Online Medicine Delivery Portal

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A dissertation submitted for the Degree of Master of Information Technology

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Declaration

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge, it does not contain any material published or written by another person, except as acknowledged in the text.

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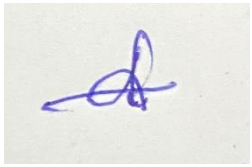

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This is to certify that this thesis is based on the work of

Mr. Dulan Damasean Udugampola

under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

Certified by:

Supervisor Name: Prof. Prasad Wimalarathne

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Abstract

The current retail pharmacy exhibits critical inefficiencies and drawbacks when it comes to selling or delivering medicine items to customers. In a typical scenario of purchasing items over a pharmacy counter, customer has to encounter time wastage, inconvenience due to waiting in queues, health issues due to encountering many contact points and unsecure payment methods posing high risk of getting infected by pandemic diseases such as COVID-19.

Though a handful of E Pharmacy systems exist in the industry, they only offer sell and deliver medicine items their physical pharmacy store. Due to the high cost in affording and implementing an online pharmacy system, small to medium scale pharmacies who are willing to deliver online and continue their business during the pandemic, are unable to do so.

By the time the thesis is composed, the country is in the situation where physically visiting any outside premises causes a potential health threat. Even during such situation, authorities and officials have failed to implement a proper delivery mechanism of medicine to general public due to poor communication mechanism and mismanagements in delivery mechanism.

The project Online Medicine Delivery Portal can be identified as an E Pharmacy solution which is implemented with the intention of addressing inefficiencies in the common retail Pharmacy system in Sri Lanka and problems highlighted above. Unlike a conventional single store E Pharmacy application, the OMDP acts as a complete solution which offers customers with flexibility to compare item prices across multiple Virtual Pharmacies registered in the OMDP and upload prescription to multiple pharmacies and receive the best price offering with advanced order tracking functionality. The project OMDP also enables customers and pharmacy personnel to transact safely with contact less and secure payment methods.

The project OMDP will be initially delivered to “The Nawinna Pharmacy Pvt Ltd Kurunegala” and “The Pharmacy and Grocery Pvt Ltd Kurunegala” who are also the clients of the project. Both the above pharmacies are based in Kurunegala district. Both of the clients currently do not possess any form E Pharmacy application. Both clients are recognized as leading retail pharmacy companies in the market.

Table of Contents

List of Figures

List of Tables

List of Acronyms and Abbreviations

OMDP – Online Medicine Delivery Portal
MVC – Module View Controller
OOP – Object Oriented Programming
WAMP – Windows Apache MYSQL Server.
ER – Entity Relationship
UI – User Interface
DDL – Data Definition Language
PC – Personal Computer
MIS – Management Information System.

1 Introduction to Online Medicine Delivery Portal

E Pharmacy is a system that operates over internet where customers are able to buy medicine items online and receive items. (S.Al-Jaradi, n.d.)

The current era can be identified as the age of internet, where manual, conventional and time-consuming business tasks are performed over internet-based applications. The age of internet caused the paradigm shift of many conventional industries from brick and mortar to click and mortar. Similarly, the concept of E Pharmacy started to emerge the internet-based version of retail pharmacy which was later identified to be a good solution for the inefficiencies of the conventional retail pharmacy.

Most common issues in the retail pharmacy system are the practical inconvenience, time wastage in waiting in queues and the mismanagements involved during the process. The process from preparing the item to handing over the item to the customer, involves human interactions with contact points between customer and pharmacist which cause high risk of spreading of pandemics diseases such as COVID-19.

In the context of practicality, pharmacists are unable to know the availability status of the drugs real time, without having to reach the items physically. Similarly, without having to reach the pharmacy customers are unable to determine whether an item of interest is in stock or whether the item is available for purchase with or without a prescription.

In Sri Lanka, several E Pharmacy applications are implemented by leading pharmacy retail chains. They offer the capability of purchasing items online over the counter or by uploading a prescription via the system. In all of the above-mentioned systems, customers are only allowed to browse or search items from the host pharmacy inventory.

Being an E Pharmacy system, the proposed Online Medicine Delivery Portal (OMDP) carries more advance functionalities such as real time Order Tracking, enhanced authentication and secure payment methods.

When compared with the existing E Pharmacy applications in the island, the OMDP offers the customer with the capability of searching or browsing medicine items of multiple pharmacies registered with the OMDP.

With further developments and integrations, the OMDP will be able integrated with third party Channeling Services, Hospitals and possible IOT devices such as Smart Watches and Sensors.

The clients who are involved in this project are “The Nawinna Pharmacy Pvt Ltd Kurunegala” and “The Pharmacy and Grocery Pvt Limited”. Both the above pharmacy clients are in requirement of an online system which allow them to sell and deliver their medicine items (Over the counter items and prescription items) to the customers while eliminating inefficiencies in their current retail system. According to initial analysis, this requirement was highly experienced by both clients, when continuing their business activities amidst a plague such as Covid-19.

1.1 Motivation

When current pharmacy retail is considered with respect to the clients involved in the project, an efficient and user-friendly method is not available to compare prices of individual drugs or drug types in multiple pharmacies at a glance. Hence customer is unable to receive a good price offering to his or her medication.

A major drawback in the current Pharmacy retail is that, it fails to secure the privacy of customers who are not willing to speak with pharmacists. In terms of making payment, the current Pharmacy System lacks a Safe, convenient and contactless Payment method. This requirement is strongly experienced during a pandemic situation like COVID-19, where the disease can spread even from a contact of money.

For patients who are mandatory to receive their medication on time and their Care Takers who require to be on Schedule when treating their Patients, A proper system cannot be found to manage and notify themselves without skipping doses.

When considering the present situation gathering in numbers is not very safe, government started to impose curfew and lock down in most of the areas in the country. Due to above restrictions, Patients are not able reach pharmacies and purchase any form of medicine. Pharmacist cannot accommodate large queues of patients within their premise, hence patients and pharmacists face inconvenience and wastage of time. Patients who need regular medication are facing life threatening situations due to not receiving medicine on time.

To address the above highlighted issues, authorities provided the below solutions to deliver medicine to patients during the pandemic period.

1. Delivery of Medicine via Post.
2. Purchasing Medicine via hospitals and pharmacies by submitting recent prescriptions via WhatsApp, Viber and Imo.

Both of the above solutions exhibit common issues. Some of them being,

Most of the delivery trucks and vehicles were not appeared to have reached destinations. Delay in processing orders and delivery. The payment method being cash. People, especially in lock down areas have raised complains that they were not in possession of enough cash, due to not being able to reach the local ATM. Physical contact with cash itself poses the risk of spreading the disease. Inefficiencies and Mismanagements are involved in the above-mentioned process. involves high probability of human errors when processing orders.

The project OMDP is implemented with the aim of addressing above highlighted issues prevailing in the client environments, while acting as an E Pharmacy platform which connects multiple pharmacies and customers in Sri Lanka.

1.2 Objectives

This section discusses on how objectives of the OMDP are laid out to achieve the aim(s) defined in previous chapter.

- Providing a universal live search functionality which enables customers to search medicine items of interest across pharmacies registered with OMDP, based on any keyword.
- Providing a single step mechanism to register a pharmacy with a valid pharmacy registration in possession.
- Providing an e-commerce platform for registered pharmacies to sell medicine items to registered customers, (Keralli, 2018) eliminating the requirement of preparing physical stalls.
- Provide an advance order tracking functionality assisted by email updates for customers to manage, submit and view over-the-counter orders and prescription orders.
- Provide an advance order tracking functionality assisted by email updates for pharmacist to manage, process and dispatch orders.
- Providing a universal live search functionality for pharmacists to view availability items of interest when processing orders and prescriptions.
- Develop a shopping cart functionality to assist customers when ordering items over the counter.
- Develop an order tray functionality to assist pharmacists when preparing an order accepted by the pharmacist.
- Building a private prescription repository for OMDP customers, to store frequently used prescription when submitting orders.
- Develop a transparent process for customers to upload a valid prescription to a pharmacy and receive and view an order quotation prior to confirming the order.
- Providing multiple inbuilt, secure and contact-less payment methods for customers to perform safe transaction.
- Construct a dashboard for real time analytical information display and generating management reports for pharmacy managers. Dashboard also includes order tracking and order information display in real time.
- Provide options for managing pharmacy inventory and setting pharmacy availability of the pharmacy for sales, from the same interface mentioned above.
- Construct an interface for system administrators to manage OMDP users and pharmacies registered with the system.
- Collect data regarding product satisfaction via customer feedback and order rating.
- Providing MIS reporting functionality for pharmacy managers.

1.3 Scope of Study

With the intention of achieving the aims and objectives laid out in sections “1.1 Motivation” and “1.2 Objectives” below limitations and de-limitations are defined to set the scope of project OMDP.

Initially, the study is limited only to buying and selling of pharmaceuticals over the internet, in order to maintain the magnitude of the project within manageable limits, due to time and geographical limitations due to the COVID 19 pandemic. The time limitation refers to the time duration allocated for the individual project of the master degree program.

The feasibility study of the OMDP was forced to be limited to Kurunegala district city limits, owing to the current pandemic situation.

The technologies related to development and implementation of OMDP is delimited to web-based technology. The study does not include any mobile development technologies or mobile components. The project OMDP does not investigate separately into validating prescriptions via the application. This can be identified as a major delimitation in the study.

The study has limited access to information regarding universal search functionality offered to customers by the only similar system available based in a foreign market. The similar systems found in local market, does not offer the capability. Owing to the above reasons, an accurate study of a proper item ranking algorithm is limited.

The study of OMDP is limited to retail purchase of items by customers. The study does not cover wholesale marketing, online bulk purchases and corporate customer purchases.

Furthermore, the study does not investigate into delivery personnel value perceptions and application related components.

1.4 Structure of the Dissertation

The project is intending to design, develop and implement a System as per the Objectives and Scope items listed in previous sections. As per the dissertation writing guidelines presented for the Master of Information Technology Degree program, the following list of items/topics are expected to be included in the Dissertation.

The Introduction chapter clearly describes the high-level problem background explaining why the project topic is matter of interest in the specific context. Based on the background and problem formulation, the objective of implementing project OMDP is presented. In addition, the limitations and delimitations are discussed to create an understanding of how the scope of the project is formulated.

The Background chapter describes the understanding of the problem highlighted in "Introduction" with the use of different analysis techniques. Also, the chapter contains a review of similar E Pharmacy solutions that exist in both foreign and local industries. The chapter presents a feasibility study within the pre-determined project scope and presents a thorough analysis of functional and non-functional requirements encapsulated by the OMDP.

The Design chapter explains in detail, the design of the static and dynamic aspects of the OMDP with the use of UML diagrams and other relevant interpretations. The design of the system is segregated into three main aspects and namely the user interface design, database design and component design of the system. The design of each aspect is presented separately so that a clear blue print of the OMDP is created in the reader.

The Implementation chapter discusses the methodology adopted to translate the design blue prints presented in "Design" chapter, to a working system. The section presents a clear explanation on why the current implementation methodology was adopted. This chapter also presents details on the setup and configuration of the system infrastructure and platform. Discusses code snippets of critical components of the system.

This Testing and Evaluation chapter discusses the strategies followed in manual testing and automated testing of the implemented system in previous chapter. The chapter clearly emphasizes the approach to identify test cases of interest and describes the test plans and test procedures implemented. The evaluation refers to the usability evaluation of the system after the system is deployed in the production environment.

The Conclusion chapter presents the final outcome of the system as a summary. Discusses drawbacks and areas of improvement of the proposed system. This chapter discusses in detail, how the system will evolve and improve with future developments

2 Background

The Online Medicine Delivery Portal can be introduced, as a solution to the inefficiencies in current Pharmacy Retail System. The proposed system can be identified as an Online Platform where Patients (Users) can upload a valid prescription from their Physician or Consultant and get their dose of medicine delivered to their doorstep, while making payments safely.

Once an order is placed, the Patient and Pharmacists will able to track their order up to the point of delivery. In addition to the above services, the Users will be able to manage their prescriptions and doses of medication.

E-Pharmacies are online platforms where consumers can purchase medicines without having to visit brick-and-mortar pharmacies. (S.V. Chordiya1, 2019)

the proposed system can be identified as a web-based E Pharmacy application, as it allows the user to purchase medicine online and get them delivered to the door step, without having to reach a Pharmacy physically. With the implementation of the proposed system the patients will be able request medicine and receive medicine securely and fast, which would result in saving time, money and effort. The patients and their care-takers would also receive the benefit and convenience of not having to waste time over large queues.

Using the system customers are provided with two means two purchase medicine or Pharmacy items. Purchase of items by submitting a valid prescription and Purchase of items by using main search functionality to place orders. To guarantee the safety and regulation, medicine items could also be categorized as Medicine and items prescribed by Authorities and Over the Counter (OTC); medicine which could be bought without any prescription. (Keralli, 2018)

2.1 Review of Similar Systems

The implementation of an online can be identified as a solution for the inconveniences, mismanagements and flaws involved in the 'brick and mortar' retail pharmacy process. (Keralli, 2018). A study identifies that a transparent E Pharmacy process model allows both customers and pharmacist to perform operation in an effective and uninterrupted manner. (Ashita S. Patil, 2019)

According to the study by Abhishek S Keralli, three major components are found to be in a E Pharmacy application. A web based or mobile based application which submits orders and prescriptions, a process which involves a registered pharmacist to verify the prescription and a mechanism to forward prescription to pharmacy store from where the items will be dispensed (Keralli, 2018).

According to the model presented in the previous section, a qualified pharmacist validates the prescription as an intermediate step. The OMDP directly forwards the prescription to a an inhouse pharmacist of the relevant pharmacy store, instead of an intermediate party. This step ensures the fact that pharmacy and customer are in direct interaction.

Apart from the above deviation, OMDP includes all the components specified in the study.

This study evaluates the overall quality of the OMDP as a review of similar systems in both local and Foreign E Pharmacy Domain. In the review of foreign systems sources such as Journals, articles, user review websites were used. For local systems, information could be gathered from User reviews and User Experience. After analyzing projects which are similar to the proposed system, following business models could be identified.

1. The market place mode – System connects Pharmacies with the end user.
2. Inventory Based Model – System which provides E- Pharmacy services from a Single Physical Pharmacy Store. (Keralli, 2018)

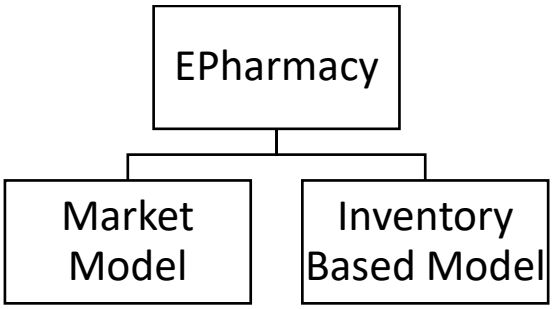


Figure 2.1-1 Business Models of E Pharmacy Applications (Keralli, 2018)

The OMDP follows the "Market" business model, allowing the users to select and compare prices from multiple Pharmacies partnered with the system. Though the concept of E Pharmacy was novel about 5 years ago, owing to the benefits of convenience and safety received when ordering medicine online, the market has grown up to $0.5 billion in the Indian market. (Approximately 2 to 3% of the Indian Pharmaceutical industry). This market is expected to grow up to $ 4.5 Billion by 2025. (India, 2021).

For the study of similar system, the author has identified "The Net Meds Pharmacy India" (Pharmacy, 2020), "The Adhama pharmacy website" (Website, 2020), "The Health Guard Pharmacy website" (Pharmacy, 2019), "The Health Net Online Pharmacy" (net, 2020).

All of the E-Pharmacies belonging all of to the above categories exhibit two methods of Operation. A Customer should be able to select and view item(s), Add the desired item(s) to the cart, Check Out and proceed with completing the order after paying online. The diagram below, shows the process flow of the operation for this scenario.

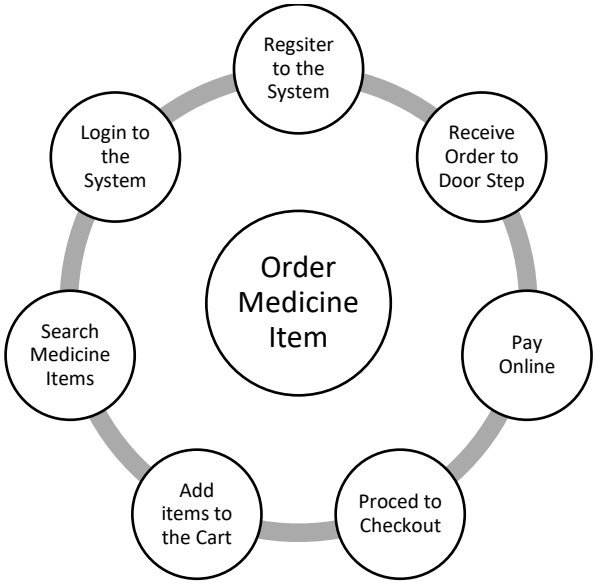


Figure 2.1-2 Process of Ordering Medicine Items (S.Al-Jaradi, n.d.)

A Customer can also Upload their prescription to the System, check the availability of the Medicine Items, Place the order and receive the items. The diagram below shows the workflow for the operation.

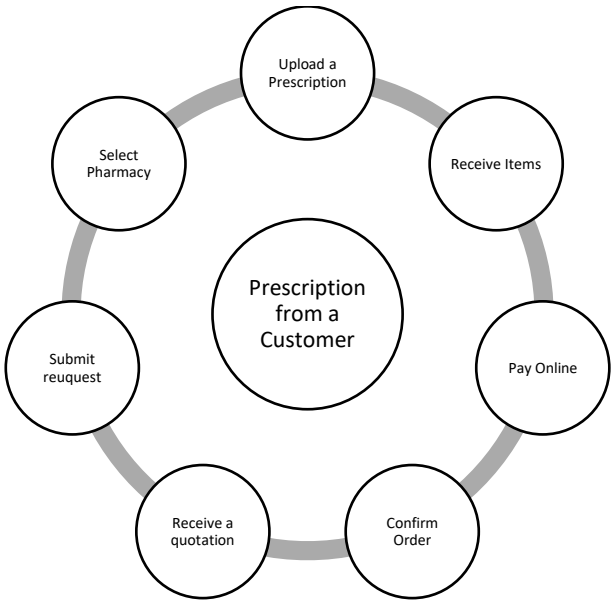


Figure 2.1-3 Ordering Using a Prescription (Keralli, 2018)

The section below reviews each Similar System Individually.

2.1.1 Netmeds Online Pharmacy India (Pharmacy, 2020)

Netmeds.com could be identified as one of the leading online pharmacies in India. During the pandemic period, where the whole country was under lockdown, Netmeds has assisted people in India get their medicine and medication delivered within the 2 to 3 days. Similar to the OMDP, the Netmeds online pharmacy delivers medicine for via prescription and over the counter medicine items and medical devices. (Singh, 2021).. When discussing about the nature of products, Netmeds pharmacy offers a wide range of products spanning from prescription items for minor illnesses to ayurvedic, homeopathic medicines, health foods, drinks, supplements to personal care products.

Similar to the OMDP, the Netmeds allows user to search an item based on any keyword, or browse items through the wide range of item categories provided within. Netmeds also allows customers to purchase medical and surgical devices, which are not offered in the OMDP.

Netmeds sells items from multiple manufactures and pharmacies deliver them to the customer. The OMDP customers are also able to view and compare items from multiple pharmacies. But due to issues in delivery and other practical issues, the customer is only allowed order items from one pharmacy. Both Netmeds and OMDP offer order delivery with secure payment methods and order tracking functionality to customers. Unlike the OMDP, Netmeds offer prioritized delivery of items for customers who seek urgent medication.

Both OMDP and Netmeds offer purchasing of items over prescriptions, the OMDP enables users to save and manage their frequently used prescriptions subjected to a pre-defined validity period. The above feature is not available in Netmeds.

Apart from online delivery of medicine items and devices, Netmeds offers diagnostic service that provides expert advice from medical professionals. (Singh, 2021). The Netmeds offer more advance features such as refill reminders, expense analytics and loyalty programs. Hence it can be mentioned that the Netmeds is a large-scale online pharmacy platform which connects multiple pharmacies, manufacturers and customers together. Hence both Netmeds and OMDP can be categorized into the “market-based model” of E Pharmacies.

