

# Pharmacy Management System for Udupila Pharmacy

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**Abstract**—There are many pharmacy management systems available in the market with different sets of capabilities. This project aims to improve the functionality and features of such systems, and ease the functioning within a pharmacy. The proposed system addresses the problems from user, administrator, and super user perspectives.

This paper describes the importance of the final product, compared to the existing pharmacy management systems available in the market. In addition, this report includes the system design, important implementations, testing procedures, and implementing strategies used for developing the final product.

**Keywords**—Java; pharmacy; database; desktop application; inventory management

## I. INTRODUCTION

Udupila Pharmacy has a manual processing system for issuing pharmaceutical items, inventory management and stock management. Hence the project was to automate this manual process in order to improve the efficiency of the business.

Since there are pharmacy management systems available in the market, the initial plan of the end system was to implement all the functionality in the existing systems in addition to some of the new features which help to ease the end users work. More descriptive details regarding the new features and other functionalities are provided under the Literature Review. Furthermore, the project plan included an objective to eliminate all the manual calculations and manual inventory keeping from the pharmacy.

Identified actors of the business environment:

- Owner
- Pharmacist
- Staff Members
- Customers

According to the main business process, in the end users environment, the entire project can be divided into six subsystems:

- Stock control system
- Billing system
- Report generation system
- Customers records keeping system
- Company records keeping system
- Salesmen records keeping system

System is designed and implemented as a single user desktop application system. Since there are many actors, different levels of data access privileges are to be provided according to the security level of the user. Therefore, the system includes 3 main access privileges and corresponding interfaces accordingly.

- Super User Level
- Admin Level
- User Level

Each privilege level has specified capabilities and restrictions involved. Higher level privileges can access lower level dashboards, but lower level privileges are not allowed to access higher levels. Hence the super user is allowed to access 'Super user' dashboard, 'Admin' dashboard and 'User' dashboard while Admin is only allowed to access 'Admin' dashboard and 'User' dashboard. Normal user is only allowed to access 'User' dashboard.

Pharmacy management systems are usually focused on their end users. This system accommodates the pharmacy customers by allowing them to request for orders, as an improvement. Once the order has arrived and is available at the pharmacy, the customer will be notified via SMS. The implementation of this process will be described under section IV B.

Apart from the functional implementation, end system has achieved system security requirements such as confidentiality, identity, authenticity and non-repudiation. Users are given different security levels related to their privileges and authentication is carried out based on the user name and password. Passwords are encrypted using MD5 function. To ensure non-repudiation, it is allowed to view login details and data modification details by super user.

## II. LITERATURE REVIEW

Available pharmacy management systems have billing system, stock management system and report generation system. Along with the above mentioned features, this project involves customers' records keeping system, company records keeping system and salesmen's records keeping system. Furthermore, new capabilities are added to the above subsystems. Identified features of the existing systems are:

- keeping details of tablets, syrups, creams, liquids, etc. (details include their code number, batch number,

name, generic name, company name, expiry date, retail price, whole sale price, manufactured date, available quantity)

- provision to search any drug based on its name and/ or code number
- provision for the Admin user to set code numbers for drugs, to aid convenient functioning of the system
- report generation on items with short expiry duration
- prioritization for the nearest expiry items when billing
- ability to enter stock limitation by the Admin user
- ability to generate lists of items in shortage
- ability to obtain managerial level reports on monthly annual basis (including profits and bestselling item)
- provision of Admin and User privileges, allowing the system to keep track on who carries out a particular sale or a stock update
- ability to obtain a list of expired items

End system includes all capabilities given above, as they are essential to perform daily operations of a pharmacy.

### III. NEW FEATURES ADDED

#### 1) Three different billing panels to eliminate manual calculations

There are three different ways for an item to be billed. One method is billing according to doctor's prescription. Doctors prescribe drugs indicating how often it should be consumed and the duration for usage. Hence the pharmacist should manually calculate the number of tablets to be given. One billing panel is used to eliminate these manual calculations. Other two billing panels are provided to handle situations where customer asks, for a specific quantity of an item, or an item for a specific amount of money. For example, customer may ask for 5 tablets or tablets worth of Rs. 20/-. Therefore these three billing panels are capable of eliminating all the manual calculations that may be required in the billing process. The system will specify the number of tablets or items to be given, after the details are provided.

