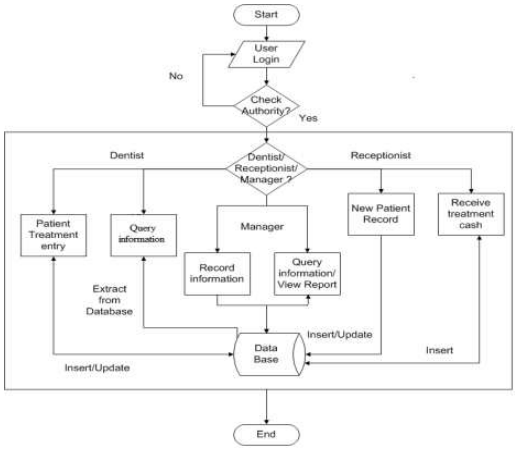

Figure 5: System flow diagram of the proposed system

The figure 5 describes the system flow of the user: the dentist, the manager and the receptionist. After logging to the system, the system will check whether he or she is a dentist, a manager or a receptionist. Afer that, the user will see the home page according to the user type. Then users can do the process according to their role. After each treatment, the dentist enter the charges and medicine to be taken. At the respectionist section, the resceptionist review this information and receive the charges and gives the receipt to patient. Managers are allowed to view all these information and can enter other expenses and income .

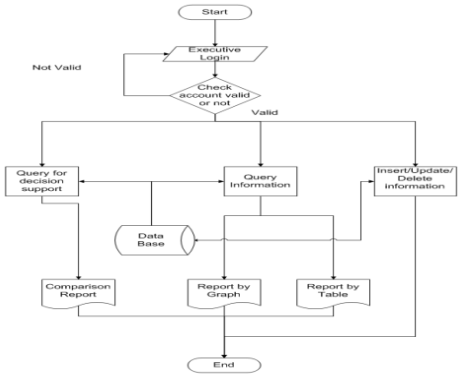

Figure 6:System flow diagram for Executive

According to the figure 6, the executive must login to the system. Then executive can view various kinds of reports which support decision making.The system provides monthly expenses and income of branches and comparison of each branch, the executive can see the benefits and failure of each branches and can make changes to impove the work. And executive can retrieve information of the system and also can see all the detail transactions.

8. Conclusion

Executive Information System improve the quality of management in organisation for extracting, transforming, processing and presenting data in order to provide strategic information. The proposed system is to develop a dental clinic EIS on client/server system to show how to overcome the security and access right problems facing in the course of application of system by using RBAC. By the advantages of Microsoft SQL Server 2005 DBMS, it have an easy and systematic ways to develop this EIS. By using this system, the owner of the dental clinic will be able to view the summary information of the financial status of all branches and also detailed information of these branches.

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