



Integrated Healthcare System

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Abstract

This project will be done on the "Integrated Health System" web application. An integrated health system refers to a comprehensive approach to health care delivery that emphasizes coordination and collaboration among different health care providers, services, and settings. It aims to improve patient outcomes and experiences while reducing healthcare costs by ensuring that healthcare services are delivered in a coordinated, efficient and effective manner. This abstract provides an overview of integrated health systems, including benefits, challenges, and key components of integrated health systems. It also discusses the role of technology in facilitating integrated health systems and presents some real-world success stories of integrated health systems.

Keywords: Integrated Hospital Systems, Computer-based Patient Record.

Introduction.

Healthcare is experiencing an information explosion in the form of knowledge and data. Medical knowledge is increasing almost every day. More complex data must be tracked throughout the patient's life. As the volume and complexity of patient data increases, so does the demand for data that supports activities outside of direct patient care. Medical records must be accessible on a daily basis for administrative, financial and even legal purposes.

Medical institutions have felt the need for a well-structured medical computer-based patient record (CPR) for at least 20 years now. Extensive analysis and research on what CPR should look like and how it should be structured Conclude that it must have the following elements: personal data (demographic and administrative), medical history listing, data security and integrity, authorized access only, remote multi-access, medical examinations and tests, links to medical databases, etc. The Integrated Health System (IHS) was devised to serve this purpose. In addition to controlling and managing hospital administrative data, many systems use CPR. The main goal was to centralize data and automate invoicing and invoicing. In the past, many institutions have implemented such systems using various platforms, mainly Unix-based systems. Recent advances in network technology and information systems have created new tools and new communication capabilities. The use of the Internet is increasing day by day, and user-friendly graphical user interfaces and new client/server architectures have been introduced in the so-called intranet.

An intranet is a private, closed network that uses the Internet's TCP/IP protocol for its underlying transmission [2]. These protocols can run on different types of network hardware and coexist with other network protocols. Users within an intranet have access to larger Internet resources, but users on the Internet cannot access the intranet, which allows only limited access. Intranets allow you to add many components to your system that were not supported by previous core systems. Such components include



video conferencing, whiteboards, etc. Another advantage of intranets is that it is very easy to use graphical Internet interfaces such as Netscape Communicator and Microsoft Internet Explorer.

Within the framework of the thesis project [3], a pilot program is being developed that addresses reengineering needs in healthcare. These needs include inpatient and outpatient medical record management, mechanisms for patient visits and bed reservations by general practitioners (GPs), pharmacy management, document management, Internet access, and email accounts.

Having these needs in mind along with the current trends for telematics in healthcare we decided that an Intranet Web Client-Server application serves best our purposes. The need of users to have access to the system from remote locations, (especially GP's) lead us to extend the network of the system to be able to be connected to the Internet and have access through it using a username and password. The application has four major modules which are: the patient record, the scheduler, the department's monitor program and the pharmacy program.

Methods.

(i) **System Architecture-Implementation.**

Our system's solution is based on Web technology and is intended to augment a pre-existing information system, not replace it. It provides a user-friendly, secure graphical interface and adds exciting features such as Internet access, Internet telephone, access to complete electronic patient records (including medical images), remote access, email and more. It is a combined hardware and software system that provides hospitals with the capability to connect hospital-based and office-based physicians together, in an inexpensive network the so called Intranet. Furthermore it facilitates the networking of hospitals across wide regions and provides routing features that enhance the sharing of services. The Intranet can use standard modems with dial up phone lines and leased lines interchangeably. The system provides physicians with the capability for bi-directional communications with the hospital, other participating hospital network members, and with each other. Using e-mail, the physicians can exchange messages, images, files and other valuable clinical information, and, participate in wideranging discussions about anything they choose.

If a leased line with Internet service is added to the central server, physicians and hospital staff can have full access to common Internet services like the World Wide Web, Newsgroups, etc. Hospitals can easily build their own internal Webpages. to provide valuable information such as test compendia, meeting schedules, policy manuals, and much more, electronically. By posting general information on the Internet, while limiting sensitive clinical information to the Intranet, hospitals and physicians can benefit immediately from the best that technology has to offer today.