#### 2) Ability to keep company details

In a pharmacy with manual record keeping, the pharmacist and its staff should keep details of their suppliers. This system itself provides facility to keep those details, to provide easy and efficient access.

#### 3) Ability to maintain records of salesmen

Furthermore, the implemented system facilitates record keeping on salesmen within the system itself. This enables quick access to information whenever needed. There is no risk of data losses.

#### 4) Ability to keep details of regular customers

The system provides facilities to keep track of its regular customers and access their details efficiently. In certain

situations, customers may ask about the medicine they bought recently. Hence it is necessary to keep track of individual customer purchase records. Only the super user is allowed to access such medically confidential data.

#### 5) Generating item shortage lists based on supplier

The list of items to be purchased can be obtained based on their suppliers. When an item is added to the system, the system allows setting a stock limit to that item. Whenever user requests a shortage list, items that are below the stock limit which have been specifically requested by a customer will be added to the list accordingly, along with the supplier of the drug.

#### 6) Ability to record orders by customers

End system provides the facility of ordering items that are currently not available in the market. This is a new implementation. Once a customer has place an order, relevant details will be added to a separate table in the database. When 'Admin' user gets the list of items in shortage from a particular supplier, order details will be added to that list of items to be purchased. Once the stock is received, and recorded in the system, the relevant customer will be notified via SMS.

## IV. DESIGN AND IMPLEMENTATION

### A. Design

This document uses 4+1 architectural view model to describe the architecture of the pharmacy management system, based on the use of multiple, concurrent views. Different views depict the system from the viewpoint of different stakeholders such as end user, software developer, project manager, and pharmacy manager etc.

#### 1) Use-case View:

A number of use case diagrams were drawn to illustrate the significance of all functionalities in the application.

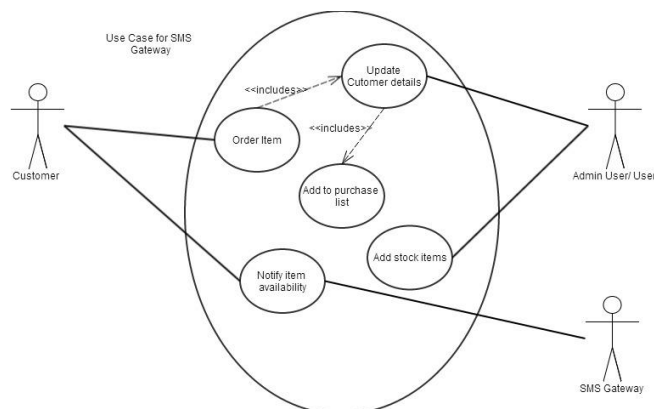


Fig. 1. Use case of SMS Gateway.

One of the main subsystems of the entire project is the Management System. It can be divided in to 6 subsystems as shown in Fig. 2. Each subsystem has a set of specified functionalities to be performed. Detailed descriptions of each subsystem of the Management system are provided below.

i. Stock Controlling and Management System

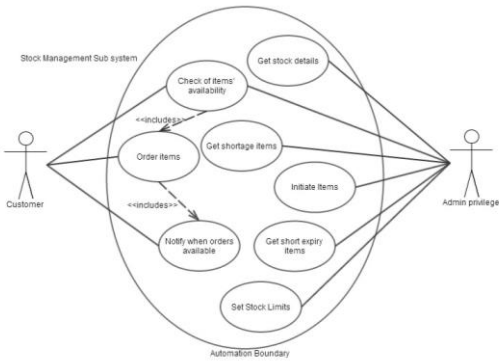


Fig. 2. Use case for Stock Management System.

Stock Controlling and Management system will keep all the records of stock items. Admin User will be provided with user privilege to set details on pharmaceutical items, such as the generic name. Then the stock entries can be added to the database. User level can only search for the items available in the stock. Stock taking is only allowed under Admin level privilege.

The Admin can set a storage limit to each item. Whenever that item stock goes below the set limit, item will be added to the list of items to be purchased under its supplier.

Stock controlling system does not allow addition of any item which expires within next 6 months period. Furthermore, it allows to get the short expiry list and the system will warn about the expired items.