Netmeds are also possess a mobile application which offers the same functionalities and capabilities as the core web application. In the case of OMDP system, since the project scope is restricted to a web application, any mobile components are not included.

Based on the above review, the Netmeds can be identified as a complete stack solution for an online pharmacy which connects multiple producers with users.

2.1.2 Healthnet Sri Lanka (net, 2020)

Healthnet.lk can be identified as a reliable (net, 2020) online Pharmacy application in Sri Lanka. The pharmacy has a web-based application as well as a mobile application which supports all the mobile platforms. But by the time the thesis being composed, Healthnet has discontinued their web-based application and continued operation over the mobile application. When compared with the OMDP, the Healthnet online pharmacy can be categorized into the "inventory-based" model. The main reason for the above categorization is that, Healthnet only performs sale of items from their inventory, unlike the OMDP. The system also provides a range of medicine item categories as provided in the OMDP and Netmeds online pharmacies. The study revealed that, the web-based application only provided the online sale of over-the counter items while the mobile application only provided the upload of prescription and delivery. Healthnet used the two distinct platforms to provide the functionalities separately. The study is not able clearly identify a specific reason for separating functionalities as above.

When ordering items over prescription, Healthnet has integrated a robotic assistant to guide customers in achieving their tasks successfully. This chat assistant will guide the user in through initial stages of placing the order. This novel feature can be identified as a completely novel feature which does is not available in any of the systems of interest. The user interacts with the pharmacists via a chat interface. (net, 2020)

Similar to the OMDP, the Healthnet web application provides the functionality of saving prescriptions for frequent ordering and future use. This feature is further extended in the Healthnet system so that, a single user is able save medication of their family members or relations and receive refill alerts, when the medication is being completed.

The study reveals that Healthnet online pharmacy system also provides users with a transparent order tracking functionality similar to the OMDP system. (reviews, 2020)

When compared with the OMDP, Healthnet offer users with the limited option of searching or browsing of items only in their inventory. The Healthnet system does not exhibit any functionality or feature to connect multiple pharmacies with customers.

2.1.3 Health Guard Pharmacy Sri Lanka (Pharmacy, 2019)

Healthguard pharmacy is recognized as a leading pharmacy retail chain in the local market. The system of interest is the online web-site of Healthguard pharmacy which performs sale online sale and delivery of medicine items only from Healthguard pharmacy inventory.

System also offers purchase of items via prescription. But the system does not offer any form of transparency in prescription process, unlike the OMDP system. The user (customer) who submits has to accept whatever the items delivered by the pharmacy and accept the price offered (Pharmacy, 2019). This can be identified as a major drawback in the process, which discourages users from ordering prescriptions over online systems. Healthguard pharmacy offers search functionality. But the search is not as responsive when compared to OMDP and above quoted systems. Also, when compared to OMDP the Healthguard offers a limited range

of item categories for customers to browse and purchase (Pharmacy, 2019). The system similar to typical online ordering systems, Healthguard web-site offers shopping cart, order checkout and payment method selection features. The overall system can be identified as a typical online ordering system which does not exhibit novel features or functionality when compared to OMDP and above quoted online pharmacy systems.

2.1.4 Pharm Easy Online Pharmacy India (PharamEasy, 2010)

The Pharm Easy online pharmacy is recognized as a leading online pharmacy in India. (PharmEasy, 2018). Similar to the Netmeds online pharmacy, the PharmEasy has performed a major role in online purchasing and delivering medicine items and devices during the pandemic period. PharmEasy follows a similar business model as OMDP and Netmeds online pharmacies, which connects multiple pharmacies and manufactures with customers (Anusha, 2021). PharmEasy can be identified as an identical system to Netmeds in scale, internet technology and market share. But the "aubank.in" ranks Netmeds above PharmEasy in online pharmacy rankings in India (aubank, 2021), in terms of convenience of item delivery. PharmEasy offers user with a wide range of item categories for customers, spanning from prescription items to ayurvedic medicine, Supplement/Nutrition drinks and surgical devices. Similar to OMDP and Netmeds, PharmEasy provides customers with a responsive and accurate search utility when purchasing items. Similar to other systems of interest referred in this chapter, PharmEasy also provides core online delivery features such as shopping cart, checkout and payment method selection. The customers are provided with secure payments for Netmeds users (Anusha, 2021).

The OMDP, Netmeds and PharmEasy enables users to view real time inventory status of any item partnered with their system. (PharamEasy, 2010). When compared to Netmeds and OMDP, the PharmEasy does not offer uses to save and re-order prescriptions which are not within the predefined validity period. (Keralli, 2018). Both Netmeds and Pharma Easy validate an uploaded prescription via a qualified pharmacist. If the prescription is valid, the it will be forwarded to the relevant pharmacy where the order will be prepared and dispatched. (Keralli, 2018).

The PharmEasy also connect the users with their local pharmacies, laboratories and diagnostic centers. (Anusha, 2021). System the feature of booking diagnostic tests and laboratory systems for registered users. (Anusha, 2021). The system also supports scheduling of regular orders and prescriptions for customers who seek regular and long-term medication for diseases.

From the literature review conducted on similar systems which are considered to be identical to OMDP, it is evident that the local pharmaceutical market does not possess an online pharmacy platform to connect users with local pharmacies. The novelty of the concept in the local market will create a new revenue model in the local online pharmacy industry. The study of similar systems, will also provide an insight on how the concept of OMDP system intends to address problem domain described in "1.Introduction" chapter.

The below table provides a concise comparison of the detailed systematic review of the systems of interest.

System Name	Business Model	Search and Order Items	Upload Prescription and Order	Order Scheduling	Order tracking	Transparent review prescription	Additional Functionality and Comments
Netmeds India (Pharmacy, 2020)	Market Based Model	Available	Available	Available	Available	Available	System is identical to the OMDP in business model. The system offers more advance features such as teleconsultation services, online diagnostic services and booking of laboratory and diagnostic services. (Singh, 2021).
PharmEasy India (PharamEasy, 2010)	Market Based Model	Available	Available	Available	Available	Available	Identical in business model to the OMDP. Similar to Netmeds, PharmEasy provides features such as teleconsultation services, online diagnostic services and booking of laboratory and diagnostic services. (Anusha, 2021)
Healthnet Sri Lanka (net, 2020)	Inventory Model	Available only in web-based applications	Available only in mobile application	Not Available	Available	Available	In addition to the web bases system, a mobile app is also available. Included technologically advanced features such as online chat functionality for the interaction between customer and pharmacist when processing prescriptions. The Healthnet is identified as a reliable system in terms of item delivery. (reviews, 2020)
Health Guard Pharmacy Sri Lanka (Pharmacy, 2019)	Inventory Model	Available	Available	Not Available	Available	Not Available. User accepts items send by pharmacy	Simple online E Pharmacy Application, only sells medicine item in Health Guard Pharmacy Chain.

Table 2.1.4-1 Comparison between similar systems

The study of upcoming chapters explains in outline, the potential technologies and architectural strategies.

2.1.5 Related Technologies

This proposed system is a web-based application. Key technologies to be associated with this project are

- HTML.
- CSS.
- Bootstrap for web interface design.
- JavaScript.
- PHP.
- MYSQL/Firebase
- Code igniter development framework.
- Design diagram drawing tools. – Star UML (S.Al-Jaradi, n.d.)

All of the above technologies are open source and technical skill and learning curve can be manageable. Initially the system will be hosted in XAMP server in local development laptop.

Bootstrap with Code Igniter framework was found to be most suitable in interface designing. PHP could be identified as an ideal language to code the business logical components.

As database Management system, MYSQL was identified to be used in similar scale of projects. When upgrading to Enterprise scale, Database could be migrated to high performance RDBMS such as MSSQL or Oracle.

The System will follow Model View Controller Architecture to separate business logic from User Interface and other aspects of the System.

Security aspects such as sensitive Data masking, transaction logging an auditing is feasible from application level or Database Level. (Inc, n.d.)

2.1.6 Related Design Strategies

Most of E Pharmacy Systems can be found as Client-Server Applications and Mobile Applications (Android or iOS). Considering the resource availability, feasibility, learning curve of the technologies and time restrictions, development of a web-based design could be an ideal design for a System.

The ideal infrastructure for development could be chosen as Apache Server on Windows Environment. The motivation is that Apache is open source and Windows Platform is easily available on any Personal Hardware device. WAMP (Windows Apache MySQL Server) is easily installable and Configurable.

Services could be easily Managed from single console in WAMP server, rather than installation standalone instances of Apache Server and MYSQL instances.

Choosing a Windows based Development platform over Linux is due to the lack of Development or Project experience in Linux Environment. Shifting to Linux may also cost additional Effort and time installing Virtual Machines and Virtual Environment.

Moving for a Cloud based platform for development stage may incur additional costs for resources. A stable internet connection is mandatory when working in such Environments, making it impossible to develop systems Offline.

2.2 Feasibility Study

2.2.1 Project Overview

The study covers development of the OMDP as an E Pharmacy solution which connects customers with pharmacies. The system offers buying and selling of items over the counter, or via valid prescription for customers and pharmacies. The study also intends to offer a solution for inefficiencies, time wastage and mismanagement in conventional brick and mortar retail pharmacy in Sri Lanka.

To verify the above-mentioned facts and figures, a feasibility study is carried out based on the key clients involved in the project.

To gain an initial insight into the problem, a background study of both the clients is carried out. Based on the results of the study, the business profiles of each client can be summarized and interpreted as shown in the table below.

Client Reference	Client Name	Number of employees	Number of branches	Possess Online system/website	Monthly business turnover	POS system type
Client 1	The Pharmacy and Grocery	20	N/A	N/A	Customer refused to reveal	Manual cash register system
Client 2	The Nawinna Pharmacy	More than 100	6 branches in Kurunegala	N/A	Customer refused to reveal	On premise system exists.

Table 2.2.1-1 Client business profile

As mentioned in the above table, the clients are assigned a reference number for the author's convenience. The above references will be used throughout the thesis in future.

2.2.2 Market Analysis

The study covers key clients of the project as mentioned in the "1 Introduction Chapter" and E Pharmacy systems hosted by renowned pharmacy chains in Sri Lanka. The study is geographically bound to urban areas in Kurunegala district.

From the above statistics in "Table 2.2 1 Client business profile", it can be observed that Client 2 is a large-scale company in terms of employees and branches. Based on observation and external references, it was identified that the Client 2 possesses more than 50 % of the total market share in the district. Hence it can be inferred that Client 2 has a wider customer base when compared to Client 1.

The study was able to identify the requirement of an ePharmacy system. Both clients were presented with two solutions; Implementation of dedicated online systems for each pharmacy and registration of each pharmacy with OMDP solution which acts as a platform to sell medicine items over the internet.

Initially Client 2 elaborated more on a dedicated online system for their inventory while Client 1 was interested upon a cost-effective, online solution which is capable of producing the deliverables.

After recognizing the capacities and capabilities of the both the client businesses, it was established that the provision of the OMDP E Pharmacy platform is the most optimum solution in addressing the problem domains of both the clients.

The feasibility study of the OMDP solution is further broken down into below sub sections, in order to explain both internal and external facts governing the implementation of the solution.

2.2.3 Technical Feasibility

This proposed system is a web-based application. Key technologies to be associated with this project are HTML, CSS, JavaScript, PHP, MYSQL/Firebase, CodeIgniter development framework and Design diagram drawing tools. – Star UML (S.Al-Jaradi, n.d.).

All of the above technologies are open source and technical skill and learning curve can be manageable. Initially the system will be hosted in WAMP server in local development laptop.

The system is expected to be hosted in the ".lk" domain of Sri Lanka. A service provider for internet and other connectivity purposes is chosen on a subscription basis and will be added to infrastructure cost.

All the internal and external endpoints and service URLs will TLS 1.2 encrypted. The renewable SSL certificate will be purchased based on annual subscription. Since the app does not involve any multimedia streaming, expected to have to have a low network bandwidth consumption. Later based on the increasing resource capacity requirements, the system will be hosted in a cloud-based service.

Since the study deals with providing E Pharmacy platform to pharmacies to sell items over the system, additional infrastructural implementation is not required in any of the client (customer or pharmacy) ends. Only a device with a working internet connection and a web browser is sufficient. Hence the OMDP can be identified as a feasible project in terms of technology and implementation.

2.2.4 Design Feasibility

Four main stakeholders could be identified in this project. They are namely, Customer, Pharmacy manager, Pharmacist, System Administrator.

Theis sections explains in details the study of user interface feasibility for each individual user category. When the scenario of customer and pharmacist is studied in the context of the application, it was identified that customer expects a mechanism to track any kind of order placed via the system. Providing a shopping cart for customers to temporarily to manager order items. Providing a portal to upload and submit prescription to the pharmacy. A separate functionality for upload, saving and managing prescriptions. Providing of a universal item search utility is highly feasible for both customers and pharmacists.

A typical pharmacist is provided with an order tray to assist preparing order items. A utility to accept and view incoming orders and prescriptions to pharmacy is preferred. Providing a search utility to search items in the inventory is shown to be feasible option for pharmacists.

Feasibility of a managers user interface depends on the amount of summarized information a manager can obtain in a given time for management decision making purpose. Generating static reports should also be included. Inventory management can be identified as a mandatory function in the manager interface in the context of the application.

A monitoring dashboard which includes user management and pharmacy management were identified as feasible functionalities for high privileged user such as administrator.

It could be observed that the project boundaries could be clearly established for this individual project spanning a limited number of months, the Waterfall Software Development model is a feasible option to proceed with the Software development process.

2.2.5 Operational Feasibility

The Online Medicine Delivery Portal is highly feasible in most of the Urban areas in Colombo and Nearby areas, since those areas have high population of users with computer literacy and internet connectivity at the same time. Even under COVID 19 pandemic situation, the OMDP could be operational without any interruption or limitation, since medicine is an essential service.

2.2.6 Economic Feasibilitys

Most of the tools and software and development environments are open source and freeware. Hence system does not incur additional software license costs. Since the OMDP is launched as a web-based application, a fixed costs for hosting will be incurred. For bug fixes and release updates conditional costs will be incurred. The cost of delivery of medicine items will also be incurred based on regular delivery cost calculations.

The system does not incur any hardware or software (infrastructure) implementation costs on pharmacy or customer client ends. A PC(s) with enough resources specifications to run an internet browser is sufficient for users to use the OMDP system.

From the study of the client profiles, it is identified that Client 1 does not possess financial capacity to implement or purchase a dedicated E Pharmacy system when compared to Client 2. Hence it is verified that the project OMDP is economically feasible.

2.2.7 Legal Feasibility

The medicine dispersion and delivery could be performed according to the guidelines issued by National Medicine Regulatory Authority. ((NMRA), 2019)

2.3 Requirement Analysis

2.3.1 Product Perspective

The OMDP is expected to be a Web based E Pharmacy solution, which enables Customer to order their medicine online and receive them to the door step. The proposed system follows a client server architecture with MVC pattern. The system is included with all the subsystems and components required to achieve the desired functionalities.

The components, subsystems and interfaces which are involved will be discussed in the "3. Design" section of this Document.

The system shall have access to third Party Payment gateway systems such as VISA, MasterCard and Google Location APIs. The functionality of above interfaces and systems will be out of the scope.

2.3.2 Product Functions

In a nutshell, the OMDP can be identified as an E - Pharmacy Platform which enables Customers to

- Search and View Item Details and Availability
- Order and Purchase Item Online.
- Make Payments Online.
- Track Order Status.
- Upload prescriptions and receive Orders Online.

Pharmacy Staff can accept orders, check real time medicine inventory and Pharmacy managers are able keep track of incoming, pending and completed order list.

The following Functional and Non-Functional requirements are identified during requirement analysis. Since the project's initial scope is based on Urban city limit area, the focus group to conduct initial feasibility and requirement analysis are identified as. Large to Medium scale Pharmacies within city limits. and Customers of age group 18 to 60.

A simple survey was conducted by producing a questionnaire to Customers who buy medicine from above group of selected pharmacies. Some randomly selected senior citizens were personally interviewed via online methods such as Zoom, Skype or Microsoft Teams. Occasionally, a random visit was made to Pharmacies to observe the operations.

The f main stakeholders were involved in the Requirement Analysis Process are namely the Customer, the Pharmacist, Pharmacy Manager and System Administrators.

After the requirement analysis, the main System Users, System Constraints and System requirements (both functional and non-functional requirements) are identified. The above identified specification are listed in below sections.

2.3.3 User Characteristics

Four types of users namely, the Customer, Pharmacist, Pharmacy Owner and the System Administrator interact with the system.

In a nutshell, the Customers will use the system to search Medicine Item or Pharmacies, Purchase Items and Make Payments Online.

The Pharmacist (Pharmacist) will use the system to accept incoming orders placed by customers, prepare the order and dispatch the orders for Delivery.

The Pharmacy Managers use the System to Manage their Pharmacy Inventory, View Inventory and Sales details real time. The Dashboard view may display the Incoming, Pending and Completed Orders.

The System Administrator will also use a Dashboard view to Monitor and Manage system Users and Modules.

2.3.4 Constraints

Since the system is completely Web based, the Internet connection may be a Constraint for the operation of the system. Hence working Internet Connection and a Web Browser is mandatory for the operation of the system for both Customers and Pharmacists.

The System may occasionally request access to Current user location. To access precise location, Geolocation modules should be supported in the working Browser. Java script and Flash should also be enabled in the Browser.

Limitations in Concurrent User request processing. Some User requests may be queued, reducing the performance of the System.

2.3.5 User Interface Requirements

Customers and Pharmacy Staff Users may require a simple Web Interface of a typical Web Application. Pharmacy Managers and System Administrators may be provided a Web based plus a Dashboard to View Interactive Summarized Information.

2.3.6 Operating Environment

The system is expected to operate in a PC with specification capable of running Web browsers. A working internet connection is mandatory. Using via mobile phone browsers is not recommended at the moment.

2.3.7 Software Interfaces

This section specifies both internal, external software and API's expected to be used in building the OMDP. As observed in a typical client server application.

The most critical software interface is the Code Igniter Software Binary. Code Igniter is identified as the main framework which is used achieve the MVC architecture for OMDP. From Database Connections, form validation to routing requests between models and views; Code Igniter acts as main frame of the OMDP software. For compatibility of lower database and Middleware versions, Code Ignited Version 3.13 will be used to build the proposed system.

As middleware infrastructure, Apache application server will be used. The Code Igniter Framework will be deployed in the Apache Server Environment.

For persistence, MYSQL version 5.6 would be used. The Application communicated with the database via the Code Igniter Framework deployed in the Apache Servers. If client requests Database migration could be done from MYSQL to any required platform.

The system will have access to third party payment gateways. This due to the inbuilt Payment facilities that will provided in the OMDP.

2.3.8 Hardware Interfaces

Web based application runs on Web browser except Internet Explorer installed on a Windows, Linux or MAC based PC. No external devices required

2.3.9 System features and functional requirements

Functional Requirements - Customer

The below functional requirements are refined for the proposed system.

1. *User Registration in the System*

1.1 The system shall allow to visit the user registration Page of OMDP.
1.2 The system shall allow the user to fill in all the mandatory field in the Registration Form in the Page above.
1.3 The system shall allow to clear all the fields of the Form in the Page in 1.2
1.4 The system shall allow to declare consent the information to be correct.
1.5 The system shall allow the user to register in the system.

2. *Login to the System*

2.1 The system shall allow user to enter valid email and password to login.
2.2 The system shall allow user with valid credentials to login.
2.3 The system shall not allow a user with invalid credentials to login.
2.4 The system shall allow the valid user to reset the password if forgotten or misplaced

3. *Logout of the System*

3.1 The system shall allow user to logout of the existing login session.

4. *Search and View Medicine Item Details*

4.1 The system shall allow user to enter a keyword in the search bar.

4.2 The system shall allow user to search by using medicine name, medicine type and Pharmacy Name

4.3 The system shall display the search results that matches any keyword or part of the keyword.

4.4 The system shall return “no result found” if keyword or part of keyword does not match.

4.5 The system shall allow users to view the item details.

5. *Add Items to Cart*

5.1 The system shall allow users to add items by searching or browsing to the cart.
5.2 The system shall not allow users to add more than 5 items to cart.
5.3 The system shall allow users to leave the cart.
5.4 The system shall allow users to access the cart.

6. *View Items in the Cart*

6.1 The system shall allow the user to access the cart
6.2 The system shall allow user to view the shopping cart details.