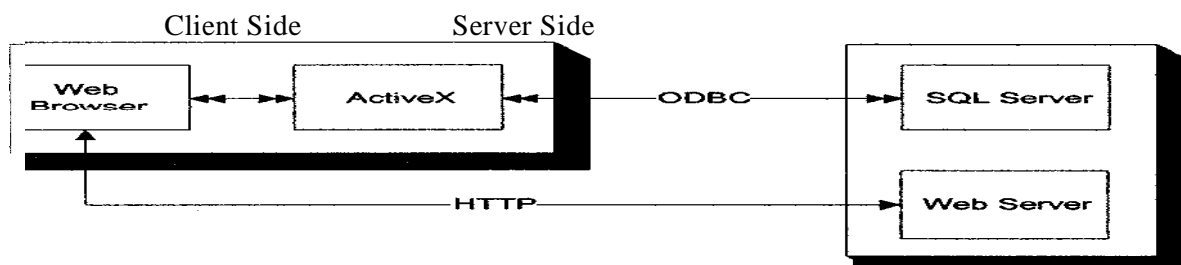


Figure 1: The Client - Server Implementation Using ActiveX Components



The architecture we have followed in the design of the application is a Web based client/server architecture. The architecture is shown in figure 1. On the client side, there is an ActiveX-enabled Web Browser, which is used as a standard client interface. The application has been developed using Microsoft Visual Basic version 5.0 and in fact it is an Active X Document. That means, it is a full featured Visual Basic Application which runs only in an Active X Container like Microsoft's Internet Explorer. This way, there is a link of the Active X Document Application to the Web Site and the users can download an actual Visual Basic Application that runs within their Web Browser. In this approach all the application specific logic resides on the client. On the *server side* there is Microsoft's IIS 3.0 acting as the Web Server and Microsoft's SQL Server 6.5 as the database server both running on an NT 4.0 Server. The communication of the client with the server consists of two parts. In the beginning the web client uses the HTTP protocol to communicate with the Web Server and download the Active X Document Application. After the document is downloaded and registered to the windows registry, it takes control and communicates with the database server through the standard ODBC protocol. The user interface includes ActiveX-based GUI elements (menus, toolbars, property sheets etc.) and this way we achieved to have a very User Friendly interface as it addresses people having minimum or even no experience on computer usage.

(ii) System's Components

The communication infrastructure consists of (a) a Local Area Network (LAN) interconnecting all the clients and the servers of the system in the interior of the hospital, and (b) the necessary physical connection to the external internet that is used for enabling access to remote users. In TMH we installed a 10Mbps Ethernet LAN network. For the connection of the Intranet with the Internet we used a firewall software configuration to secure the internal network. A router and a fast connection (e.g. T1 connection) is also required to connect the Intranet to the Internet. The Networking protocol is TCP/IP. NETBEUI has also been used to support the Microsoft Networking.

Since data reaching the end-user web browser may be encrypted an appropriate decryption software will be employed. The security and privacy of the transmitted data is ensured by the following mechanisms:

- (i) Web browsers and servers perform end-to-end data encryption to protect all data transfers between clinical databases and end users. This encryption foils any attempts to eavesdrop. At the account-holder level, authentication is verified via private passwords.
- (ii) Access control lists are in place to limit usage of certain features and limit access to patient information based on individual staff members' positions and duties.
- (iii) E-mail messages between patients and physicians can be signed and encrypted so that any sensitive content is safeguarded.
- (iv) On the hardware-level the system will be provided with tape backup systems and operating system level hard drive mirroring. This means that every time something is saved on a server, it is also saved to a duplicate hard drive. In the event of a hard drive failure, no data will be lost.

Redesign Methodology and Processes

The vision was to put the patient at the centre of the business process and develop strong links with the primary healthcare (GP) and community services. We divided the single patient care process in a series of smaller processes that fit in to a continue as shown below. The scheduler is integrated to the patient record and offer save user friendly interface to schedule the examinations of a certain patient in any department of the hospital.

- (b) The department's monitor program is the application used by every to department and it communicates directly with the scheduler to review, realise, postpone or cancel any scheduled examination..
- (c) The drug store monitor program is used to manage any needed supplies for drugs.



Results.