In addition to above features, the system will provide the list of items to be purchased under each supplier.

ii. Billing System

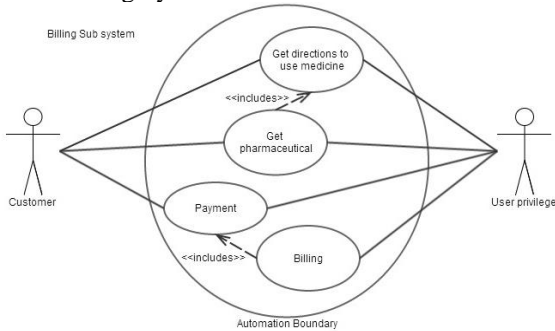


Fig. 3. Use case of Billing System.

Billing subsystem provides functionality for billing items for each customer. It can link with a regular customer or new customer.

Billing system allows searching for items that are currently available in the stock. There are three panels to enter items. Billing for multiple situations, such as medicine provision according to doctor's prescription, or for a given amount of money, or a specific number of tablets, are facilitated through different panels. In addition, facilities are provided to order items which are out of stock. Then that item will be added to the list of items to be purchased.

iii. Customer Records Management System

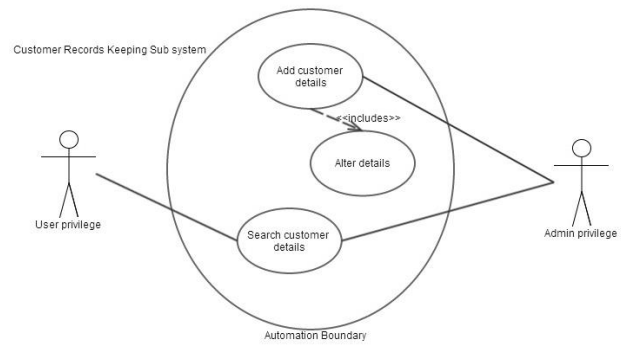


Fig. 4. Use case of Customer Record Management.

In certain situations customers request to buy a drug from a brand that they bought early. In such an occasion, it is necessary to have records of the regular customers and their purchases.

The customer records management system provides facilities to keep records as well as to search reports efficiently.

iv. Companies Records Management System

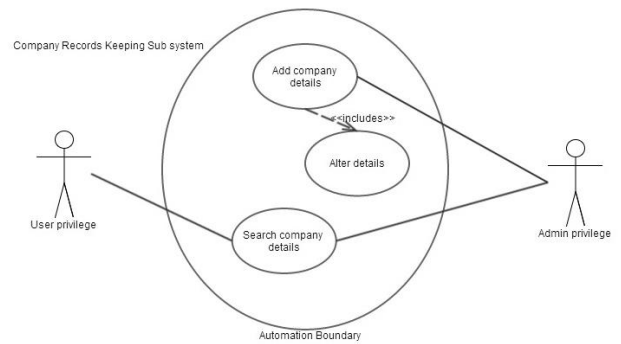


Fig. 5. Use case of Company Records Management.

In the existing business environment, pharmacist uses a manual record keeping system to keep supplier details. But manual records are difficult to maintain, as well as to retrieve entries. This proposed system itself provides a way to keep supplier details. It will include efficient and reliable searching.

v. Salesman Records Management

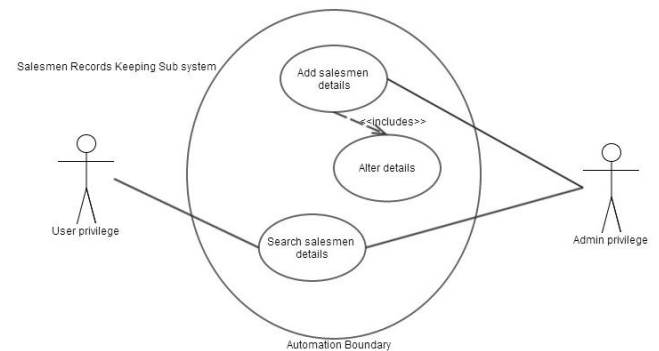


Fig. 6. Use case of Salesman Records Management.

