

# The Analysis and Design of an Integrated Hospital Management System. The Case of Motherlove Hospital

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## Abstract

Information handling at the hospital is very imperative to both patients and the management of a hospital. Several Hospital Management Systems have been developed with some number of inconsistencies of data representation thereby, affecting the effectiveness of the system in its entirety. Current systems tend to store information in multiple databases which can result to data redundancy, but this system will store all information in one database so that information is updated to the same database to avoid double entries in the system. The system is visualized as a web based application with three-tier architecture. The three-tier architecture provides an increased degree of security because its multiple zones isolate protected healthcare data making it difficult for a hacker to get system-level access to the database. This research work brings to light some of the challenges in existing systems, provide a gap analysis, propose an effective and robust Hospital Management System that will perform better than the existing ones. The research work also presents the analysis and design of the proposed system using flowcharts and Use Cases.

**Keywords:** *Two-tier and three-tier architecture, Use Cases, Data Redundancy.*

## 1. Introduction

The timely provision of complete and up-to-date patient data to clinicians has for decades been one of the most pressing objectives to be fulfilled by information technology in the healthcare domain (Bisbal and Berry, 2009). This situation has given rise to increase in the number of Hospital Management Systems across the globe. Although these applications have become very much known to majority, however, its adoption by some other hospitals has been very slow. For example, the chosen case for this study, Mother-love Hospital, still keeps to the old method of organizing information. This comes along with several challenges such as Data redundancy, data inconsistency, difficulty in accessing data, data isolation, integrity problems, atomicity problem, concurrent access

anomalies, and some security problems as opposed to Database Management technologies that seek to resolve the problems as mentioned above (Gihan and Haneen, 2013). Also, healthcare generates large volumes of data at disparate clinical environments at distributed locations, and by wide variety of users (Bisbal and Berry, 2009). Physicians most often make their decisions from these data sources and hence must be well organized such that it will not be prone to some basic errors.

Notwithstanding the fact that the Hospital Management System comes with several benefits, the current development has taken a trend that exposes it to one major problem. That is; the Electronic Medical Record (EMR) Systems that are highly centralized, each Healthcare Provider (HP) has its local EMR system. This makes health information for any patient dispersed among different HPs and, therefore, its retrieval will be a challenge (Zhang and Liu, 2010). In most cases the application is developed in modules and each has its own database therefore updating records becomes a big challenge. They do not have prompt feedbacks such as short message service (SMS), emailing module or live chart to and from physicians (Doctors).

Now, more than ever, people have become more health conscious and are taking necessary steps to ensure that they have a sound body and mind; that is why everyday there is an increase in patients who go for check-ups and treatments. A medical institution is primarily devoted to the diagnosis and care of patients. Basically, patients spend a substantial amount of time in clinics waiting for services to be delivered by the doctor or health professional. The degree to which the patients are satisfied with the care received is relevant not only to the doctors' expertise in their field but also to the quality services offered by the Hospital Management System to ease the processes the patient goes through. As the numbers of patients keep rising, managing a health facility can become increasingly difficult, but an effective and efficient system can make all

the work seem easy. Therefore, this research work seeks to analyze and design a Hospital Management System that will allow hospital staff (doctors, nurses) access to patient records, reduce the stress in tracking records, reducing patients waiting time and increasing the number of patients served.

## 2. Literature Review

### 2.1 Current Procedure at Motherlove Hospital

Currently, at the Motherlove Hospital, all operations are done manually. Before a patient can receive treatment from doctors, first of all, they need to register. Afterwards, the Hospital issues an Identification Card that has a unique number on to the patient. If this card is misplaced, you will need to register again. The ID cards are also linked with the patients file that contains the patients diagnosis information. After registration, the attendants search patient's file using the information on the ID card. The patient may be assigned to a doctor/physician/expert for diagnosis. Lastly, billing and payment is done. It is evident that as the number of patients grow, the dependency on human effort in the search of files and information for patient will be very difficult.