7. *Remove Items in the Cart*

7.1 The system shall allow users to remove items in the cart given that the cart is not empty.

8. *Select payment method from System in built Payment Methods.*

8.1 The system shall allow user to add valid Payment methods.
8.2 The system shall not allow user to process without payment method.

8.3 The system shall verify the payment method.
8.4 The system shall allow user to remove payment method.
8.5 The system shall allow user to only add up to 3 payment methods excluding cash.

9. Place an Order

9.1 The system shall allow user to checkout of the cart after performing above all.
9.2 The system shall validate the added payment method
9.3 The system shall allow user to place an order.
9.4 The system shall allow user to cancel the order with the given time interval.
9.5 The system shall allow user to track the current status of the order.

10. View Status of an Ongoing Order

10.1 The system shall allow user to view and track the current status of the order until order is complete.
10.2 The system shall not allow the user to cancel or alter the order details.

11. View history of previous orders

11.1 The system shall allow user to view past completed orders.

12. Upload Prescription to system

12.1 The system shall allow users to add prescriptions to the profile.
12.2 The system shall allow users to upload prescriptions to the profile.
12.3 The system shall allow users to save prescriptions to the profile.
12.4 The system shall allow users to delete prescriptions to the profile.
12.5 The system shall allow users to submit the prescriptions to the pharmacy.

Below system features are refined for development and functional requirements associated with each feature are listed below.

13. User Registration in the System

13.1 The system shall allow to visit the user registration Page of OMDP.
13.2 The system shall allow the user to fill in all the mandatory field in the Registration Form in the Page above.
13.3 The system shall allow to clear all the fields of the Form in the Page in 2.1.9.1.1.2
13.4 The system shall allow to declare consent the information to be correct.
13.5 The system shall allow the user to register in the system.

14. Login to the System

14.1 The system shall allow user to enter valid email and password to login.
14.2 The system shall allow user with valid credentials to login.
14.3 The system shall not allow a user with invalid credentials to login.
14.4 The system shall allow the valid user to reset the password if forgotten or misplaced

15. Logout of the System

15.1 The system shall allow user to logout of the existing login session.

16. Accept or Reject Incoming Orders from Customers

16.1 The system shall allow user to view incoming orders in the homepage.
16.2 The system shall allow user to accept incoming orders in the homepage.

17. Adding Items to Customer Order

17.1 The system shall allow user to open accepted order in previous section
17.2 The system shall allow user to search items in the pharmacy inventory.
17.3 The system shall show resulting items from the search to the user.
17.4 The system shall allow user to add items from the search result in 17.3 to the accepted order in previous section.
17.5 The system shall allow user to add items from the inventory to the accepted order in previous section.
17.6 The system shall show the total value of the current items in the accepted order.

18. Removing Items from Customer Order

18.1 The system shall allow user to remove items from the items added as per 2.1.9.5.4 from the accepted order in 2.1.9.4.
18.2 The system shall remove the item from the current order of the user.
18.3 The system shall show the total value of the current items in the accepted order after removing the item.

19. Viewing Similar Items

19.1 The system shall suggest similar items when search items are not in the inventory.
19.2 The system shall allow users to view items resulted in the above section 19.1.
19.3 The system shall allow user to add items from the search result in 19.1 to the accepted order in 16 section.

20. Updating Order Status after order is processed

20.1 The system shall allow user to review items in the current order.

20.2 The system shall allow user to update status of the order to "Dispatched"

20.3 The system shall assign the completed order in 2.1.9.8.2 to delivery.

20.4 The system shall update status of the order to "Dispatched".

21. View order status until the order is delivered to the customer.

21.1 The system shall allow user to view and track the current status of the order until order is delivered.
21.2 The system shall not allow the user to cancel or alter the order details.

22. View Prescriptions uploaded by the Customer.

22.1 The system shall allow user to view prescription submitted by Customers as in section. 2.1.9.1.14.5
22.2 The system shall allow user to review prescription submitted by Customers as in section. 2.1.9.1.14.5

Below listed are the system features refined for Manager users and functional requirements associated with each of the features.

23. User Registration in the System

23.1 The system shall allow to visit the user registration Page of OMDP.
23.2 The system shall allow the user to fill in all the mandatory field in the Registration Form in the Page above.
23.3 The system shall allow to clear all the fields of the Form in the Page in 2.1.9.1.1.2
23.4 The system shall allow to declare consent the information to be correct.
23.5 The system shall allow the user to register in the system.

24. Login to the System

24.1 The system shall allow user to enter valid email and password to login.
24.2 The system shall allow user with valid credentials to login.
24.3 The system shall not allow a user with invalid credentials to login.
24.4 The system shall allow the valid user to reset the password if forgotten or misplaced

25. Logout of the System

25.1 The system shall allow user to logout of the existing login session

26. Management Dashboard for Pharmacy Manager or Owner

26.1 The system shall display pending, accepted and completed orders in tabular form.
26.2 The system shall display sales with respect to item category, item and brand.
26.3 The system shall display real time stock inventory details to the user.
26.4 The system shall allow user to generate analytical sales reports custom made.
26.5 The system shall allow user to generate analytical sales reports with in build template.
26.6 The system shall allow user to view inventory item details.
26.7 The system shall allow user to add inventory item to the stock.
26.8 The system shall allow user to remove inventory item to the stock
26.9 The system shall display information in 2.1.9.3.4.1 with respect to each user in section 2.1.9.2

Below listed are the system features refined for Admin users and functional requirements associated with each of the features.

27. User Registration in the System

27.1 The system shall allow to visit the user registration Page of OMDP.
27.2 The system shall allow the user to fill in all the mandatory field in the Registration Form in the Page above.
27.3 The system shall allow to clear all the fields of the Form in the Page in 2.1.9.1.1.2
27.4 The system shall allow to declare consent the information to be correct.
27.5 The system shall allow the user to register in the system.

28. Login to the System

28.1 The system shall allow user to enter valid email and password to login.
28.2 The system shall allow user with valid credentials to login.
28.3 The system shall not allow a user with invalid credentials to login.
28.4 The system shall allow the valid user to reset the password if forgotten or misplaced.

29. Logout of the System

29.1 The system shall allow user to logout of the existing login session.

30. Admin Dashboard for System Administrators

30.1 The system shall allow user to add all user categories to the system.
30.2 The system shall allow user to remove all user categories from the system
30.3 The system shall allow user to add pharmacies to the system.
30.4 The system shall allow user to remove pharmacies from the system
30.5 The system shall allow user to monitor overall functionalities of the system.
30.6 The system shall allow user to generate custom sales reports.

2.3.10 Non-Functional Requirements

The following sections describes the system requirements which are attributes expected out of the final system.

Performance Requirements

The proposed system contains a search functionality for customers to search Medicine Items and Pharmacies. This search query should result the output within maximum of 30 milliseconds. The performance of the search functionality would affect the complete user experience of the system.

Concurrency and queuing of order requests made by customers should be taken into consideration. The System should be able forward customer orders to the relevant in a minimum period of time.

Default Response times specified by the Payment Gateway Providers will be applied to the proposed systems. Overall System response time should be below 40 milliseconds in Order to provide the optimum user experience and efficiency.

Security Requirements

In this section, the security of User accounts, User sessions and Payments should be considered. In order to verify secure login, two-factor authentication could be implemented. Forcing system users to user passwords with high complexity and Use of Password expiry and Password Lock Policies for Users.

Secure communication between client browser and Application Servers and Web Servers.

Availability

Expecting 100% availability of the system. All Database, application and Networking Infrastructure components should be implemented with Clustering and High Availability. When implementing in cloud environment server instances to implemented multiple data centers.

3 Design

The Online Medicine Delivery Portal is a web-based E Pharmacy App which provides Online Sale and Delivery of Medicine Items. Furthermore, it provides functionality to upload a prescription to the System and get the medicine item delivered online. The system also provides the functionality to keep track of your medicine doses and receive refill alerts.

3.1 Overview

Each category of stakeholder would receive a Web Interface with functionalities privileged to the relevant User category.

The proposed system would be able to provide the customer to choose and purchase the medicine items from the Pharmacy Store which provides them the best price offering. The proposed system is able to

provide the customer with up-to-date information regarding the status of the order. Each step of the order is made visible to the Customer via the shopping cart.

The proposed system would provide a separate web views for the roles of pharmacy staff and pharmacy Manager. The Manager view will be provided a dashboard for real time sales information and inventory information.

A separate view will be provided for Administrators tasks such as user management, Pharmacy Management and Inventory management tasks which typical pharmacy staff and customers are unable to perform. This view shall also contain a dashboard for Monitoring purposes.

This section provides architectural overview of the proposed system, covering all the static and dynamic aspects of the proposed system. Static aspects of the system are elaborated using Class Diagrams, Package Diagrams and other static architecture designs. Use Case diagrams and Use case realizations and Sequence diagrams are used to elaborate Dynamic aspects of the proposed system. This section is divided into three main components, namely the Database Design, Architectural Components and UI design.

3.2 Scenarios (Use Case) View

Audience

This view could be referred by all the stakeholders,

- Customer.
- Pharmacy Staff.
- Pharmacy Manager
- System Administrators.

Describes all the possible scenarios, use cases which define or describe functionalities of the system. The section also defines the system actors and use cases, with the help of Use case diagrams and Use case realization.

Related Artifacts

Use Case Diagram, Use case realization

The following system actors could be identified in the proposed OMDP.

- ✔ Customer
- ✔ Pharmacy Staff
- ✔ Pharmacy Manager
- ✔ System Administrator

3.2.1 Use Case Diagram - Customers

The use case diagram for the Customer is shown below.

Figure 3.2-1 Use Case Diagram for Customer

3.2.2 Use Case Diagram – Pharmacy Staff

The use case diagram for Pharmacy Staff Member is shown below

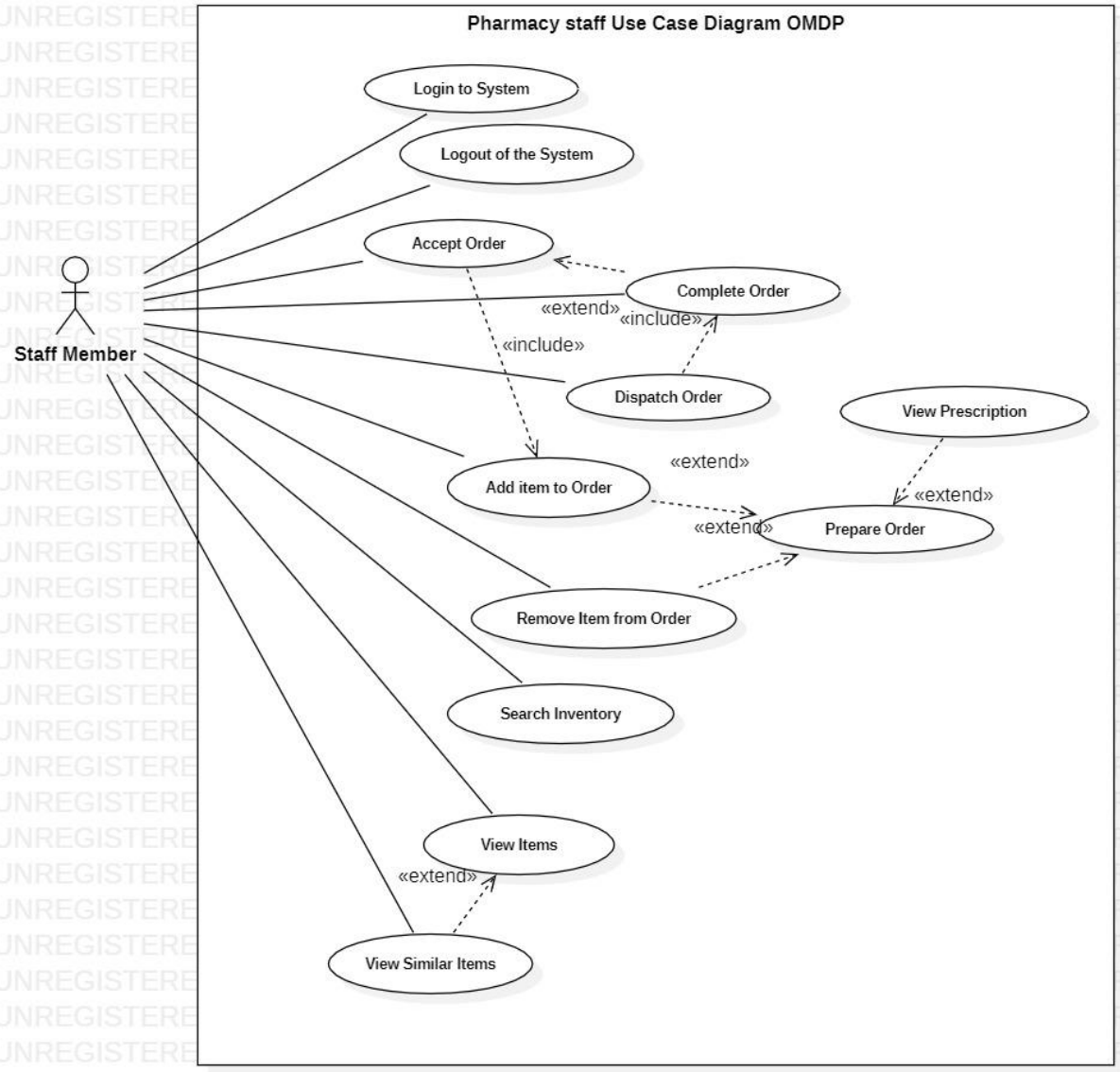


Figure 3.2-2 Use Case Diagram for Pharmacy Staff

3.2.3 Use Case Diagram – Pharmacy Managers

The following figure shows Use case Diagram for Pharmacy Managers.

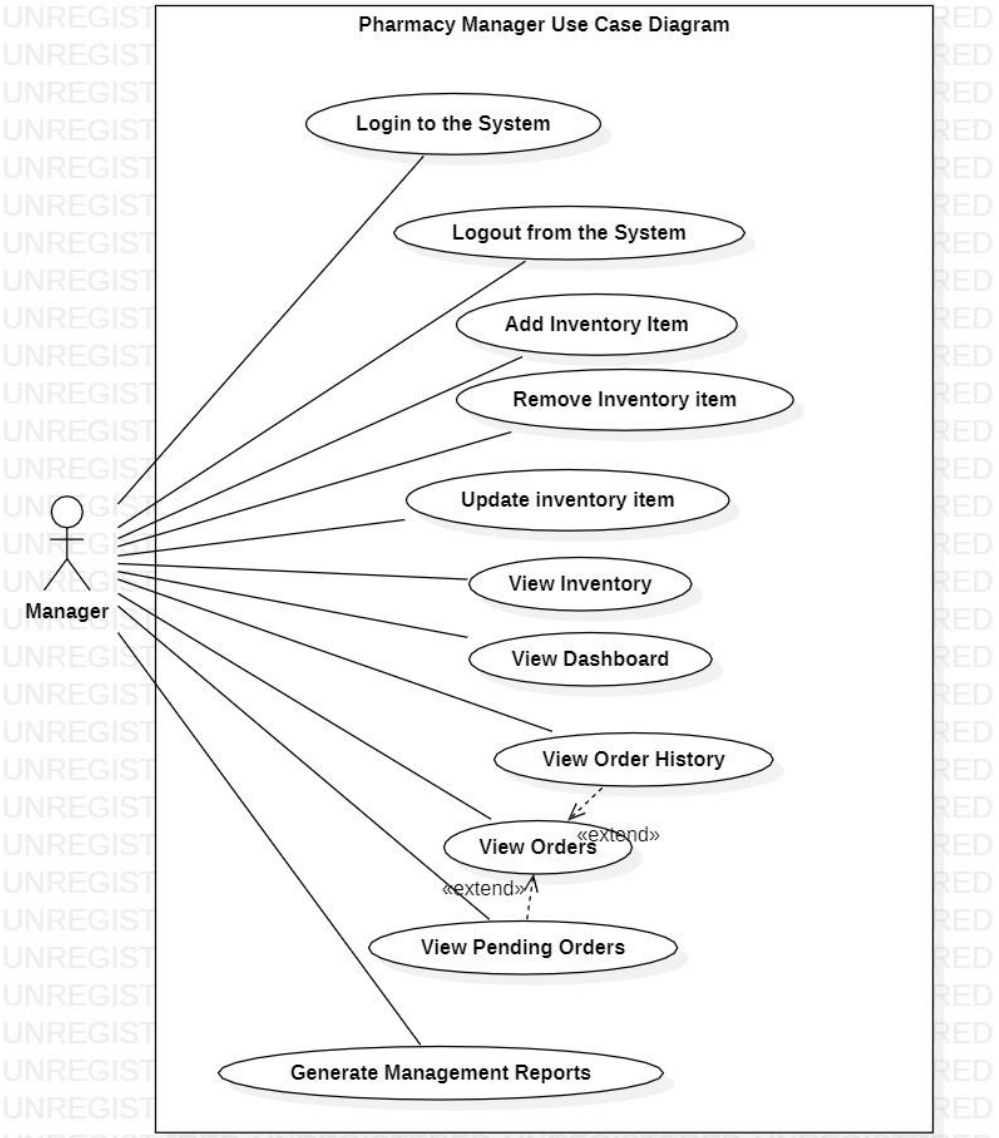


Figure 3.2-3 Use case diagram for Managers

3.2.4 Use Case diagram – System Administrator

The following figures shows the Use case Diagram for System Administrators.

Figure 3.2-4 Use Case Diagram for System Administrator

3.2.5 Database Design

All the data will be included in a single Instance MYSQL database namely “omdp”. The ER diagram below shows the overall Database design of OMDP.

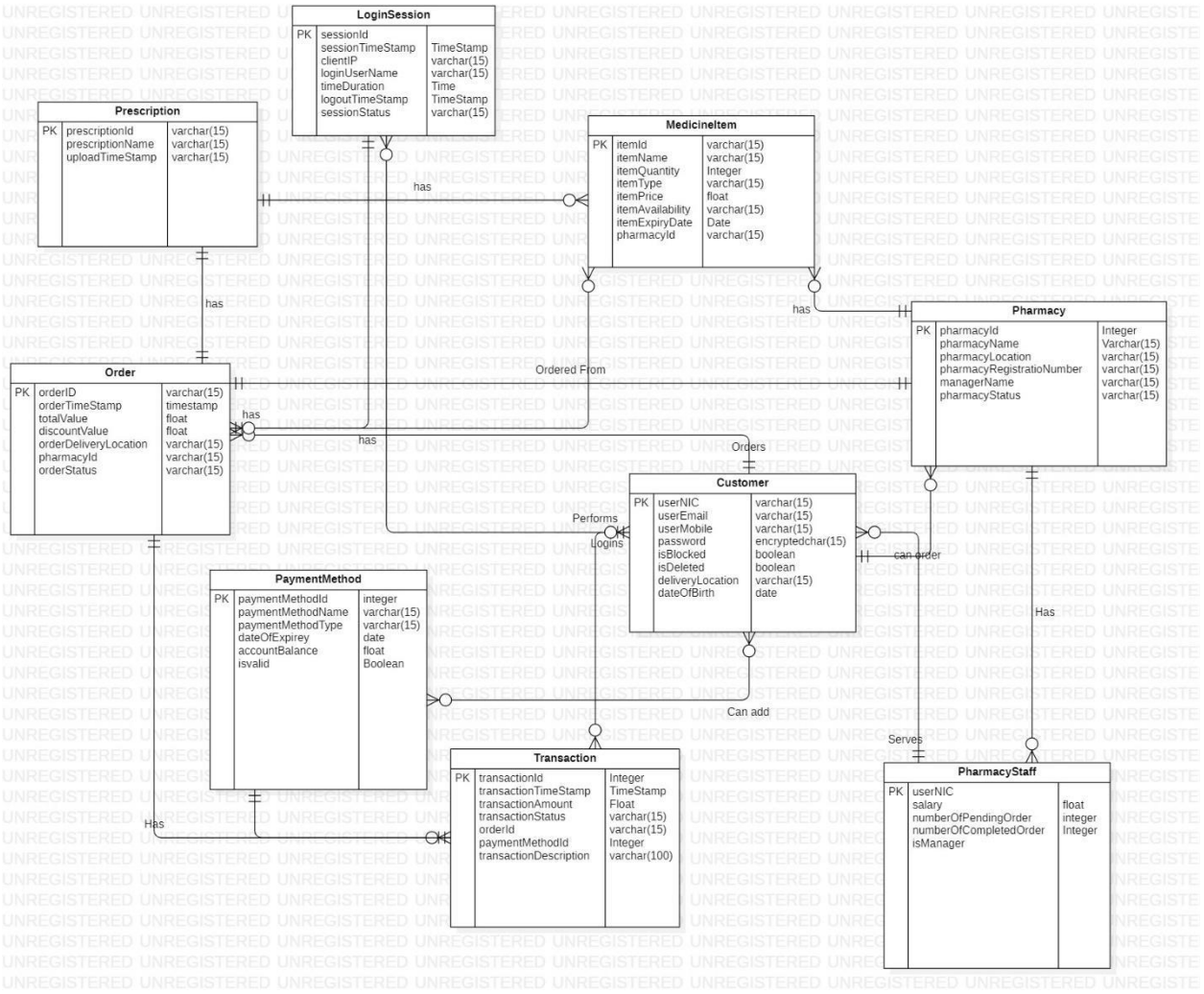


Figure 3.2-5 ER Diagram of OMDP

The relationships joining the database tables are mapped using Unique key constraints and foreign key referential constraints, to maintain Consistency and Integrity of Data in the system persistence. TCP/IP connections are used establish network connectivity between Application and Database.