In the existing business environment, pharmacist uses a manual record keeping system to keep details on salesmen, such as recruited supplier and contact details. However, it is very hard to maintain as well as to search entries. Therefore system itself provides a way to keep salesmen details. It will include efficient and reliable searching.

vi. Report Generation Subsystem

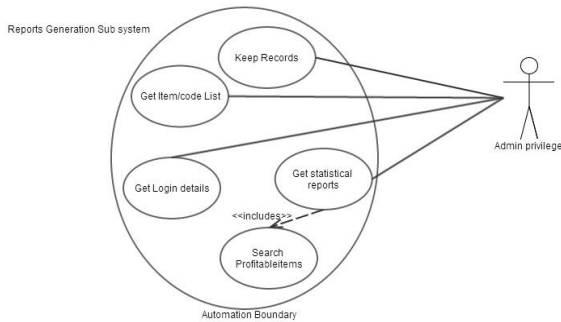


Fig. 7. Use case of Report Generation System.

Report Generation subsystem is used to generate managerial level reports for the accordingly privileged users.

2) Logical View:

Logical design of the overall project can be represented using a three tier architecture model. This framework of three - tier architecture model will segment applications' components into three layers.

Presentation tier includes all the user interfaces which give user access to the application. This layer presents data to the user and optionally permits data manipulation and data entry. Presentation tier communicates with the business service layer for manipulation of data. Middle tier of three-tier architecture will consist of business and data rules according to the business environment. This layer is used to solve business problems and achieve major productivity advantages. Handling of business algorithms and legal or governmental regulations, and data rules are performed by this tier. Data tier or data service layer performs manipulation of data stored in the database. This controls access to the data to ensure persistence of data.

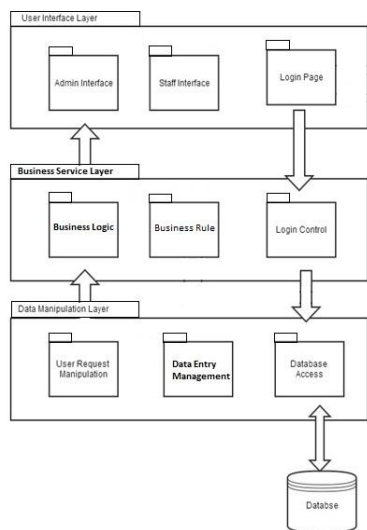


Fig. 8. Logical View of the System.

3) Process View:

Process view describes the system's decomposition into lightweight processes and heavyweight processes and their communication in between.

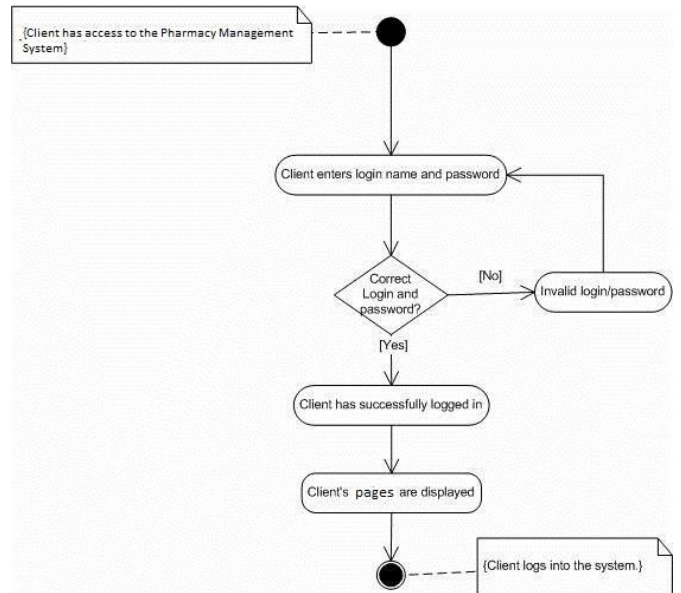


Fig. 9. Activity diagram of Login Process.

4) Deployment View:

Deployment view illustrates the physical topology of the system components after deploying the system to its user environment.