### 2.2 Gap Analysis Of Existing System

Table 1: Gap Analysis of Existing System

| Name of System   | Functions   | GAP   |
|--|---|---|
| CMS by Business Computer Application Inc (Azuan, 2005) | <ul style="list-style-type: none"> <li>• Patient Registration</li> <li>• Scheduling Appointment</li> <li>• Database Management</li> </ul> | The system covers registration and scheduling of appointments but it doesn't cover the complete management of In-Patient and Out-patient department. The few modules cover only a part of the system. |

|                                  |  |   |
|----------------------------------|--|---|
| CMS by AIZ Company (Azuan, 2005) | <ul style="list-style-type: none"> <li>• Patient Management</li> <li>• Medicine Inventory</li> <li>• Billing</li> <li>• Patient Medical Examination</li> </ul> | GAP: it was to provide a flexible CMS, but it doesn't control appointments patients have with doctors or even keep track of patients. Room allocation/check also not present so room availability has to be checked manually. As a stand-alone system, data are not continuously updated. |
| Finch Data Soft CMS (FDS, 2010)  | <ul style="list-style-type: none"> <li>• Patient Registration</li> <li>• Room Allocation</li> <li>• Billing</li> </ul>   | GAP: this handles registration, room allocation and billing. More modules are needed too. No inventory of medicine, so availability of medicine is unknown before prescription. Here focus is more on Inpatients than Outpatients.  |
| Dee Medical OPD CMS              | <ul style="list-style-type: none"> <li>• Patient Registr</li> </ul>  | The system is strictly for Outpatients. It only   |

|   |  |   |
|---|--|---|
| <p>(In-House developed application, 2014)</p> | <p>ation</p> <ul style="list-style-type: none"> <li>Billing</li> </ul> | <p>extends to the Inpatients during registration where they are given registration numbers. This number is now used for locating an Inpatients' file using the manual filing system. It is an organised filing system but the time taken to retrieve a file is long. Room availability check cannot be performed.</p> |
|---|--|---|

In the above table the various systems are considered with their functionalities and the deficiencies. It is realized that the existing system do lack the integration of SMS, email, and live chat. Also, in the complex applications, each module is linked to a distinct database thereby upon updating of records there are redundancies. Patients need to have easy access to their information, likewise the physicians (doctors). Therefore, the integration of SMS, email, and a chart module that will allow patients to communicate with physicians is important in this instance.

### 3. The Proposed System

#### 3.1 Theoretical framework of proposed system

The proposed system is a web-based system so activities are done over the network. With the use of one database, the system needs to backup all data as it enters into the database. So once any bit of information is stored in the database, the backup is immediately stored on the cloud. From here the patient can access the system from the cloud

to view the patient admit-history. The administrator manages all system data and activities, from registration to using the feedback module to send SMS or email to the patient to ensure patient satisfaction after services rendered. Also in the feedback module is a live chat for real-time communication with patients once they are logged in to the system. The administrator also generates reports from the system when the report is needed. The doctor can access information from the database, so he/she knows how to attend to the patient before the patient meets him/her. If a patient is referred to the laboratory, the lab technician takes a number of tests and saves them to the database so the doctor can access the information without communicating to the lab technician. If referred to the pharmacist, the drugs or medication that is prescribed to the patient is saved to the database. With one database, we can see it is all about the various departments updating information on the patient data that is already stored in the system and if there is any need for that information, it is easily retrieved from the database. Since the information in the database is backed up in the cloud, as soon as any update is made, the cloud is updated with the information. This is basically how the system works. All information from the users will be stored to the database and the information is backed up on the cloud, so data is secure and readily available anytime it is requested.

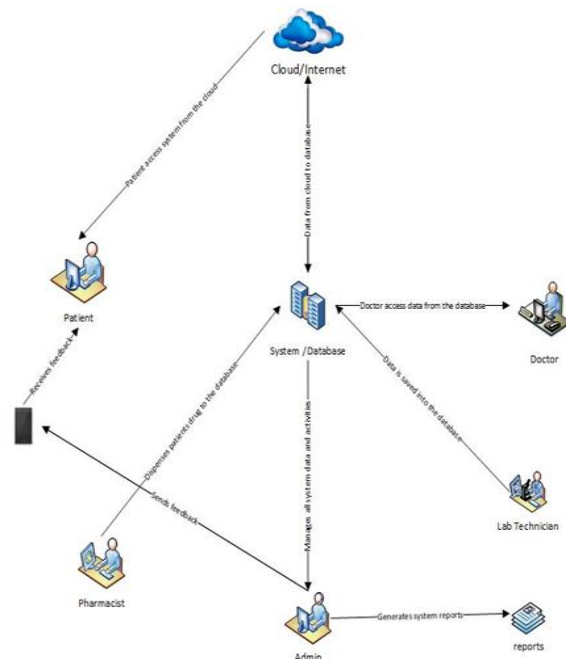


Fig. 1 Theoretical framework of the proposed system.