The implemented Integrated Healthcare System is now being tested by our team. After logging into the Intranet's system with a username and password this patient care process, reflects the *Patient Journey*(P.J.) through the whole care process. The idea is that this model reflects as closely as possible the actual path that the clients follow when receiving treatment from a healthcare organisation. We found the concept of *Episode*, central to the whole process, since it can group a number of important information such as the *status* of the patient care process (Assessment, Admission, Treatment, Follow up, Discharge), the Admission and *Discharge date/time*, a *primary* and a *final diagnosis* etc. Within this framework a starting point has been made. All key processes within the organization have been evaluated, mapped and redesigned.

The goal was to identify and agree on ways to reduce number of actors and decisions within the process, reduce blockages and lessen the number of steps within a process, decrease the number of inputs/outputs, shorten the timescale, consider how an information system could simplify the process, look for ways to increase the ability to manage the process effectively and increase stability of the process.. Our analysis continues by studying several scenarios of the patient's journey. We tried to analyse the whole patient's journey using the so called *use cases*. The use cases helped a lot to define the main classes of the system: The *Patient* class, The *GP* class. The *Insurance Company* class, The *Contact* class, The *Medical history* class, The *Episode* class

Functionality of the System-Summary of Features

Five major modules along the whole system can be identified:

- (a) The patient record is the core of the system reflecting the patient's central role in the redesign of the organisation's view authentication, the user is confronted with the form depicted below. From here he can perform the patient's data search.

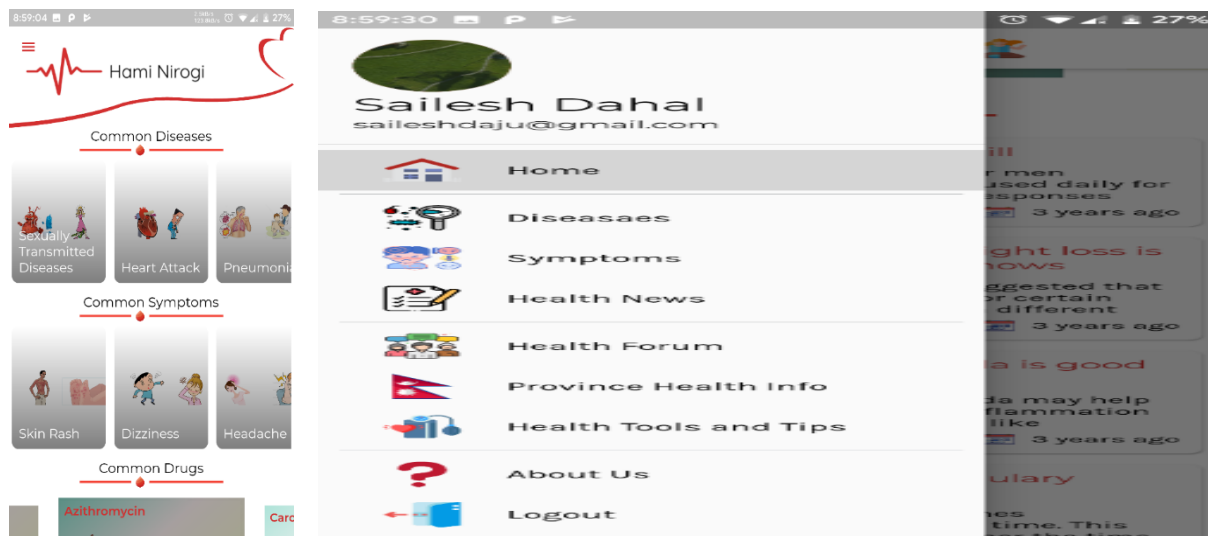


Figure 2. Home Screen

From the form shown in figure 2, the user can access the different modules HIS database such as the GP records, the Examination records, the patients records, etc. Each time that a patient is contacting the hospital, through an Emergency Medical System or his GP, a new episode is recorded regardless of the duration of it. Every new episode is recorded into the database using the form shown in figure 3. If a test is needed then the user is automatically sent to another form where he can perform the



scheduling of the Examination event. This form is depicted in figure 5 below. The user, a GP from his office for instance, is graphically choosing the date and the time of the examination, while he is not allowed to choose time- slots already schedule other users. On the other hand, these data now stored into the system are also available to each department responsible for a specific medical examination.