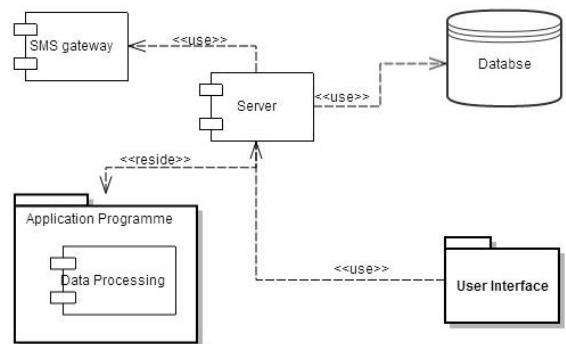


Fig. 10. System Component Diagram.

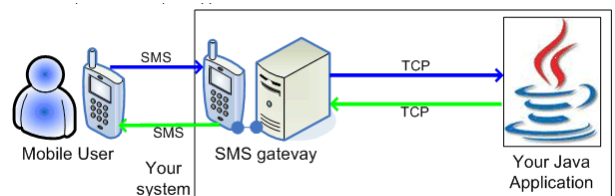


Fig. 11. SMS Communication.

5) Implementation View:

The Implementation view depicts the physical composition of the implementation in terms of implementation of

subsystems and implementation of elements (directories and files, including source code, data, and executable files).

For the comprehensibility Implementation View has divided into three layers.

Presentation Layer concerns about the system's interface to the outside world. Graphical User Interfaces are handled using this layer. Control layer handles all the controlling of the system including data handling, data access handling, data manipulation, interface controlling, and user login controlling etc. Data Layer is responsible for all the actions such as data storing, retrieval and any other action related to data.

### 6) Data View

Database schema is designed according to rational databases, using first normal form in a way that all the elements are atomic. To avoid data redundancy and memory wastage, data repetition has been reduced as much as possible.

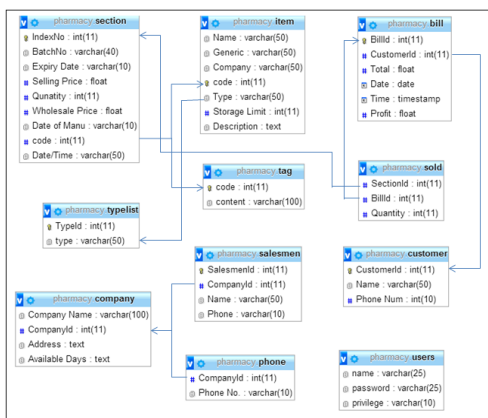


Fig. 12. Database schema.

### 7) User Interfaces

There are different interfaces for normal users, administrator users and super users. Interface designing is mainly focused on the usability, comprehensibility and efficiency of usage, and acceptability.



Fig. 13. Login page.

### B. Important Implementation Details

System was developed as a Java desktop application using the Netbeans framework. System is compatible with hardware resources available in the pharmacy. And the database was implemented using MySQL server 2008 [2], [3] & [4].

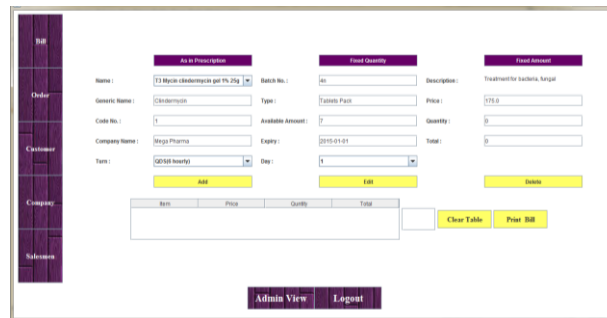


Fig. 14. User Dashboard.

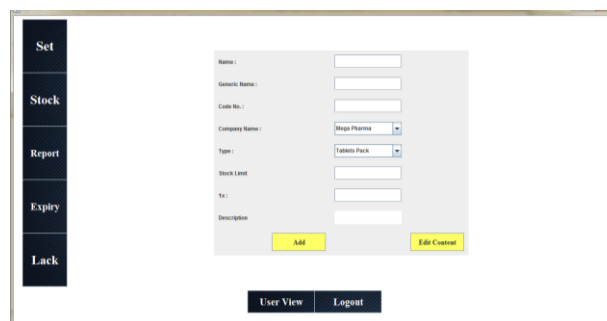


Fig. 15. Admin Dashboard.



Fig. 16. Super User Dashboard.