The application schema user for a customer has read only access to relevant Inventory tables and Read write access to transaction tables. Complete access is only given to Administrator.

Application contains main tables namely the

1. Users
2. Pharmacy
3. Order Transaction

Which contain sensitive data of Customers and Pharmacies. Also note that these tables are not mentioned in the above ER diagram.

A main table named ‘Users’ contains details of all the application Users, including Customers, Pharmacists and System administrators. The “order transaction’ table intends to map Order details with the relevant transaction.

To ensure role separation and security of the system, only Administrators are allowed read write. access to the main tables.

Also, the major business logic would be contained as database procedures and functions.

3.3 Architectural Design

This section identifies and describes the different components in the OMDP proposed system. The flow of information from one component to another component and the interfaces involved can be shown in a component diagram as shown below.

In this section the UML diagram which conveys the architectural image clearly is chosen to interpret different Use cases of the System.

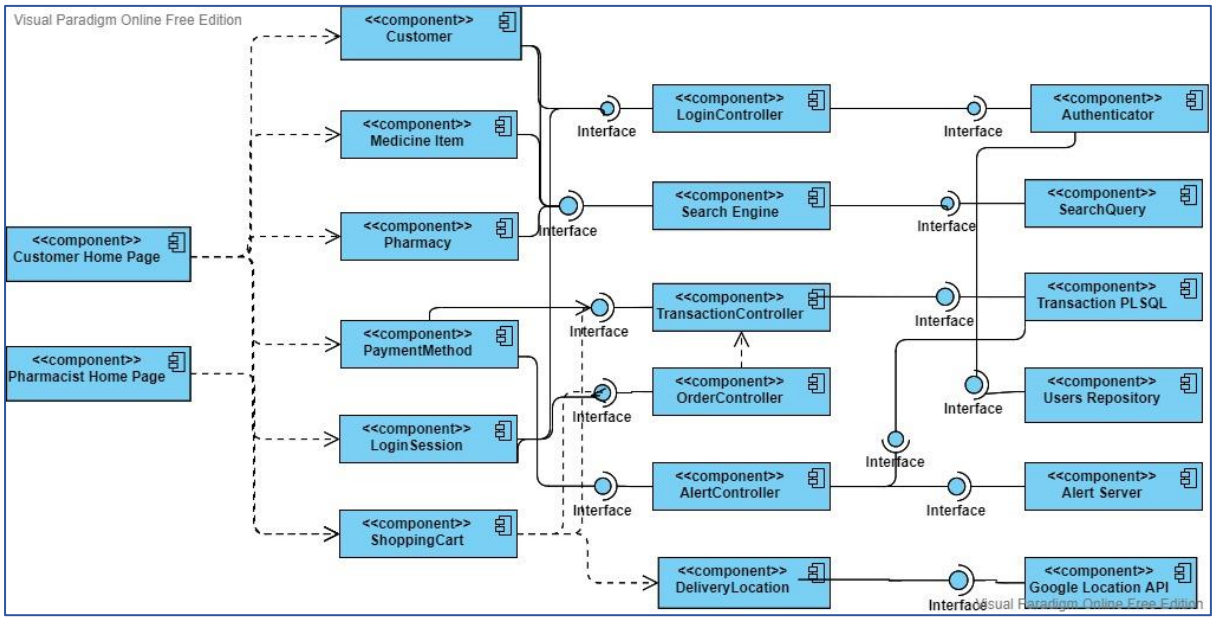


Figure 3.3-1 Component Diagram for OMDP

In order to provide an insight into communication between different components of the OMDP. The below diagram shows the interaction and the flow data within different component interface, when user Logins to the system. All the User logins are secured with multiple authenticating methods.

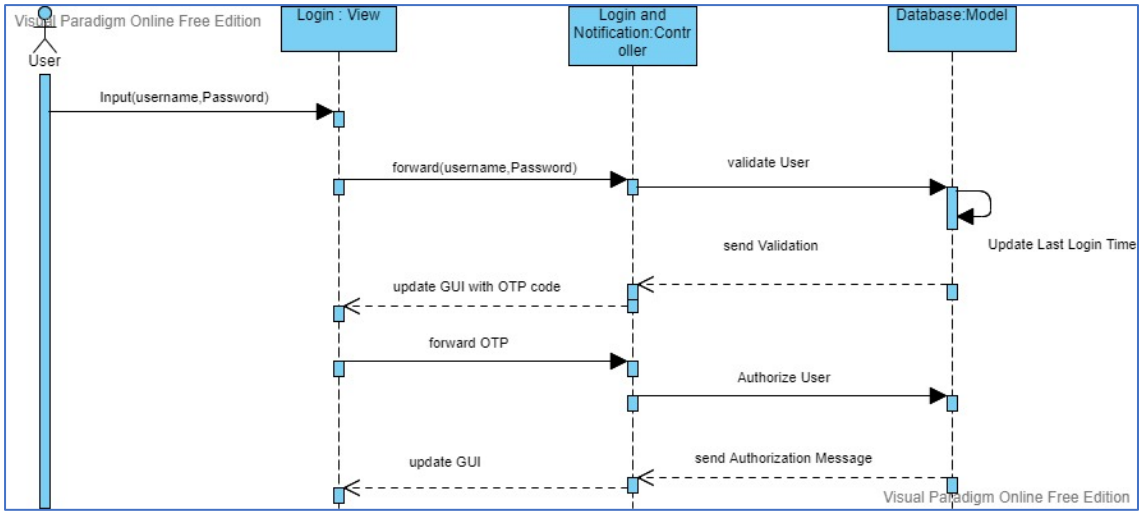


Figure 3.3-2 Sequence Diagram for User Login

The Search Functionality can be depicted via a sequence diagram as shown below.

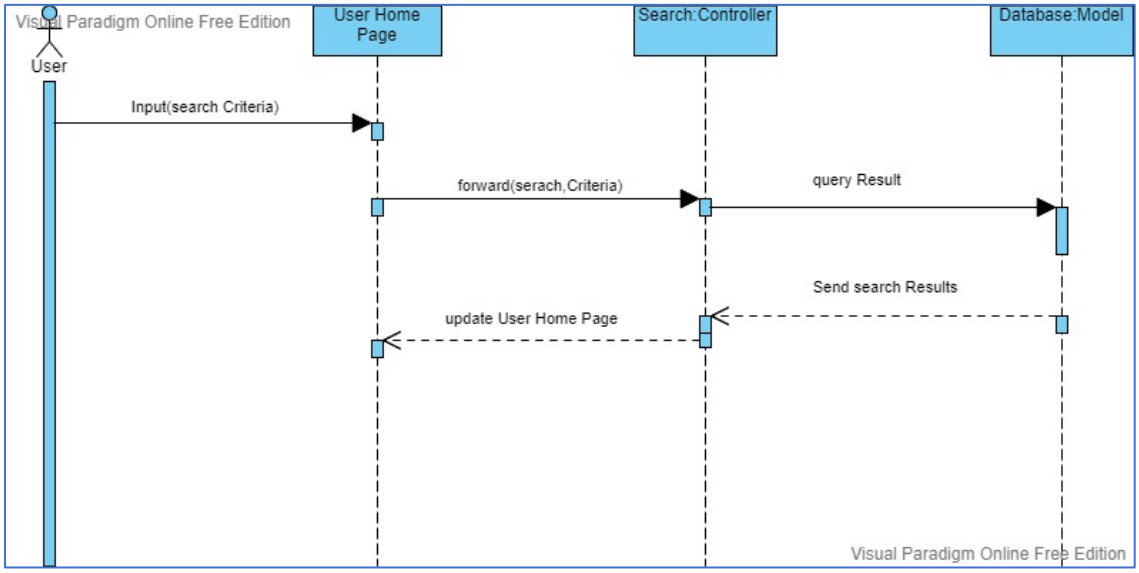


Figure 3.3-3 Search function - Sequence Diagram

To indicate the process flow and breakdown of decision making in making an Online Purchase, the following Activity Diagrams can be used.

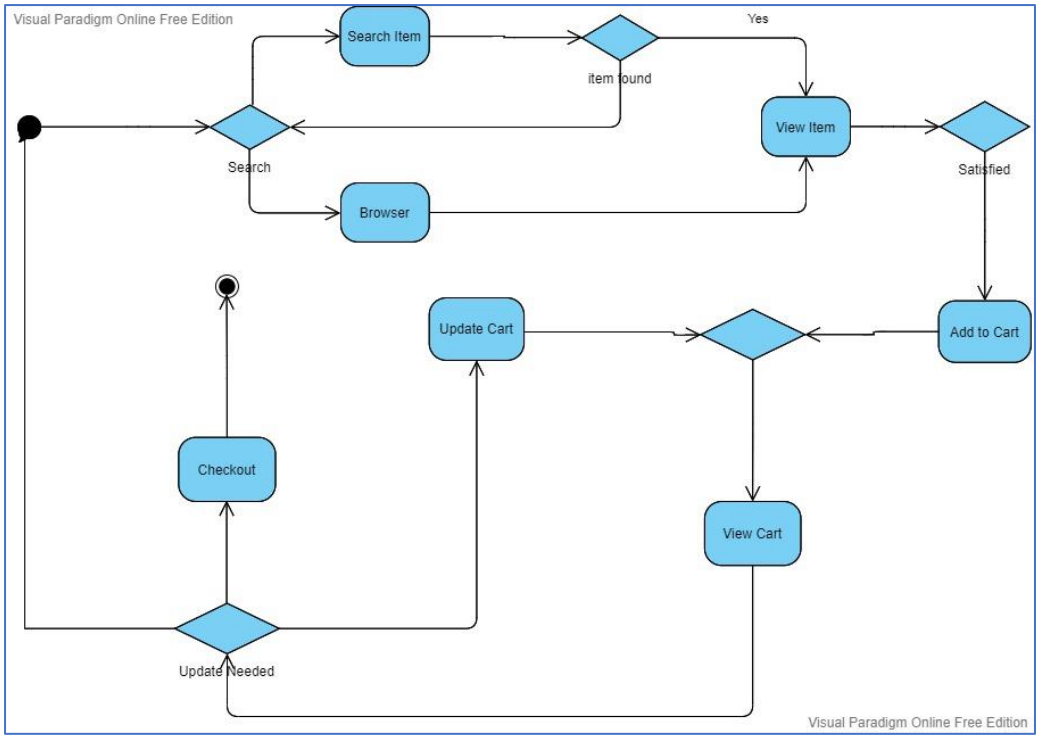


Figure 3.3-4 Activity Diagram for Order Placement

After getting checkout and the order is forwarded to the Pharmacy. This order is accepted by the Pharmacy before the order is completed. The Activity diagram below shows the sequence and process flow when the order is accepted by Pharmacy to the reception of the order.

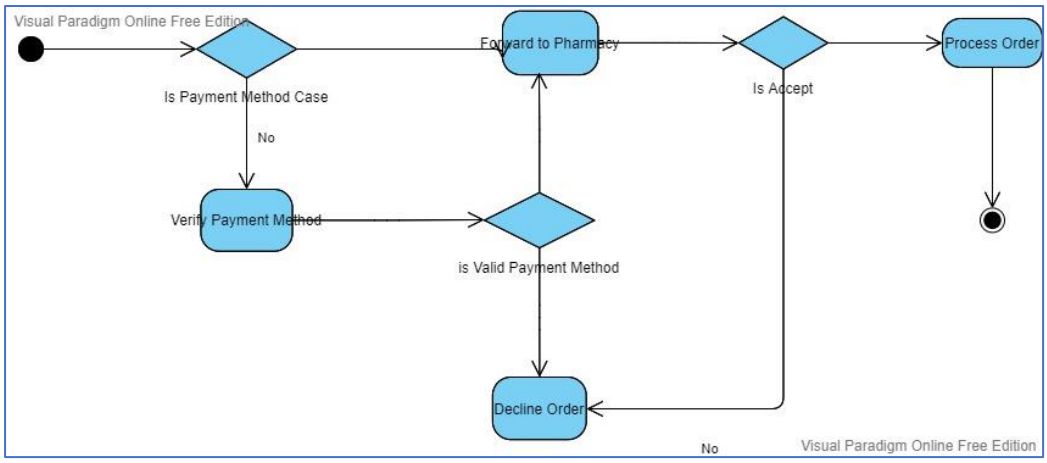


Figure 3.3-5 Order Acceptance - Activity Diagram

After the order is finished processing, the goods will be dispatched to the delivery. The OMDP is offers in-built order tracking system which enables user to track the order from point of dispatch to Delivery.

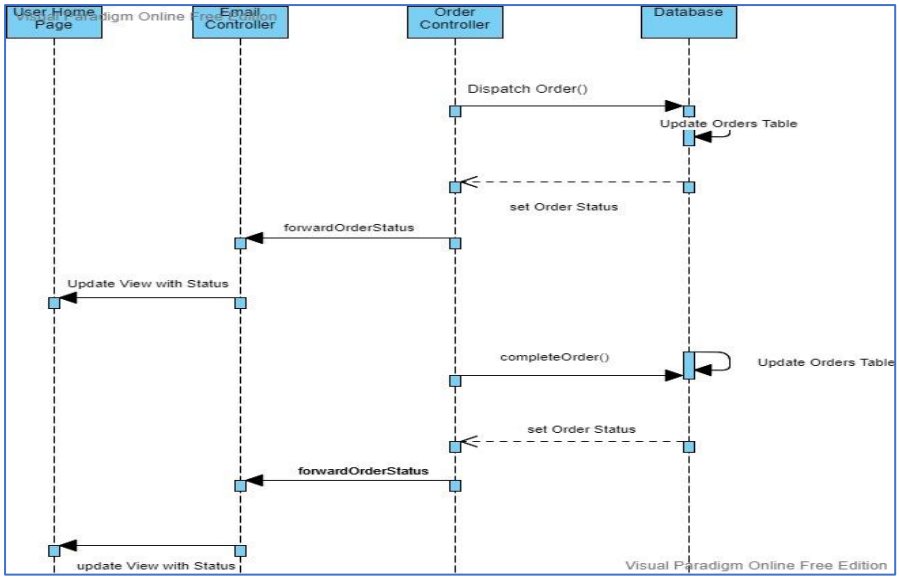


Figure 3.3-6 Sequence Diagram from Dispatching of Order to Completion of Order

The process of payment method will be handled from the payment gateway provider. To provide an image of the Architecture from Development perspective, the class diagram can be used as shown below. The class diagram depicts various forms of relationships between object classes and the degree of cardinality involved.

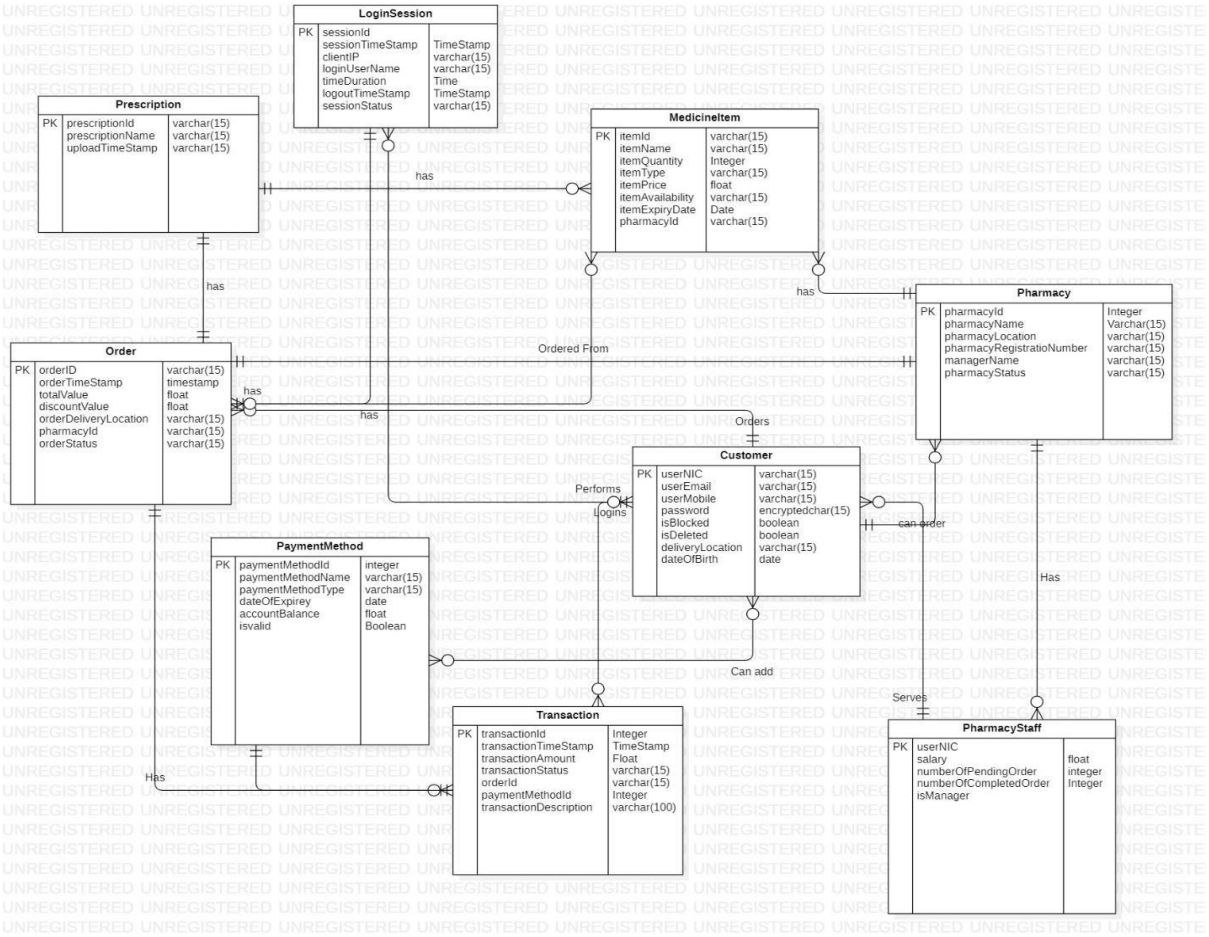


Figure 3.3-7 Class Diagram for OMDP

3.4 Architectural Goals and Constraints

The following key requirements and system constraints can be identified in defining the system architecture of OMDP system.

3.4.1 Development Environment

The system will be developed using PHP, JavaScript languages and based on the Code Igniter Framework. Bootstrap and CSS will be used for User Interface Design. The proposed system is expected to develop in WAMP server environment.

3.4.2 Client User Interfaces

Since the proposed system is completely web-based system, a web browser installed on a PC with working internet connection should be used to access the system. The proposed system is expected to support Google Chrome, Firefox and Microsoft Edge web Browsers installed in Windows or Linux PC.

3.4.3 Persistence

All data will be written to a Single Instance MYSQL database deployed in the WAMP server environment.

3.4.4 System Security

All the User credentials are encrypted using Strong encryption algorithms such as RSA. Sensitive user information such as NIC number, email, Card Numbers are masked and displayed in Notifications. Login and log off of Users to system and Online Payment could be secured with Two Factor authentication.