### 3.2 Benefits Of The Proposed System

**Cloud Storage:** Cloud backup delivers next generation intelligent data backup and recovery to protect organisation's business critical data in one simple unified solution. The purpose behind cloud storage is to protect the information from the risk of loss associated with fire, theft, hacking, or any kind of technological disasters. With current encryption and security practices, data backed up in the cloud is highly secure (Clark, 2012).

Cloud solutions leverage the elasticity of cloud computing to become more agile in responding to changing circumstances, like rapid data growth, which can easily be accommodated because it is cloud based, so increasing or decreasing your storage capacity should be painless. It also allows the user to concentrate solely on his/her work without worrying about data loss. You can restore lost data with zero downtime.

The cloud is invisible as it has no singular physical location, so remote access is also a simple and feasible benefit of cloud backup. Once you can connect to the remote server, you have access to all the data that you have stored in the cloud. From wherever your contact point is, gaining access to the information backed up on the cloud from your system ensures consistency and an easy approach across departments.

**Single Database:** A single database decreases the quantity of information managed and saves clinicians time spent on repeated data entry (Russel, 2013). The greatest benefit of a single database is data integrity. One of the cardinal rules of database design is that no redundancy is allowed, which means no piece of data should ever be repeated within the database. When information is about to be entered in the system from any department in the hospital, if the information is already stored in the database, the system will notify the user that the information about to be entered is already available in system, thereby preventing data redundancy. So when any change is to be implemented, there is only one place to look to make the changes.

With a single database it is much easier to develop reports that show a broad range of activities performed in hospital. With multiple databases, records need to be matched, de-duping needs to occur and the opportunity for duplicate records is greatly increased.

With a single database, support is focused on one product. With multiple databases, even if they are all built on the same platform, separate support is required for each database. In conclusion, the hospital management system will simplify and centralize updates on information, improve quality of service, reduce errors and increase efficiency of the system.

**Feedback Module:** This module contains SMS, e-mail and live-chat service in which all will be used as a medium to convey important information to patients and even staff. With this module you can send general broadcasts of urgent/important information, such as alerts/updates on epidemics. You can broadcast to the masses at low cost and the message is available in the patient's phone inbox so when they are ready they can read quickly and easily at no cost. For booking/scheduling, the feedback module decreases long queues, which can help resolve physical space issues. It is also time saving for patients and they have the option to reschedule their appointment if the desired slot is unavailable. With the feedback module, the system requires feedback on patient's condition, which can benefit the patient as they receive better attention from well informed caregiver. This module can also be used for updates like health and diet tips to patients at home. And also a step in fostering good relationship with patients, for instance; sending greetings for birthdays will be a good way to build up hospital rapport that is not costly for the automated system. It can also be used to get feedback on out patients that are on medications, asking how they feel since they started taking the drugs prescribed to them as there is no medical personnel to watch them till their next appointment. This is a good way of extending care to the patients and building a better relationship with them.