SMS sending process was implemented using the Ozeki NG - SMS Gateway. Ozeki has released the Java SMS SDK, due to continuous demand from JAVA developers for a tool that is capable of adding SMS functionality to JAVA applications efficiently. This SDK communicates with the Ozeki NG SMS Gateway, through a TCP/IP socket. The socket is always connected, which makes it possible to receive SMS delivery reports and incoming SMS messages instantly. The Ozeki Java SMS SDK implements the TCP/IP communication and provides methods calls and events you can implement to achieve the desired functionality. Using this SDK, fast and efficient SMS solutions can be developed [1].

## V. SYSTEM EVALUATION AND OUTCOMES

All Unit testing were done using JUnit framework. Both functionality and GUIs were tested using JUnit 4.10 libraries.

As deliverables, an improved version of a pharmacy management system, with an embedded database and a SMS communication system, was built.

## VI. CONCLUSION AND FURTHER IMPROVEMENTS

The project is to develop a pharmacy management system for Udupila Pharmacy. Since there are many pharmacy management systems available in the market an attempt was made to add new functionality to the system in addition to general functionalities. Some of the new features included are 3 panels for billing in order to eliminate all the manual calculations, keeping of records of customers, suppliers and salesmen by system itself, to reduce manual record keeping, providing ability for efficient searches, allowing to get the list of items to be purchased on supplier basis, enabling of ordering items, and notifying customers on order arrival via SMS.

At the end of the given time, I was able to implement all the requirements that I specified in the Software Requirements Specification Report. During the implementation certain changes were made to the initial plan, such as addition of a super user view and using Ozeki NG SMS Gateway to send SMSs.

System was designed as six subsystems. They are Stock Management, Billing, Report Generation, Customer Records Keeping, Company Records Keeping and Salesmen Records Keeping subsystems. All the information gathered and manipulated in these six subsystems is provided through three views, according to the permission levels of three different types of end users of the system. They are super user, admin user and normal user.

Throughout the design process I highly valued the security of the system. Thus multiple actions were taken to ensure the security of the system such as using super user view to ensure non-repudiation, using password encryption, using username and password for user authentication. Furthermore, using 3 views for different users according to their level of data accessibility, ensure customer details confidentiality and provide security from possible attacks are some of the measures taken to guarantee the security of the system.

During the development phase I used the camel case standards to maintain the software quality. Some of the conventions I used are using meaningful words for variables, method of variable starting with a lowercase letter, every other word in the variable or method starts with an uppercase letter and constants are declared in uppercase letters. In addition to above, using design patterns like singleton, keeping comments in the code, keeping relevant indentations were followed to improve the quality of the software.

Project was developed according to the object oriented paradigm. Entire project was divided into packages according to its specific functionality. Each class represents an object with unique functionality. Hence the system maintains loose coupling and high cohesion. Object oriented concepts such as inheritance, encapsulation and polymorphism were used, thereby improving code reusability, data protection, maintainability, and understandability of the code.

In certain occasions it was difficult to work according to the planned project schedule, as certain unexpected difficulties were encountered. More time was taken to identify the

requirements for the system, as all the end system requirements should match with the client's problems. And when I was coding I met a bug in Java Date class where it does not give the correct date. List of expired items was totally depended on the current date. And the results given were changed depending on the current date. It took about two weeks for me to identify the problem.

Even though the exact dates did not match with the scheduled dates, all the planned work was carried out within the given time frame. As the initial version of the software I worked out with the priorities of the system and with the added new features. Because of the time and limitations of other resources we had to decide on possible software development plan.

User interfaces can be improved and the alarming mechanism to warn user about the expired items, can be established as further improvements of the pharmacy management system. This can be attributed to a drawback of this developed system; user should manually check for list of expired items, and if the user is forgotten to check the list problems may arise on keeping expired items within the pharmacy premises as the expired items are not automatically disposed.

Finally, it was a great experience to develop an entire software project following all the standards in a software development project. Various areas to be concerned when developing such as how to correctly identify the requirements of the client, how to handle requirement changes during developments, how to tackle with the time while overcoming unexpected situation, coding while keeping the quality of the software, how to generate reports while developing the system, how to learn a new technology or mechanism to get its maximum use for the end system along with other minor details relevant were learnt throughout the project.

## ACKNOWLEDGEMENT

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