3.5 Use Case Realization

3.5.1 Customer Use Case Narratives

Customer Register with the System

Use Case Name	Customer Register with the System
Scenario	Customer who wishes to use the System, creates a user profile by Entering a Valid Email Id, NIC and Mobile Number
Triggering Event	User enters required fields and click Sign Up button.
Actors	Customer
Brief Description	Customer registers with the System and creates a valid user profile prior to receive the functionality and services provided by the OMDP
Related Use Case	Null
Pre-Conditions	User should access the System landing page and click on the Sign Up link.
Post-Conditions	If provided information are Valid, Customer Profile will be created and a Success Message will be prompted
Flow of events	User types in System URL and visits the landing page, selects the Sign Up link and visits the User registration Form.
Exceptions	If invalid values are entered in the form by user, an error message will be thrown when form is submitted by user. If mandatory fields are left blank, an error message will be thrown when the form is submitted by the user.

Table 3.5.1-1 Use Case Realization - Customer Registration

Login to the System

Use Case Name	Customer Logins to the System
Scenario	Customer Logins to the System to purchase medicine and or receive functionalities offered by the System.
Triggering Event	User enters login credentials and enters the Login Button.
Brief Description	User Logins to the system.
Actors	Customer ,Pharmacy Staff, Pharmacy Manager, System Administrators
Related Use Case	Null
Pre-Conditions	User should access the System landing page and click on the Sign Up link. If user is Customer, the user should be registered and posses a user profile. If other users, should posses a valid User profile created as in the above use case

Post-Conditions	If Login credentials provided by the user are valid, the User will be redirected to the authorized Home Page .
Flow of events	User types in System URL and visits the landing page, selects the Sign In link and visits the User login page.
Exceptions	If invalid values are entered in the form by user, an error message will be thrown when form is submitted by user. If mandatory fields are left blank, an error message will be thrown when the form is submitted by the user.

Table 3.5.1-2 Use Case Realization Login to the System

Logout of the System

Use Case Name	Customer logout from the System
Scenario	Customer Logins to the System to purchase medicine and or receive functionalities offered by the System, after using the system the customer logout of the system.
Triggering Event	User clicks the "Logout" link in the profile Home.
Brief Description	User logout of the System
Actors	Customer, Pharmacy Staff, Pharmacy Manager, System Administrators
Related Use Case	Login to the system
Pre-Conditions	The User should be registered user in the system, and should have active Login session to the System.
Post-Conditions	After Logout, the user will be redirected to the OMDP Home Page.
Flow of events	User Click on the Logout link on the User profile home.
Exceptions	None

Table 3.5.1-3 Us Case Realization Logout of the System

Search Medicine Item(s)

Use Case Name	Search Medicine Item(s)
Scenario	Customer uses the universal search bar to search medicine items on various keywords.
Triggering Event	Customer logins to the system by entering valid credentials and searches medicine items by entering keyword in the Universal Search Engine.
Brief Description	Customer logins to the system and uses the universal search.
Actors	Customer
Related Use Case	Null
Pre-Conditions	User should login into the system to use the functionality

Post-Conditions	If keyword matches medicine items, the result set will be returned.
Flow of events	User Logins to the System and Types a keyword in the Universal Search Bar and clicks the Search Link or Button.
Exceptions	If entered keyword does not match any item, no rows will be returned and a message will be returned.

Table 3.5.1-4 Use Case Realization Search Medicine Item(s)

View Medicine Item Information

Use Case Name	View Item Information(s)
Scenario	Customer uses the universal search bar to search medicine items on various keywords. Customer views more information about an item.
Triggering Event	Customer logins to the system by entering valid credentials and searches medicine items by entering keyword in the Universal Search Engine. Clicks on an item in the search result list.
Brief Description	Customer logins to the system and uses the universal search and views more details about it
Actors	Customer
Related Use Case	Search Medicine Item
Pre-Conditions	User should login into the system to use the functionality.
Post-Conditions	If keyword matches medicine items, the result set will be returned. Clicking on the item in the search results willer redirected to the item Information Page.
Flow of events	User Logins to the System and Types a keyword in the Universal Search Bar and clicks the Search Link or Button. User Clicks on a resulted item.
Exceptions	None

Table 3.5.1-5 Use Case View Medicine Item Information

Add Medicine item to Cart

Use Case Name	Add item to cart
Scenario	Customer searches the medicine items and adds the item wishes to purchase to the shopping cart.
Triggering Event	Customer searches the item in the Universal Search Bar. In the result set , clicks on the relevant item customer wish to purchase and click on the “Add to cart” link to add the item to shopping cart.

Brief Description	Customer logins to the system and uses the universal search item and Adds the item to Shopping Cart.
Actors	Customer
Related Use Case	Customer Placed the Order.
Pre-Conditions	Registered User should login to the System.
Post-Conditions	If the selected item is available in Stock, the item will be added to the Shopping Cart. The current number of items in the Shopping Cart will be increased by one
Flow of events	User Login to the System, input the Search Keyword in the universal Search Bar, Selects the relevant item and Clicks on the "Add to Cart" Link.
Exceptions	If Item is Out of Stock , an error will be thrown mentioning the Item cannot be added. If maximum number items is reached, Item will not be added to the Cart.

Table 3.5.1-6 Use Case Add Medicine item to Cart

Remove Medicine item from Cart

Use Case Name	Remove item from cart
Scenario	Customer searches the item in the Universal Search Bar and adds the item to the Shopping Cart. The Customer removes the item which was added to the Shopping Cart.
Triggering Event	Customer searches the item in the Universal Search Bar. Accesses the current Shopping Cart by Clicking on the Shopping Cart Icon on the top right hand corner of the Web view and clicks on the remove item link to remove an item.
Brief Description	Customer logins to the system and removes an item in the shopping cart previously added to the shopping Cart.
Actors	Customer
Related Use Case	Add item to Cart.
Pre-Conditions	Registered User should login to the System. At least one item should be added to the Shopping Cart.
Post-Conditions	When the remove item link is clicked against an item in the Shopping Cart, the item will be removed from the Shopping Cart.
Flow of events	User Login to the System, Clicks on the Shopping Cart Link on the top of the View.
Exceptions	None

Table 3.5.1-7 Use Case Remove Item from Cart

Add Delivery Location

Use Case Name	Add Delivery Location
Scenario	Customer has finished adding items to the shopping cart and proceed with the checkout procedure, before placing the order.
Triggering Event	Customer.
Brief Description	Customer logins to the system and uses the universal search engine, adds items to the Shopping Cart. To complete the order as the first step in checkout procedure from the Cart, the User should add the Delivery Location.
Actors	Customer
Related Use Case	Customer Places the Order
Pre-Conditions	Registered User should login to the System. At least oner Item should be present in the Shopping Cart.
Post-Conditions	Once Deliver Location is Confirmed and added, the Customer Shall proceed with the Payment and Placing the Order.
Flow of events	User Login to the System, input the Search Keyword in the universal Search Bar, Selects the relevant item and Clicks on the "Add to Cart" Link. Once items are added to the Cart, the Customer adds the Delivery Location add the point of Checkout of the Order.
Exceptions	If Location is set to blank, Customer is not allowed to proceed to the payments. If a location is selected more than 5km radius form Pharmacy Location , Customer is not allowed to proceed to the payments.

Table 3.5.1-8 Use Case Add Delivery Location

Select Payment Method

Use Case Name	Select Payment Method
Scenario	Customer has finished adding items to the shopping cart and proceed with the checkout by selecting a valid Payment method and entering Payment Details.
Triggering Event	After adding delivery Location , the user proceeds to the payment page by clicking on the "Next "Link. User selects the desired payment method and Inputs the payment method Information.
Brief Description	Customer logins to the system and uses the universal search engine, adds items to the Shopping Cart. To complete the order as the first step in checkout procedure from the Cart, the User should add the Delivery Location. Before placing the order, customer has to select payment method and Enter relevant payment method Information.
Actors	Customer

Related Use Case	None
Pre-Conditions	Registered User should login to the System. At least oner Item should be present in the Shopping Cart. As the next step, Customer should have set a valid Delivery location.
Post-Conditions	Once Payment method is selected and required details are provided, the customer will be proceeded to the order summary page before completing the order.
Flow of events	User Login to the System, input the Search Keyword in the universal Search Bar, Selects the relevant item and Clicks on the "Add to Cart" Link. Once items are added to the Cart, the delivery location is selected user will proceed to the payment page, select payment method and enter payment details.
Exceptions	A valid payment is not selected, an error message will be prompted. If mandatory fields are not selected, an error message will be prompted.

Table 3.5.1-9 Use Case Select Payment Method

Place Order

Use Case Name	Place Order
Scenario	After customer has completed selecting , the user shall confirm order details and Proceed with placing the order.
Triggering Event	After adding the Payment method, the user shall click on "Next" link to view a summary of the current order. In the summary page, the user shall confirm and Submit the order.
Brief Description	After completing the Payment Method selection, the user shall view; confirm the order details and Submit the order or cancel the order upon his/her wish
Actors	Customer
Related Use Case	None
Pre-Conditions	The user should have selected the valid payment method before confirming and placing the order.
Post-Conditions	Once the order is placed by clicking on the Submit Button, the order will be placed and will be sent to the relevant Pharmacy Store. If the user cancels the order , order will be cancelled and redirected to the homepage.
Flow of events	User Login to the System, input the Search Keyword in the universal Search Bar, Selects the relevant item and Clicks on the "Add to Cart" Link. Once items are added to the Cart, the delivery location is selected user will proceed to the

	payment page, select payment method and enter payment details. User clicks on the Next link to proceed to Summary Page. To confirm and Place the order , clicks on the Submit button. To cancel the order , clicks on the "Cancel".
Exceptions	If the any payment methods are invalid, the order will be declined. If account Balance is insufficient in any payment methods, order will be declined.

Table 3.5.1-10 Use Case Place Order

Receive Order Updates

Use Case Name	Receive Order Updates.
Scenario	After the order is Placed, the Customer will receive in built system notfications and email or SMS notification regarding the Order, until the order is received at door step.
Triggering Event	Customer has placed the order. Notifications will be received when the Order is accepted by Pharmacy Store, Order is Dispatched to the delivery personnel.
Brief Description	User will receive notifications on each phase of the order.
Actors	Customer, Pharmacy Staff
Related Use Case	None
Pre-Conditions	The user should Login to the system and place and order following the Use cases mentioned in previous section.
Post-Conditions	User will continue to receive updates on each stage of the order from preparing order to receipt of order.
Flow of events	Order is submitted as per the use case and above.
Exceptions	None

Table 3.5.1-11 Use Case Receive Order Updates

Receive Order

Use Case Name	Receive Order.
Scenario	After the delivery personnel handover the Customer Order, delivery personnel updates order status.
Triggering Event	Customer has received the order. Delivery Personnel updates the order status as "Delivered"
Brief Description	The Customer order is received at the Customer end.
Actors	Customer
Related Use Case	None
Pre-Conditions	The user should placed an order from the System.

Post-Conditions	User will receive an order status update as "Completed". The order will be added to customers order history.
Flow of events	Order is received by Customer. Delivery personel hand over updates the status as "completed" after Payment is received from Customer.
Exceptions	None

Table 3.5.1-12 Use Case Receive Order

3.5.2 Pharmacy Staff Use Case Narratives

Login to the System

Use Case Name	User Logins to the System
Scenario	User Logins to the System to purchase medicine and or receive functionalities offered by the System.
Triggering Event	User enters login credentials and enters the Login Button.
Brief Description	User Logins to the system.
Actors	Pharmacy Staff, Pharmacy Manager, System Administrators
Related Use Case	Null
Pre-Conditions	User should access the System landing page and click on the Sign Up link. If user is User, the user should be registered and posses a user profile. If other users, should posses a valid User profile created as in the above use case
Post-Conditions	If Login credentials provided by the user are valid, the User will be redirected to the authorized Home Page .
Flow of events	User types in System URL and visits the landing page, selects the Sign In link and visits the User login page.
Exceptions	If invalid values are entered in the form by user, an error message will be thrown when form is submitted by user. If mandatory fields are left blank, an error message will be thrown when the form is submitted by the user.

Logout of the System

Use Case Name	User logout from the System
Scenario	User Logins to the System to purchase medicine and or receive functionalities offered by the System, after using the system the customer logout of the system.
Triggering Event	User clicks the "Logout" link in the profile Home.
Brief Description	User logout of the System
Actors	Pharmacy Staff, Pharmacy Manager, System Administrators
Related Use Case	Login to the system
Pre-Conditions	The User should be registered user in the system, and should have active Login session to the System.
Post-Conditions	After Logout, the user will be redirected to the OMDP Home Page.
Flow of events	User Click on the Logout link on the User profile home.
Exceptions	None

Accept Order

Use Case Name	Accept Order
Scenario	The Pharmacy Staff member is able to accept incoming orders
Triggering Event	The logged in Pharmacy Staff Member can view incoming order and Click on the "accept" button of the incoming order.
Brief Description	The user can view incoming order as dialog box on his/her Web view. The User provided with options to accept or reject incoming order.
Actors	Pharmacy Staff
Related Use Case	Place Order (Customer)
Pre-Conditions	A customer should have placed an order to the Pharmacy. Pharmacy Staff should be logged into the system.
Post-Conditions	When the order is accepted, the order is opened and Pharmacy Staff can start adding or removing items to the Order Cart.
Flow of events	Pharmacy Staff member Logs into the system. An incoming order will be notified in a prompt. Staff member accepts the incoming order.
Exceptions	If the order is not accepted the incoming order will be automatically declined after timeout.

Reject Order

Use Case Name	Accept Order
Scenario	The Pharmacy Staff member is able to accept incoming orders
Triggering Event	The logged in Pharmacy Staff Member can view incoming order and Click on the “reject” button of the incoming order.
Brief Description	The Pharmacy Staff member is able to accept incoming orders. After accepting the order, items can be added to the Order.
Actors	Pharmacy Staff
Related Use Case	Place Order (Customer)
Pre-Conditions	A customer should have placed an order to the Pharmacy. Pharmacy Staff should be logged into the system. Order should be accepted by the Pharmacy Staff.
Post-Conditions	When the order is rejected, the User will be redirected to the home page. Customer who placed the order will receive a notification.
Flow of events	Pharmacy Staff member Logs into the system. An incoming order will be notified in a prompt. Staff member clicks on the rejects the incoming order.
Exceptions	None.

Search Inventory

Use Case Name	Search Inventory
Scenario	Staff member types in a keyword to search a medicine item in the
Triggering Event	User logins to the system by entering valid credentials and searches medicine items by entering keyword in the Universal Search Engine.
Brief Description	User logins to the system and uses the universal search.
Actors	Pharmacy Staff
Related Use Case	Null
Pre-Conditions	User should login into the system to use the functionality
Post-Conditions	If keyword matches medicine items, the result set will be returned.
Flow of events	User Logins to the System and Types a keyword in the Universal Search Bar and clicks the Search Link or Button.
Exceptions	If entered keyword does not match any item, no rows will be returned and a message will be returned.

Add Medicine item to Order

Use Case Name	Add Medicine item to Order
Scenario	Staff member adds medicine item to the accepted order.
Triggering Event	Staff searches an item and clicks on "Add to Order" link.
Brief Description	Once an order is accepted by the Pharmacy the Staff member can continue adding items to the Order.
Actors	Customer ,Pharmacy Staff
Related Use Case	None
Pre-Conditions	Registered User should login to the System. and accept the order.
Post-Conditions	When the Staff member clicks on the "Add item" Link against a medicine item, the item will be added to order cart.
Flow of events	User Login to the System, accept the order go into the order, search medicine item and Click on the "Add Item" link against the item.
Exceptions	If item is out of Stock. Similar items should be suggested.

Remove Medicine item from Order

Use Case Name	Remove Medicine item from Order
Scenario	Staff member removes medicine item from the accepted order.
Triggering Event	Staff member clicks on the "Remove Item" against the added item in the Order Cart
Brief Description	An item added to the Shopping cart is removed by the Staff member.
Actors	Pharmacy Staff
Related Use Case	None
Pre-Conditions	Registered User should login to the System. and accept the order. An item should added to the Order Cart.
Post-Conditions	The item will be removed from the order Cart.
Flow of events	User Login to the System, accept the order go into the order, search medicine item and Click on the "Add Item" link against the item. To remove the item user clicks on the "Remove Item" link.
Exceptions	None.

View Medicine Item Information

Use Case Name	View Item Information(s)
Scenario	User uses the universal search bar to search medicine items on various keywords. User views more information about an item.
Triggering Event	User logins to the system by entering valid credentials and searches medicine items by entering keyword in the Universal Search Engine. Clicks on an item in the search result list.
Brief Description	User logins to the system and uses the universal search and views more details about it
Actors	Pharmacy Stadd
Related Use Case	Search Medicine Item
Pre-Conditions	User should login into the system to use the functionality.
Post-Conditions	If keyword matches medicine items, the result set will be returned. Clicking on the item in the search results willer redirected to the item Information Page.
Flow of events	User Logins to the System and Types a keyword in the Universal Search Bar and clicks the Search Link or Button. User Clicks on a resulted item.
Exceptions	None

30.6.1.1 View Similar Item Information

Use Case Name	View Similar Item Information(s)
Scenario	User uses the universal search bar to search medicine items on various keywords. If search Item brand is not available, similar items will be suggested.
Triggering Event	User logins to the system by entering valid credentials and searches medicine items by entering keyword in the Universal Search Engine. Clicks on an item in the search result list.
Brief Description	User logins to the system and uses the universal search and views more details about it. Similar itesm are suggested when search item is not available in stock.
Actors	Pharmacy Staff
Related Use Case	Search Medicine Item
Pre-Conditions	User should login into the system to use the functionality. User searches for a item in the
Post-Conditions	Similar Items are suggested in list format.
Flow of events	User Logins to the System and Types a keyword in the Universal Search Bar and clicks the Search Link or Button..
Exceptions	None

Complete Order

Use Case Name	Complete Order.
Scenario	After User has completed processing the Order, User updates the status as “Completed Prepareing”
Triggering Event	After Staff member confirms the added items in the Order Cart, Clicks on “Complete Preparing”.
Brief Description	The User completes the order and updates the status to “Complete Preparing” and Order will be available to be Delivered.
Actors	Pharmacy Staff.
Related Use Case	None
Pre-Conditions	Items should be added to the order and manual processing of order should be complete.
Post-Conditions	The Order Status will be Changed to “Completed Prepareing”. Customer and Pharmacy Staff will receive a notification.
Flow of events	Order is completed manual processing and User clicks on complete order.
Exceptions	None

Dispatch Order

Use Case Name	Dispatch Order.
Scenario	When the Order is fetched for delivery, User updates the order status as “Dispatched”
Triggering Event	When the order is Fetched for Deliver, User clicks on the “Dispatch Order Link”
Brief Description	The User completes the order and updates the status to “Complete Preparing”, Fetched for Deliver, User marks the order to be dispatched
Actors	Pharmacy Staff.
Related Use Case	None
Pre-Conditions	Order Status should be set to “completed” as mentioned in above Use Case and should be fetched for Delivery
Post-Conditions	The Order Status will be Changed from “Completed” to “Dispatched” ad Notfications will be sent to Customer and Pharmacy Staff.
Flow of events	Order is completed manual processing and User clicks on complete order. When order is fetched for delivery User clicks on Dispatch order.
Exceptions	None

3.5.3 Pharmacy Manager User Case Narratives

Login to the System

Use Case Name	User Logins to the System
Scenario	User Logins to the System to purchase medicine and or receive functionalities offered by the System.
Triggering Event	User enters login credentials and enters the Login Button.
Brief Description	User Logins to the system.
Actors	Pharmacy Staff, Pharmacy Manager, System Administrators
Related Use Case	Null
Pre-Conditions	User should access the System landing page and click on the Sign Up link. If user is User, the user should be registered and posses a user profile. If other users, should posses a valid User profile created as in the above use case
Post-Conditions	If Login credentials provided by the user are valid, the User will be redirected to the authorized Home Page .
Flow of events	User types in System URL and visits the landing page, selects the Sign In link and visits the User login page.
Exceptions	If invalid values are entered in the form by user, an error message will be thrown when form is submitted by user. If mandatory fields are left blank, an error message will be thrown when the form is submitted by the user.