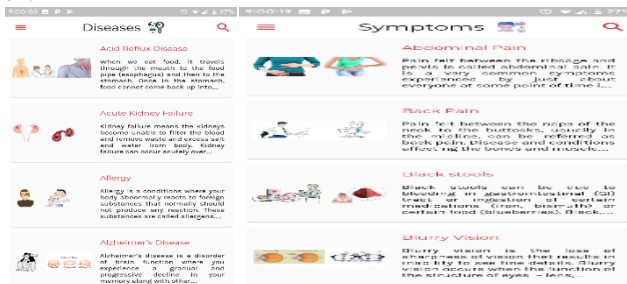


Figure3.Diseases and Symptoms

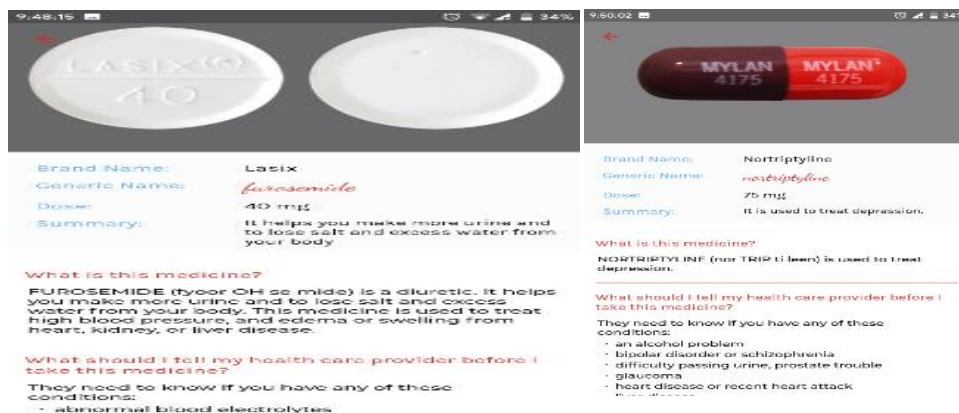


Figure4.Medicine Report

Thus, the department can view all his appointments and fill the form in figure 5 below during and after the occurrence of the examination.

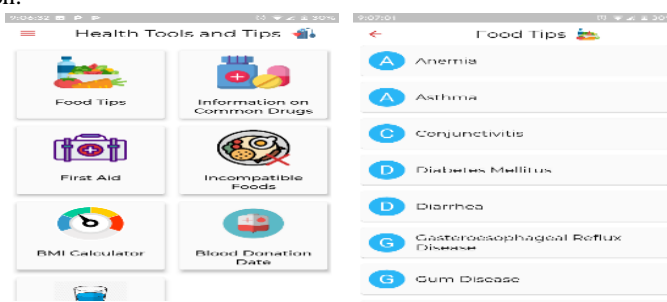


Figure5.Department's Appointments

Future Work-Conclusions.

Soon we are going to implement the disease prediction and Hospital suggestion for the particular disease and conditions. For this method we are using google api to suggest the nearest hospital based on the condition.. For Example: "If the patient experiencing pain on his/her under the ribs it'll return some disease and conditions names. After that the final symptoms will displayed for absolute disease and condition prediction. Then the final condition will display to the patient after that the web page will suggest nearest hospital for that condition. In this web page if the patient suffers from urology problems it'll



suggest to go nephrology. Because urology comes under nephrology which is more easier to solve the patient disease or condition.”. We adopted Active X Document programming to build our application. Prior to start development of our system we evaluated Java, Java Script and Active X controls each one having its advantages and disadvantages. Currently we are evaluating Microsoft's Active Server Pages (ASP) [4], a technology which combines most of the above technologies advantages. Active Server Pages is the newest level of web server technology. It offers features such as Openness, Browser Independence and ASP are compile-free pages.

The biggest advantage ASP offers is that it is client independent. The client receives compiled ASP pages which means simple HTML code. The same application will run either in a Windows 95 machine or a Unix workstation. This is of great importance especially in the field of Health Care Systems where most of the Hospitals have already installed hardware and software which they wish to preserve by simply adding more functionality on the existing systems rather than having to buy new machines with specific characteristics. Having these in mind we plan to transfer the whole application to this new technology.

Furthermore we plan to develop applications based on Microsoft's Exchange Server to enable the user with services like messaging to physicians, hospital departments and staff, messaging to Customer Service, send text, charts, graphs and other documents, include links to World Wide Web sites in messages, comprehensive network wide address book, Workflow, Scheduling, Directory of Services, Test Compendium, Marketing Information as well as Directions and Maps.

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