#### 4. Design of the Proposed System

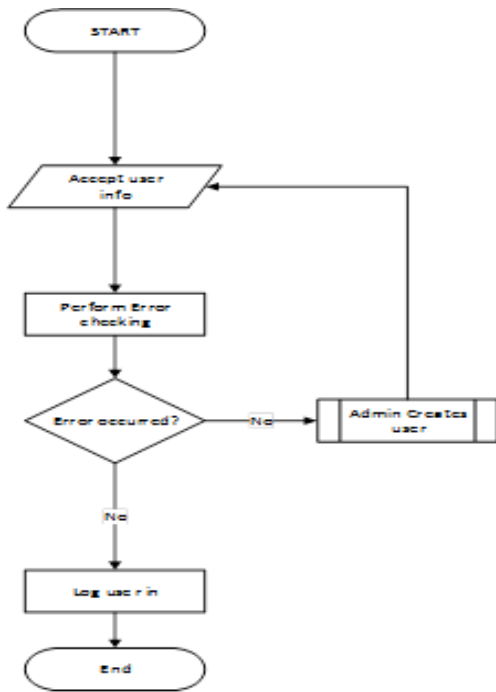


Fig 2: Flowchart of the Proposed System

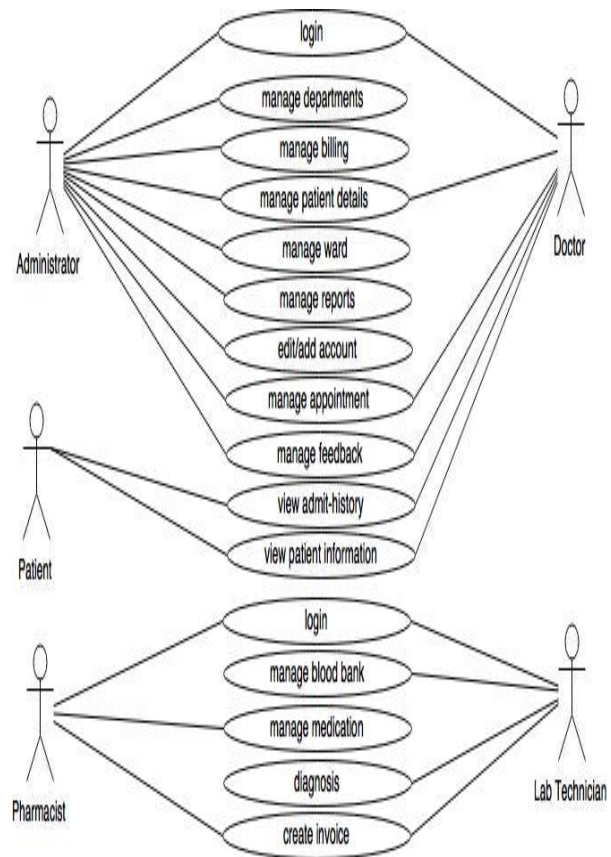


Fig 3: Use Case Diagram of the Proposed System

Figure 3 above, shows each of the actors of the system and what they can do on the system.

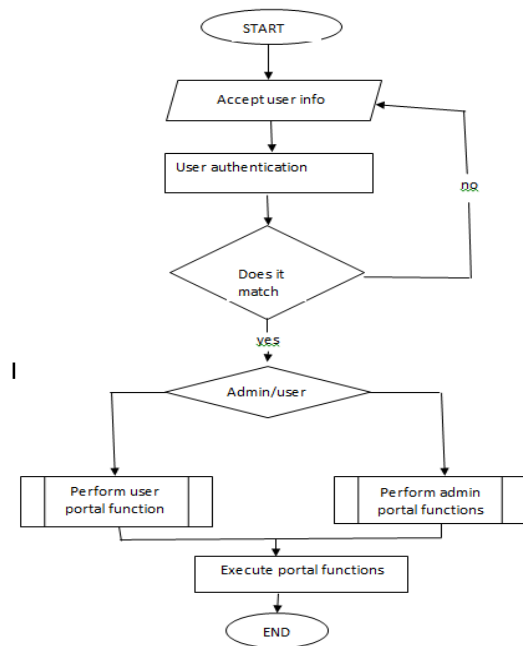


Fig 3: Flowchart of the Proposed System

#### 5. Conclusions and Recommendation

The use of computer systems to ease the performance of grueling tasks has gradually crept its way into the African society as the initial paranoia towards automated systems is fading out. Therefore, Hospital Management System can do nothing but benefit a clinic in terms of productivity and patient service provision.

Protecting the valuable and confidential information stored within databases is vital for maintaining the integrity and reputation of organizations everywhere not to mention ensuring regulatory compliance. Since the use of cloud storage is applied for backup, the hospital should not feel that the documents on the cloud are invisible to threats, so the need for extra protection is not necessary. In preserving integrity, one must have a fully secure system which means including security measures for the protected information on the cloud database. The health institution should never feel too safe in security of data because threats can come from even the insiders that are trusted to the system. A database monitoring system that can monitor database activity constantly is essential. Encryption is necessary to make any kind of data unreadable (Ranjan, 2014). If you are not able to understand what is on a file, it is of no use to the intruder.

Integrating a payment module too is important for the system. The payment module allows healthcare providers to accept credit card and check payments as well as deposit checks from the system. Here, the payments will be secure online and automated weekly security scans of your firewall will protect your payment entry and the patient data is secure. Patient's billing information is accurate and posted directly to the patient accounts and this is confidential between the hospital and the patient.

The need for a high performing robust network infrastructure is recommended to monitor activity occurring over the network. Two-tiered wireless sensor network architecture is proposed as a solution to that issue and the protocol used for the communication over the net (Liu, 2003). Available tools are robust and lend themselves to fast prototyping to ensure user needs are met accurately and completely. The network architecture offers high performance so there is little or no disappointment when the network is accessed. It will ensure secure transmission of information over the feedback module since a lot of sensitive information will be handled in that module.

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