Logout of the System

Use Case Name	User logout from the System
Scenario	User Logins to the System to purchase medicine and or receive functionalities offered by the System, after using the system the customer logout of the system.
Triggering Event	User clicks the “Logout” link in the profile Home.
Brief Description	User logout of the System
Actors	Pharmacy Staff, Pharmacy Manager, System Administrators
Related Use Case	Login to the system
Pre-Conditions	The User should be registered user in the system, and should have active Login session to the System.
Post-Conditions	After Logout, the user will be redirected to the OMDP Home Page.
Flow of events	User Click on the Logout link on the User profile home.
Exceptions	None

Add Medicine item to Inventory

Use Case Name	Add Medicine Item to inventory
Scenario	Manager adds medicine item to the inventory
Triggering Event	Manager Login to the home page, Navigate to Manage Inventory Menu and Select Add item option. Enters all the required details and Submits the form.
Brief Description	Manager adds an item to the inventory
Actors	Pharmacy Staff, Pharmacy Manager
Related Use Case	None
Pre-Conditions	Registered User should login to the System.
Post-Conditions	When manager has successfully submitted the item details, will be redirected to the Manager Inventory Page
Flow of events	User Login to the System, Clicks on the manage inventory tab and enters Manage inventory Page and click on "Add item" option. Enters the required details in the form provided and Submits.
Exceptions	If invalid values are entered in the form by user, an error message will be thrown when form is submitted by user. If mandatory fields are left blank, an error message will be thrown when the form is submitted by the user.

Remove Medicine item to Inventory

Use Case Name	Remove Medicine Item from inventory
Scenario	Manager remove medicine item from the inventory
Triggering Event	Manager Login to the home page, Navigate to Manage Inventory Menu and Select remove item option against the item. Confirms the selection.
Brief Description	Manager remove an item from the inventory
Actors	Pharmacy Staff, Pharmacy Manager
Related Use Case	None
Pre-Conditions	Registered User should login to the System.
Post-Conditions	A dialog box will be prompted to delete. When the Yes option is selected, item will be deleted.
Flow of events	User Login to the System, Clicks on the manage inventory tab and enters Manage inventory Page and click on "remove item" option against the item.
Exceptions	None

Modify Medicine item in Inventory

Use Case Name	Modify Medicine item in Inventory
Scenario	Manager modified medicine item from the inventory
Triggering Event	Manager Login to the home page, Navigate to Manage Inventory Menu and Select modify item option against the item. Confirms the changes.
Brief Description	Manager modifies details in an item from the inventory
Actors	Pharmacy Manager
Related Use Case	None
Pre-Conditions	Registered User should login to the System.
Post-Conditions	User will be redirected to a form with existing item details. User modifies the details and click "Save " link. User will be redirected back to the Manage Inventory Page.
Flow of events	User Login to the System, Clicks on the manage inventory tab and enters Manage inventory Page and click on "modify item" option against the item. Modify the relevant fields and Clicks on "Save".
Exceptions	None

Generate Management Reports

Use Case Name	Generate Management Reports
Scenario	Manager Log into the System and generate Management reports
Triggering Event	User logins to the system Navigate to reports Tab. Enters the relevant values and filters for the report and click on "generate reports"
Brief Description	User generates Management reports by submitting relevant parameters and filters.
Actors	Pharmacy Manager
Related Use Case	None
Pre-Conditions	User should login into the system to use the functionality.
Post-Conditions	Report will be generated in the window.
Flow of events	User logins to the system Navigate to reports Tab. Enters the relevant values and filters for the report and click on "generate reports"
Exceptions	If no data is available. A message will be prompted.
Use Case Name	User Logins to the System
Scenario	User Logins to the System to purchase medicine and or receive functionalities offered by the System.

Triggering Event	User enters login credentials and enters the Login Button.
Brief Description	User Logins to the system.
Actors	Pharmacy Staff, Pharmacy Manager, System Administrators
Related Use Case	Null
Pre-Conditions	User should access the System landing page and click on the Sign Up link. If user is User, the user should be registered and posses a user profile. If other users, should posses a valid User profile created as in the above use case
Post-Conditions	If Login credentials provided by the user are valid, the User will be redirected to the authorized Home Page .
Flow of events	User types in System URL and visits the landing page, selects the Sign In link and visits the User login page.
Exceptions	If invalid values are entered in the form by user, an error message will be thrown when form is submitted by user. If mandatory fields are left blank, an error message will be thrown when the form is submitted by the user.

3.5.4 System Administrator Use Case Narratives

Login to the System

Use Case Name	User Logins to the System
Scenario	User Logins to the System to purchase medicine and or receive functionalities offered by the System.
Triggering Event	User enters login credentials and enters the Login Button.
Brief Description	User Logins to the system.
Actors	Pharmacy Staff, Pharmacy Manager, System Administrators
Related Use Case	Null
Pre-Conditions	User should access the System landing page and click on the Sign Up link. If user is User, the user should be registered and posses a user profile. If other users, should posses a valid User profile created as in the above use case
Post-Conditions	If Login credentials provided by the user are valid, the User will be redirected to the authorized Home Page .
Flow of events	User types in System URL and visits the landing page, selects the Sign In link and visits the User login page.

Exceptions	If invalid values are entered in the form by user, an error message will be thrown when form is submitted by user. If mandatory fields are left blank, an error message will be thrown when the form is submitted by the user.

Logout of the System

Use Case Name	User logout from the System
Scenario	User Logins to the System to purchase medicine and or receive functionalities offered by the System, after using the system the customer logout of the system.
Triggering Event	User clicks the "Logout" link in the profile Home.
Brief Description	User logout of the System
Actors	Pharmacy Staff, Pharmacy Manager, System Administrators
Related Use Case	Login to the system
Pre-Conditions	The User should be registered user in the system, and should have active Login session to the System.
Post-Conditions	After Logout, the user will be redirected to the OMDP Home Page.
Flow of events	User Click on the Logout link on the User profile home.
Exceptions	None

Add System User

Use Case Name	Add System User
Scenario	Admin adds users item to the system
Triggering Event	Admin Login to the home page, Navigate to Manage Users Menu and Select Add User option. Enters all the required details and Submits the form.
Brief Description	User adds a item to the inventory
Actors	System Administrator
Related Use Case	None
Pre-Conditions	Registered User should login to the System.
Post-Conditions	When admin has successfully submitted the item details, will be redirected to the Manager Inventory Page
Flow of events	User Login to the System, Clicks on the manage inventory Users and enters Manage Users Page and click on "Add User" option. Enters the required details in the form provided and Submits.

Exceptions	If invalid values are entered in the form by user, an error message will be thrown when form is submitted by user. If mandatory fields are left blank, an error message will be thrown when the form is submitted by the user.

Remove User from the System.

Use Case Name	Remove User from the System.
Scenario	Manager remove User item from the system
Triggering Event	Manager Login to the home page, Navigate to Manage User Menu and Select remove User option against the item. Confirms the selection.
Brief Description	Manager remove an item from the inventory
Actors	Pharmacy Staff, Pharmacy Manager
Related Use Case	None
Pre-Conditions	Registered User should login to the System.
Post-Conditions	A dialog box will be prompted to delete. When the Yes option is selected, item will be deleted.
Flow of events	User Login to the System, Clicks on the manage inventory tab and enters Manage inventory Page and click on “remove item” option against the item.
Exceptions	None

Modify Medicine item in Inventory

Use Case Name	Modify User item in System
Scenario	Manager modified User item from the System
Triggering Event	Manager Login to the home page, Navigate to Manage User Menu and Select modify User option against the item. Confirms the changes.
Brief Description	Manager modifies details of a User in the System
Actors	System Administrator
Related Use Case	None
Pre-Conditions	Registered User should login to the System.
Post-Conditions	User will be redirected to a form with existing User details. User modifies the details and click “Save “ link. User will be redirected back to the Manage Inventory User.
Flow of events	User Login to the System, Clicks on the manage inventory User and enters Manage User Page and click on “modify user” option against the User. Modify the relevant fields and Clicks on “Save”.
Exceptions	None

Block User from the System.

Use Case Name	Block User from the System.
Scenario	Manager blocks User item from the system
Triggering Event	Manager Login to the home page, Navigate to Manage User Menu and Select Block User option against the item. Confirms the selection.
Brief Description	Manager Blocks an item from the inventory
Actors	System Admin
Related Use Case	None
Pre-Conditions	Registered User should login to the System.
Post-Conditions	A dialog box will be prompted to block. When the Yes option is selected, user will be blocked.
Flow of events	User Login to the System, Clicks on the manage inventory tab and enters Manage Users Page and click on "Block User" option against the item.
Exceptions	None

Unblock User from the System.

Use Case Name	UnBlock User from the System.
Scenario	Manager unblocks User item from the system
Triggering Event	Manager Login to the home page, Navigate to Manage User Menu and navigate to blocked users .Select unBlock User option against the item. Confirms the selection.
Brief Description	Manager unblocks an item from the inventory
Actors	System Admin
Related Use Case	None
Pre-Conditions	Registered User should login to the System. The relevant user should be blocked by the Admin User Previously
Post-Conditions	A dialog box will be prompted to block. When the Yes option is selected, item will be unblocked
Flow of events	User Login to the System, Clicks on the manage inventory tab and enters Manage Users Page and click on "Block User" option against the item.
Exceptions	If user is already Unblocked. A message will be prompted.

3.6 User Interface Design

This section provides an insight into UI design strategies of principle view components of the OMDP. For Customers, a separate landing page will be provided as shown in the figure below.

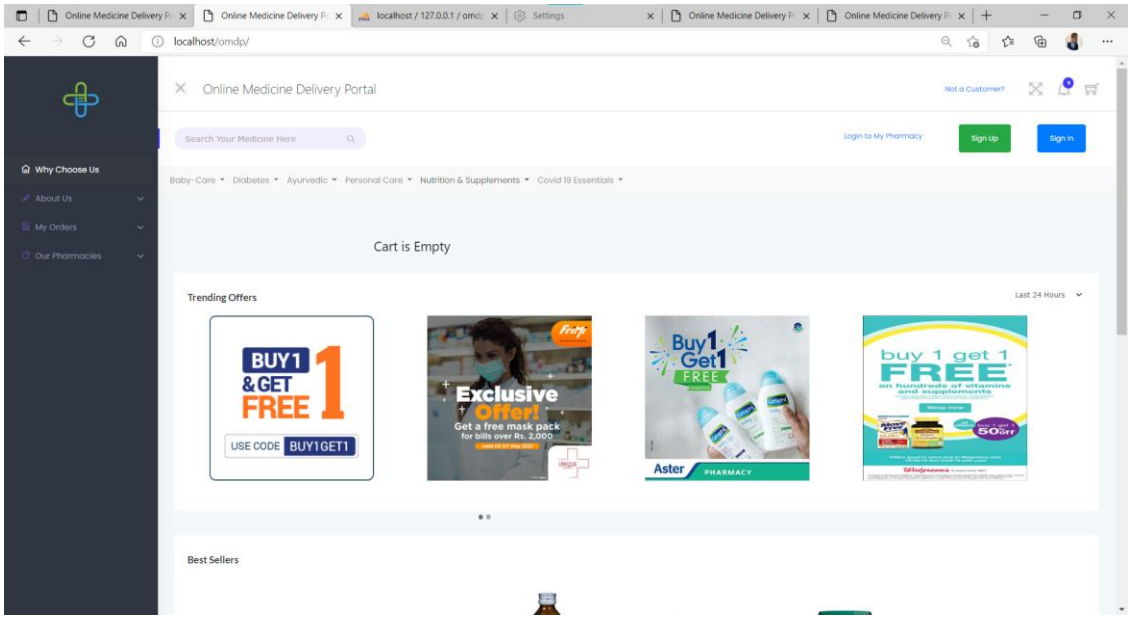


Figure 3.6-1 OMDP Landing Page for Customers

Customer who wishes login to the OMDP will be provided a Login Page as shown in the figure below. This is considered as the Sing-Sign-On Page for OMDP Customers.

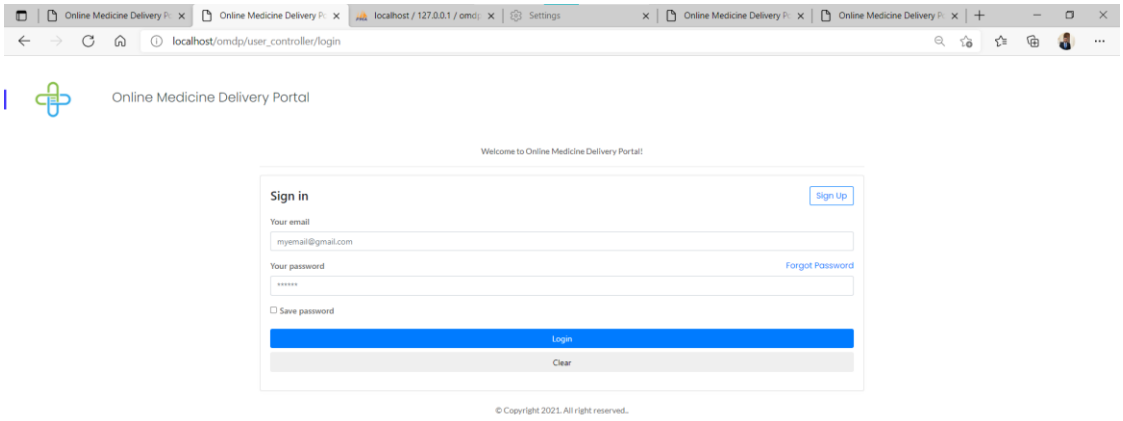
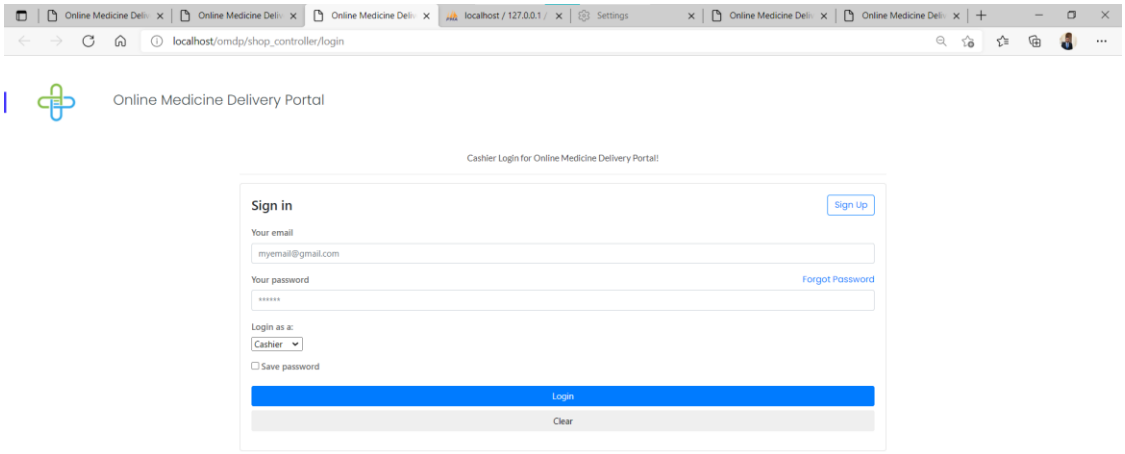


Figure 3.6-2 Customer Login Page OMDP

The figure below shows Login Page for a Pharmacy Owner (Manager) or Pharmacist User.



After signing into the system user will be directed to the relevant home page. The below figure shows the Home Page of a typical Customer User.

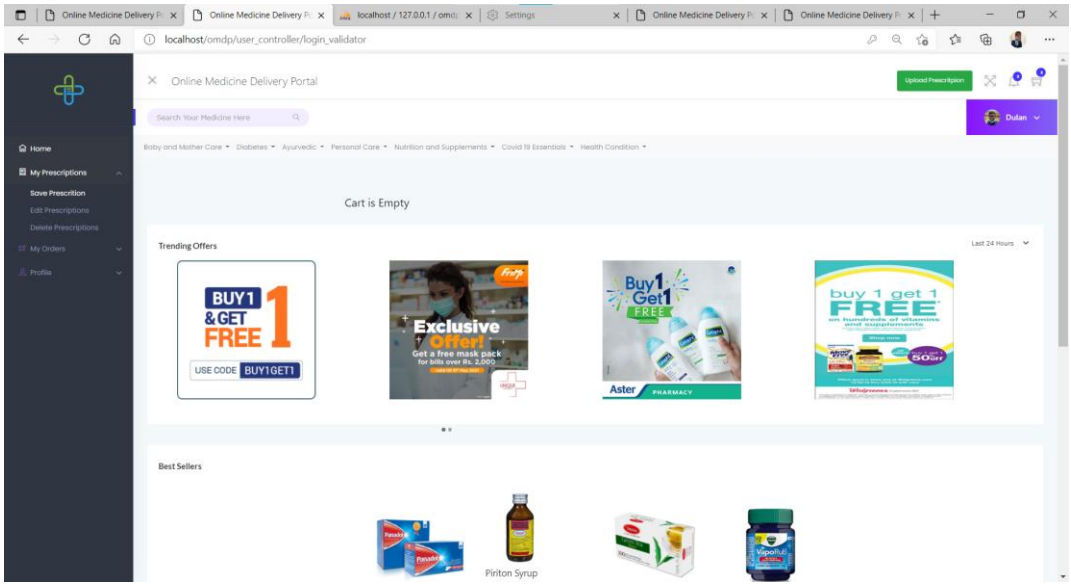
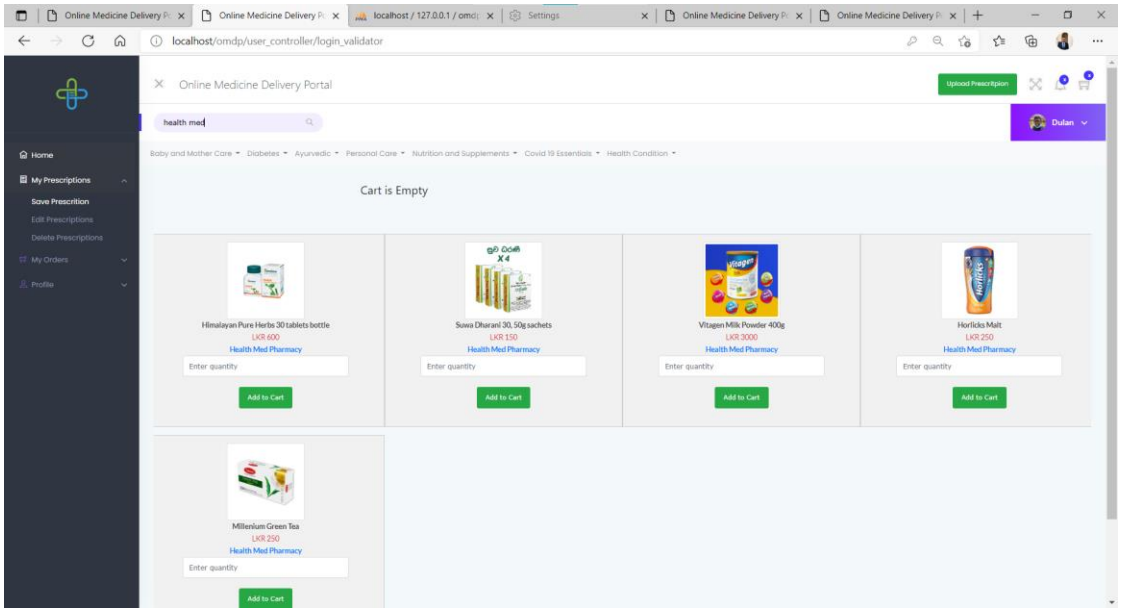


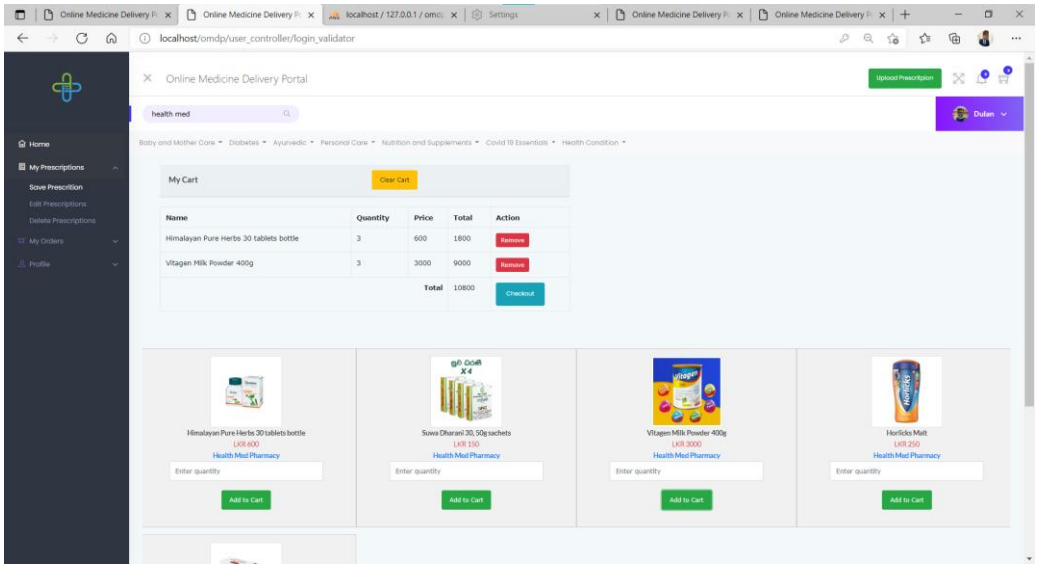
Figure 3.6-3 Home Page for a Customer Logged in

The user is able to search medicine by using the search bar provided in the home page. A sample search result is shown below. The below example shows when user is searching an item based on pharmacy keyword.

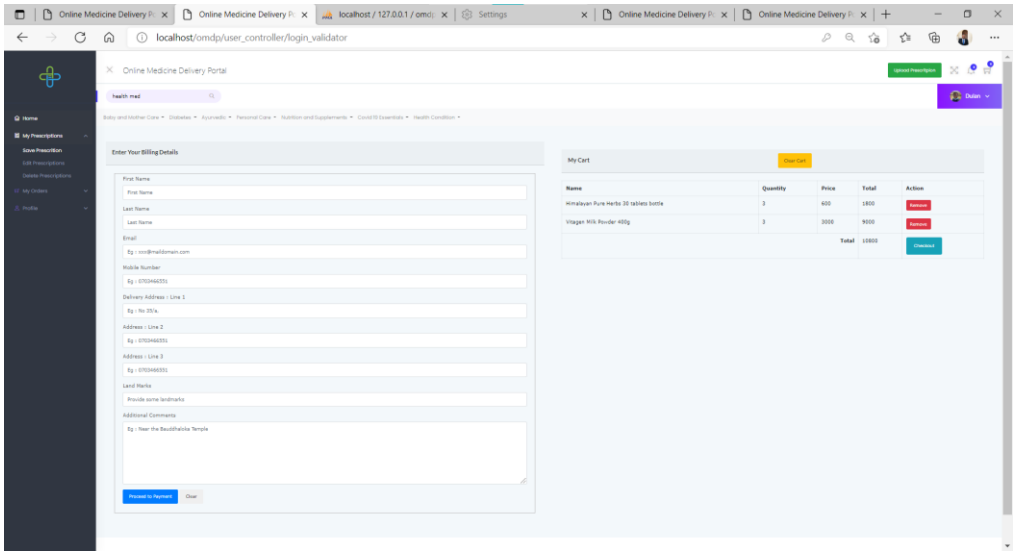


The user is able to add items into the cart by entering the quantity in the input field below each item and clicking on “Add to cart” link.

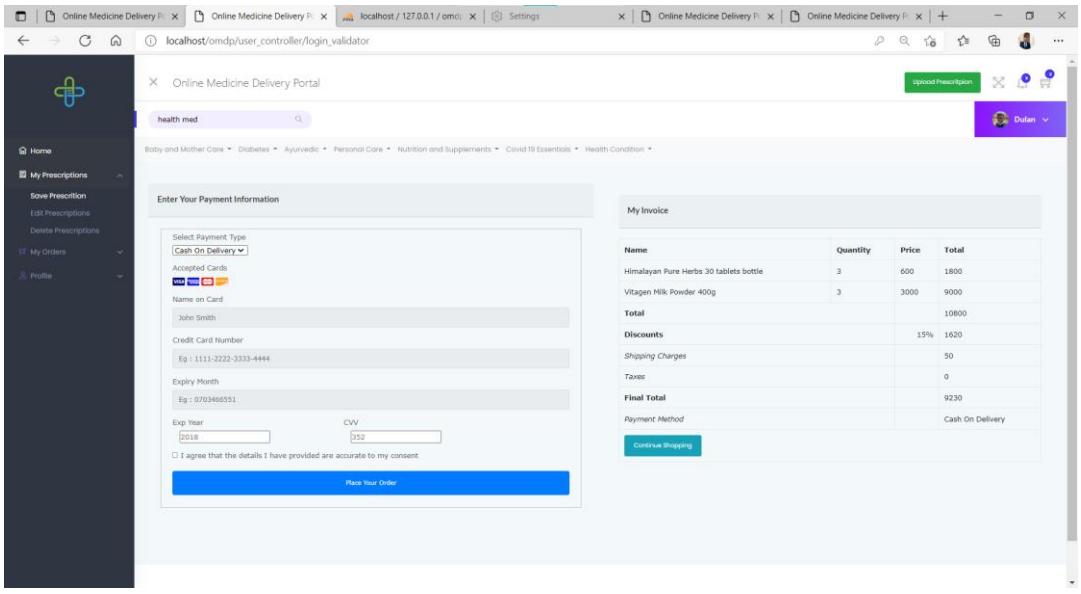
The shopping cart is provided to the user in each login session to add or remove items when shopping. The diagram below shows a non-empty shopping cart.



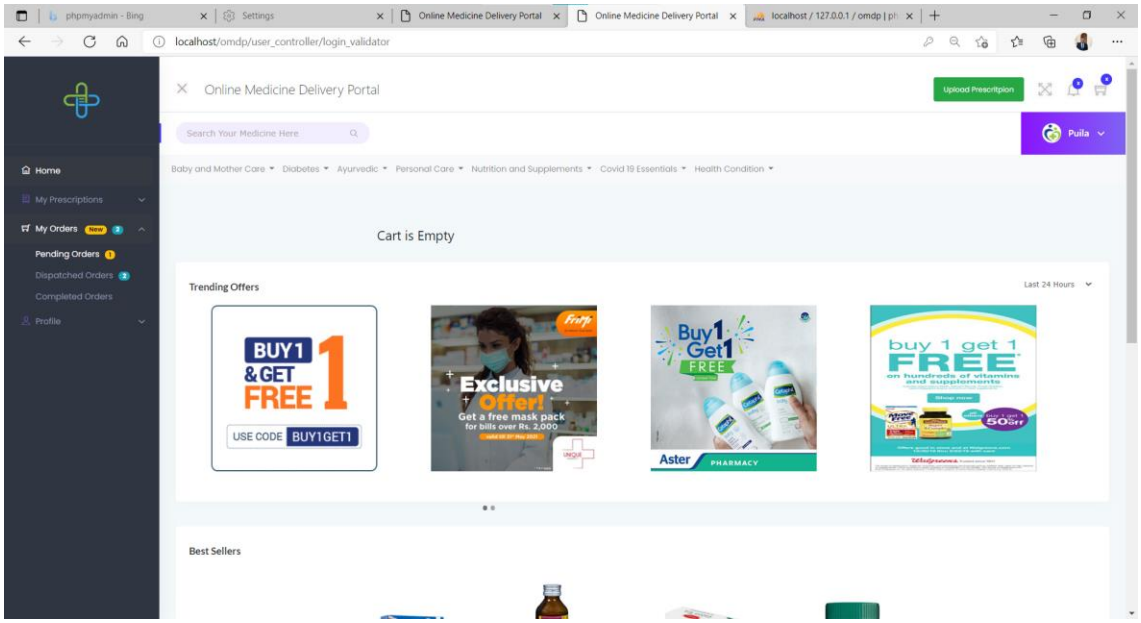
The user once finished shopping will be directed to the checkout page, to submit the delivery details. The below figure shows the Billing Details Page.



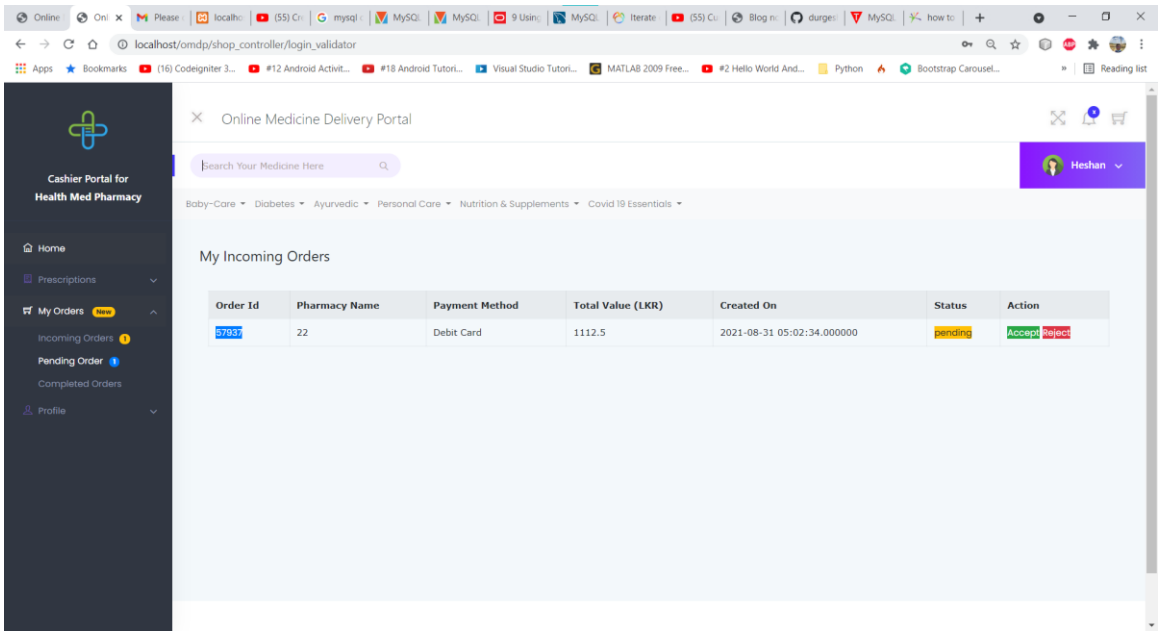
The Page prior to completing the order is the Payment Details Page. The figure below shows the Payment Detail Page.



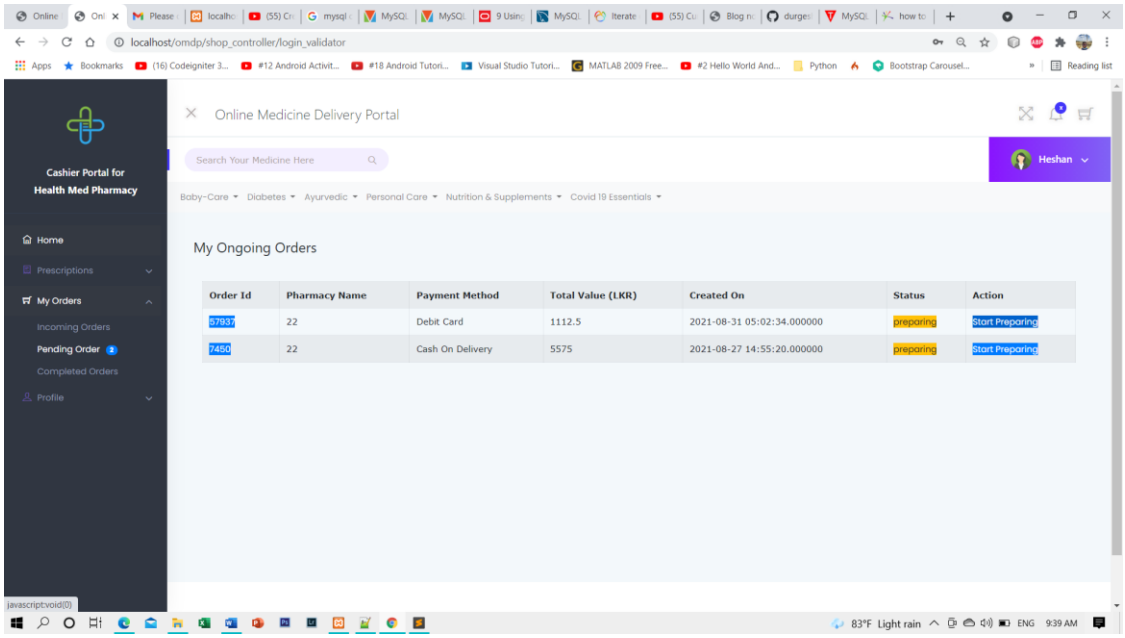
The user is able to enter the payment method details before confirming on placing the order. The figure below shows how notifications and updates are provided to Customer and Pharmacist.



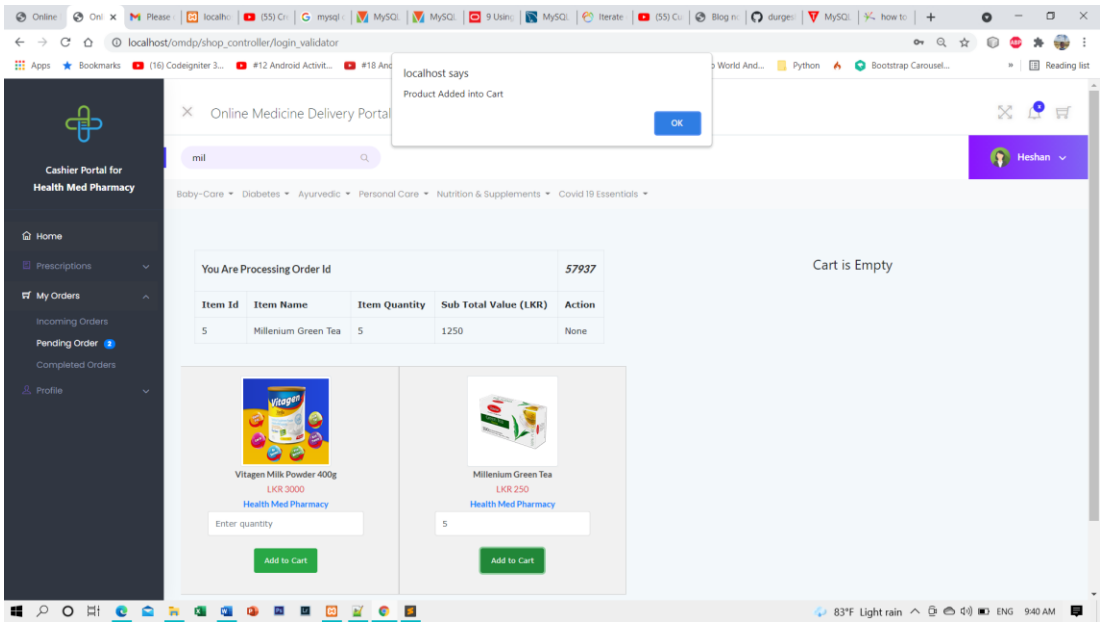
The figure below shows the Home page of a Pharmacist with order updates received. The figure below shows user prescription form for saving a prescription in the system.

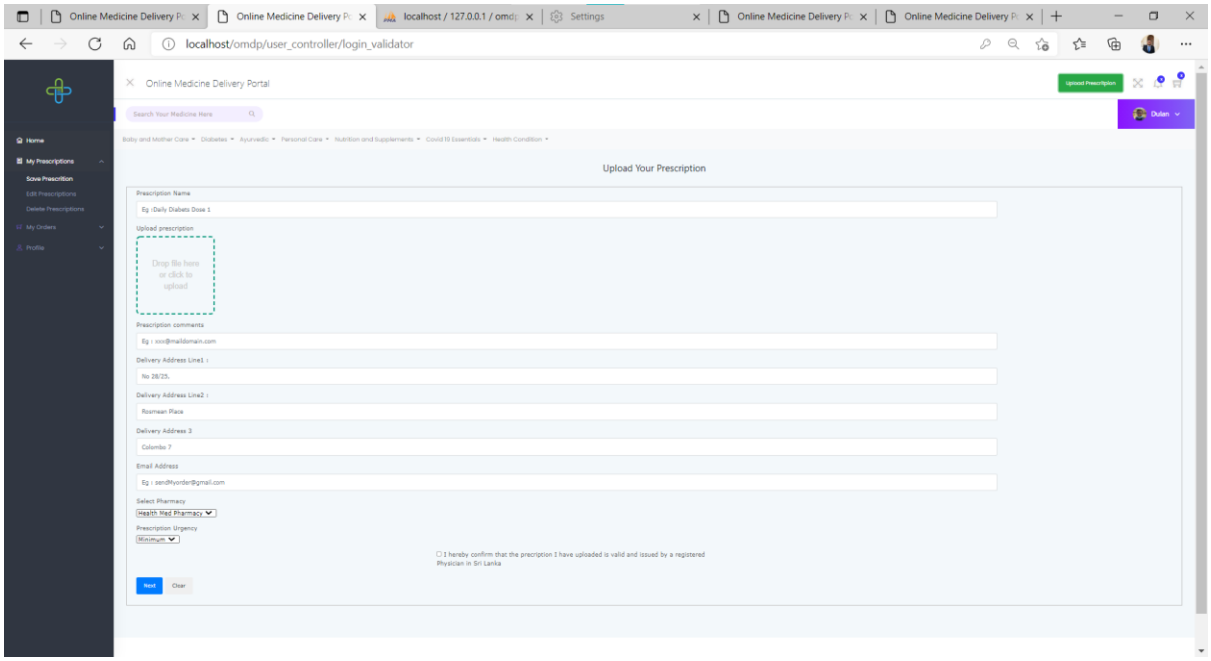


The figure below shows the order tray provided to Pharmacist when preparing the order.



A shopping cart is also provided to the Pharmacist to assist order processing.





For the Users who are not registered in the OMDP, upon clicking on the “Sign Up” button in the figure 1, will be redirected to the Customer Registration Page.

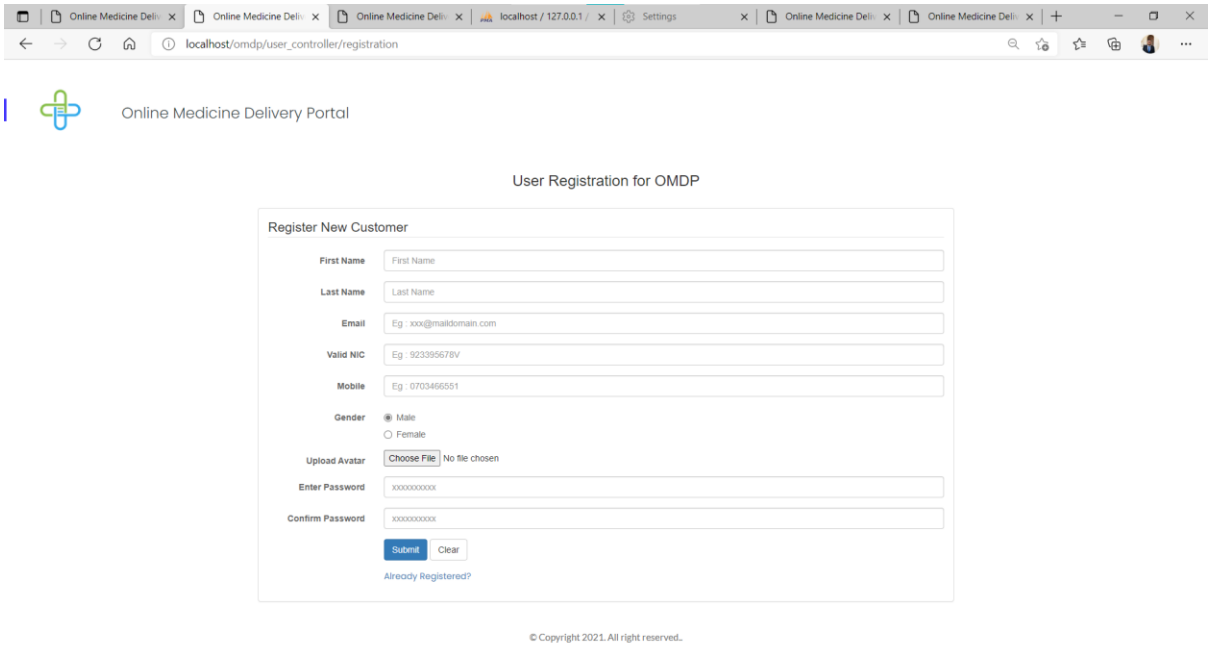


Figure 3.6-4 Customer Registration Page

Staff members should be able to Capture incoming orders, add items or remove items to current order and view inventory.

The pharmacy manager view is provided with a comprehensive management dashboard and a MIS reporting view. The figure given below shows the Management dashboard used by pharmacy manager users.

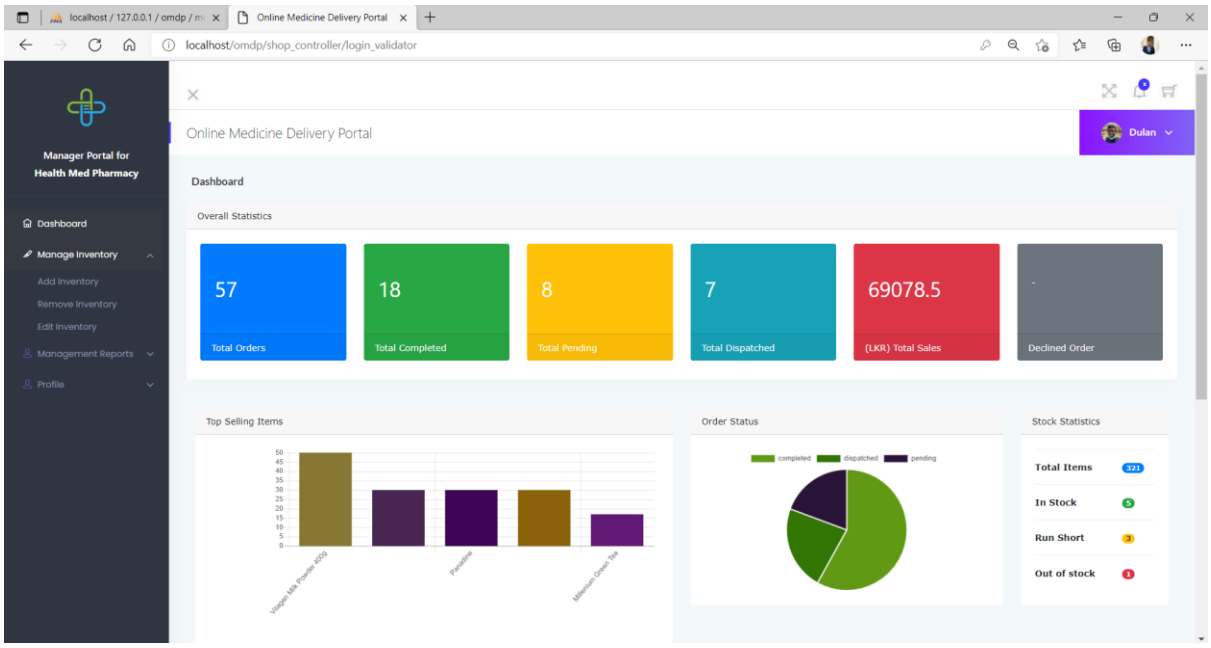


Figure 3.6-5 Management Dashboard - Pharmacy Manager

All the components are subject to refresh every 5 seconds and fetch updated data for the managers. The managers are also provided with an interface for MIS reports and printing such generated reports. The figure below show a sample MIS reporting interface provided to the pharmacy manager.

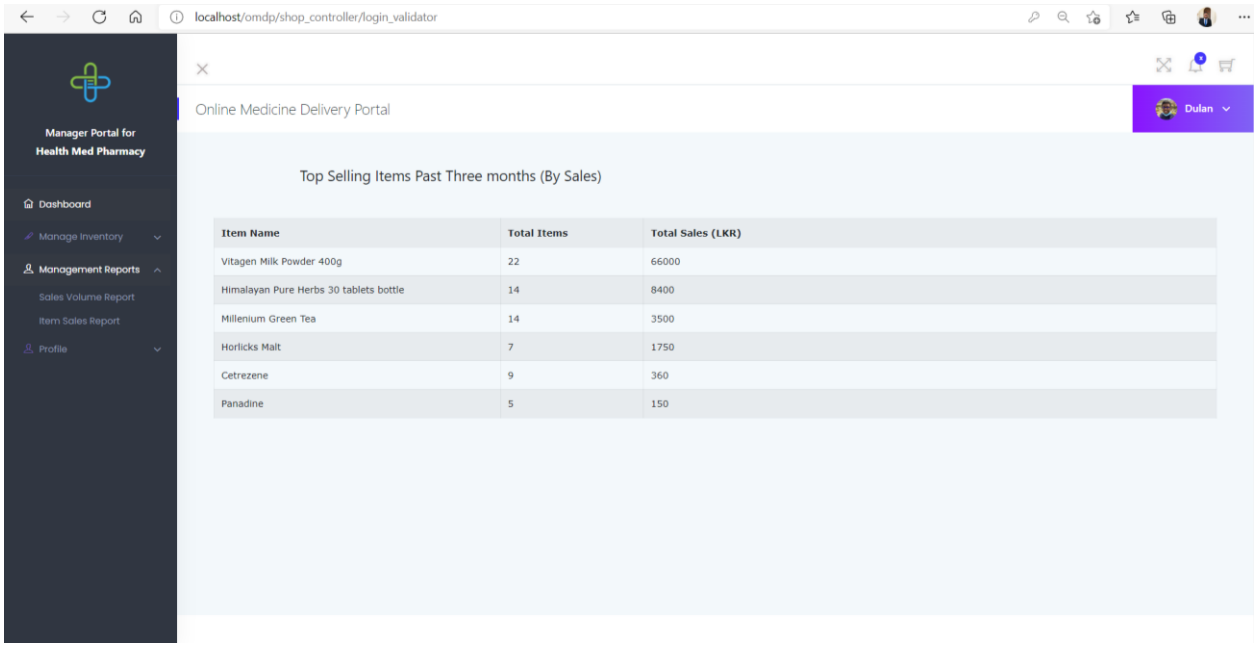


Figure 3.6-6 Sample MIS report for Managers

4 Implementation

In this phase system development is initiated based on the design specification which was developed in the stage “5.2 System Design Phase”. Individual components(units) identified in above phase are developed and tested individually for each functionality specified for it.

4.1 Server-side implementation

This sub chapter explains how the server environment (same as the development environment) in configured. The development environment XAMP is used to create the Apache server instance and MYSQL database instance. Instead of using plain PHP as the development language alone, the CodeIgniter framework was used in conjunction, to receive the benefit of rich development libraries.

The folder structure which contains the development files is shown in the below diagram.

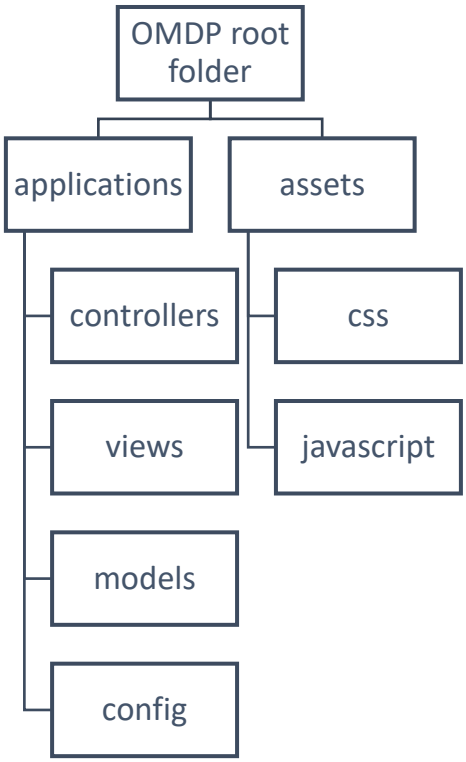


Figure 4.1-1 folder structure of OMDP web-application

All the php code related to controllers, view and models are placed in the respective folders. The assets folder contains all the CSS, JavaScript files necessary for developing the system. The application services and database services can be started from the XAMP console as shown in the image below.

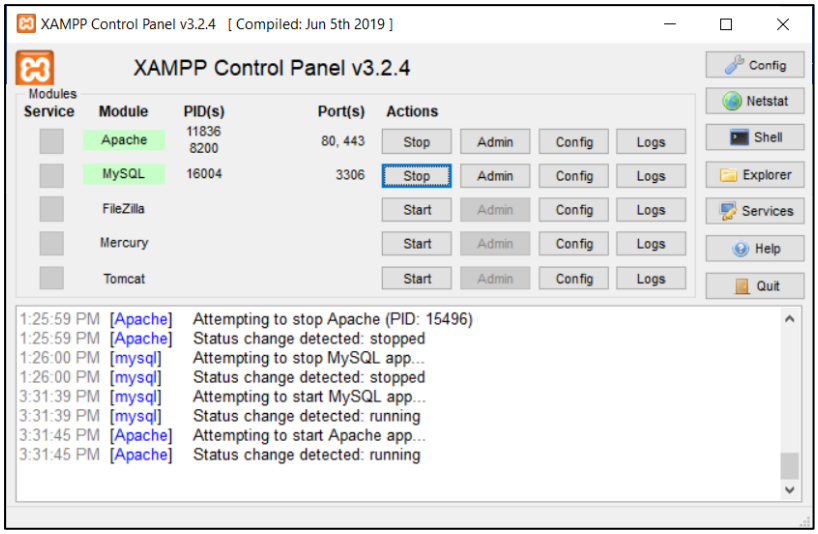


Figure 4.1-2 XAMP control panel

The config folder contains all the critical configuration of the system. Functions of important file are listed below.

- ✓ **"database.php"** file stores the database connection credentials for the system. The connection credentials in the above file are used my SQL statements in models when connecting to the database.
- ✓ **"Config.php"** file contains all the configuration of the application server.
- ✓ **"autoload.php"** contains the libraries that should be automatically loaded on start of the application. Frequently used libraries are declared in this file.
- ✓ **Routes.php** "Contains the configuration of the default controller application uses when calling index.php

The base URL expected to be used throughout the system, is defined in the config.php as show in the figure below.

```
$config['base_url'] = 'http://localhost/omdp/';
```

Figure 4.1-3 Base URL for OMDP

The following libraries and helper classes are defined in the autoload.php file so that the libraries are not needed to be called on each function written in the controllers.

```
$autoload['model'] = array();
$autoload['libraries'] = array('database','session','form_validation','upload','cart');
$autoload['helper'] = array('url','form','file');
```

Figure 4.1-4 libraries and helper functions

As mentioned in the Design chapter, the system is built according to the MVC architecture. For effectiveness of implementation, all business functions are categorized as User, Admin, Shop and Order functionalities. User functionalities consists of all the functions a and subfunctions performed by the Customer who is using the system. For example, login to the system, logout of the system, user registration, user validation and authorization etc.

The database connection credentials are defined in the database.php of the OMDP project. This connection string is used throughout the applications when making database connections.

```
$db['default'] = array(
        'dsn'   => '',
        'hostname' => 'localhost',
        'username' => 'root',
        'password' => '',
        'database' => 'omdp',
        'dbdriver' => 'mysqli',
        'dbprefix' => '',
        'pconnect' => FALSE,
        'db_debug' => (ENVIRONMENT !== 'production'),
        'cache_on' => FALSE,
        'cachedir' => '',
        'char_set' => 'utf8',
        'dbcollat' => 'utf8_general_ci',
        'swap_pre' => '',
        'encrypt' => FALSE,
        'compress' => FALSE,
        'stricton' => FALSE,
        'failover' => array(),
        'save_queries' => TRUE
);
```

Figure 4.1-5 database connection string

With the completion of the above steps, the initial server and database configuration is completed.

The system mainly consists of four controllers namely,

1. User Controller.
2. Admin Controller.
3. Shop Controller.
4. Order Controller.

4.2 User login and logout

All the system users belonging to all categories are recorded in the ‘users’ table. The DDL of the users table is shown below.

```
CREATE TABLE `users` (
  `userId` int(15) NOT NULL,
  `userEmail` varchar(40) NOT NULL,
  `userMobile` varchar(15) NOT NULL,
  `userNIC` varchar(10) NOT NULL,
  `fName` varchar(60) NOT NULL,
  `lName` varchar(60) NOT NULL,
  `gender` varchar(15) NOT NULL,
  `password` varchar(60) NOT NULL,
  `userType` varchar(15) NOT NULL DEFAULT 'customer',
  `user_pharmId` int(15) DEFAULT NULL,
  `isBlocked` varchar(2) NOT NULL DEFAULT 'N',
  `isDeleted` varchar(2) NOT NULL DEFAULT 'N',
  `lastLoginDate` date DEFAULT NULL,
  `profile` varchar(255) NOT NULL
) ENGINE=InnoDB DEFAULT CHARSET=utf8mb4;
```

Figure 4.2-1 DDL for user table

To track user login and logout activity, a separate table “login_session” is created. The item below shows the DDL of the user login table.

```
CREATE TABLE `login_session` (
  `userId` int(15) NOT NULL,
  `sessionId` varchar(20) NOT NULL,
  `loginTime` datetime NOT NULL,
  `status` varchar(30) NOT NULL,
  `logoutTime` datetime NOT NULL
) ENGINE=InnoDB DEFAULT CHARSET=utf8mb4;
```

Figure 4.2-2 login session table DDL

All the user passwords are stored as has value of passwords in the ‘password’ column and when the user is trying to login, the has value of the input passwords is compared with the password in the user table.

After the username and password are validated against the users table, the login session with a unique session id is created by the system. The system records the login time for the specific user session. When the user logout of the specific session, the logout time is recorded and the status of the session id is updated to logout. The code block for user validation is shown below.

```
// login user
public function login_validator(){
   // $this->load->view('user_login');
  $this->form_validation->set_rules('email','Email','required|valid_email');
  $this->form_validation->set_rules('password','password','required');

  if($this->form_validation->run()){
   $email=$this->input->post('email');
   $encrypted_password=md5($this->input->post('password'));
   $this->load->model('user_model');
   if ($this->user_model->can_login($email,$encrypted_password)) {
    $username=$this->user_model->getFName($email);
    $userId=$this->user_model->getUid($email);
    $profile=$this->user_model->getProPic($email);
    $sessionId=rand(10,100000);
    $loginTime=  date('Y-m-d H:i:s');
       // $loginTime='now()';
    $login_data = array('userId' =>$userId,
     'sessionId' =>$sessionId,
     'status' => "Active",
     'loginTime' =>  $loginTime
    );

    if ($this->user_model->createSession($login_data)) {
        # code...
     $data['username'] = $username;
     $data['sessionId']= $sessionId;
     $data['userId']= $userId;
     $data['profile']= $profile;
     $this->load->view('customer_home',$data);
    }else{
     $this->session->set_flashdata('msg','Cannot create session!');
     return redirect('user_controller/login');
    }
       // echo 'Welcome to omdp '. $uname;
   }else{
    $this->session->set_flashdata('msg','Invalid Email or Password!');
    return redirect('user_controller/login');
   }
 }
 else{
  $this->load->view('user_login');
 }
}
```

Figure 4.2-3 Code block for user validations

After validation of the user, all the valid session data required for the user are passed to the customer home view. The process flow of user login and logout is shown in the sequence diagram below.

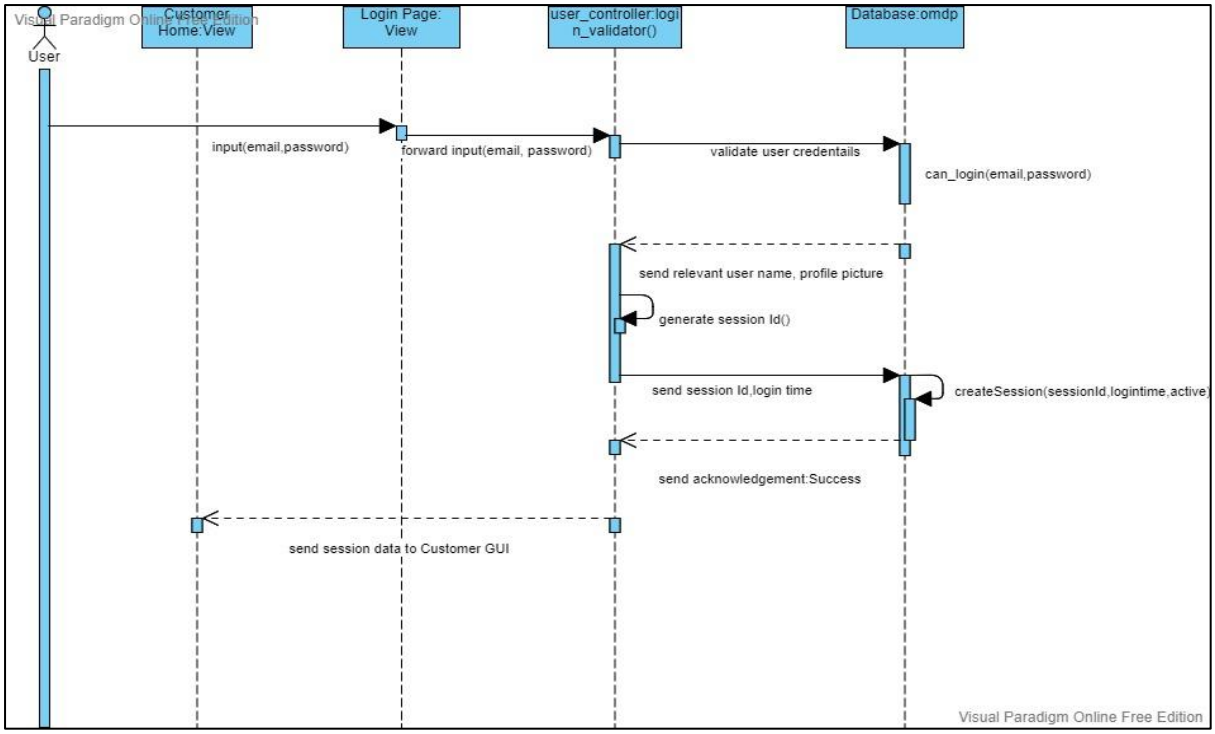


Figure 4.2-4 Sequence diagram for user login

In every action performed by the user, ajax requests are used in conjunction of jQuery to dynamically refresh only specific part of the home page while remaining the components as static. The relevant code block will be discussed in the later chapters.

When the user logout the same entry is updated with the logout time and status logout. This is implemented as the user activity auditing mechanism in the OMDP system. The below function is used in the user controller to implement the logout functionality.

```
// Update Login_session table
public function logout()
{
 $this->load->model('user_model');
 $sessionId=$this->uri->segment(3);
 $userId=$this->uri->segment(4);
 $logoutTime= date('Y-m-d H:i:s');
 if($this->user_model->completeLogOut($sessionId,$userId,$logoutTime)){
  $this->session->set_flashdata('msg','Sucessfully Logged Out of OMDP!');
  $this->load->library("cart");
  $this->cart->destroy();
  return redirect('user_controller/login');
}else
{
  echo "Failed to Logout!";
}
}
```

Figure 4.2-5 Code block for user logout

According to the above code block, after user logout is completed, any remaining items in the shopping cart is destroyed before leaving the page. The main reason is that the shopping cart created for the user session is persistent in the browser cache, and is not destroyed automatically during logout. The routing of data from a user interface to business logic and back is performed by the user controller. In this scenario data is passed as URL segments when calling code igniter functions in the user controller.

4.3 Implementation of Universal search functionality

The customer is provided with a functionality to search medicine items based on any keyword attribute of the medicine item. This is implemented so that results are returned dynamically as user types in keyword or parts of the keyword. The key technologies behind achieving this functionality are jQuery and ajax calls. The below function is responsible in obtaining the text input in the search t bar and sending to the relevant user controller to fetch data.

```
function load_data(query)
{
  $.ajax({
    // url:"<?php echo base_url(); ?>user_controller/fetch_med",
    url:"<?php echo base_url(); ?>user_controller/fetch_new_items",
    method:"POST",
    data:{query:query},
    success:function(data){
      $('#main_content_inner').html(data);
    }
  })
}
```

Figure 4.3-1 JQuery function to fetch data from Search

To return results dynamically the above function has to called dynamically on each key stroke in the search bar. This dynamic feature is implemented via the following jQuery code block.

```
// return search results dynamically
$('#search_text').keyup(function(){
  var search = $(this).val();
  if(search != '')
  {
   load_data(search);
  }
  else
  {
   $('#main_content_inner').load('<?php echo base_url();
?>user_controller/main_inner_content_cust')
  }
});
```

Figure 4.3-2 Dynamically call function to load data

As per the above code block, the load function is executed if the search input value entered by customer is not null. The database query which retrieves the data according to the user input is shown below. All the above jQuery code are implemented in the customer home page.

```
function fetch_live_data($query)
{
	$this->db->select('m.*,p.pharm_name,p.pharm_id');
	$this->db->from('medicine_items as m');
	$this->db->join('pharmacy as p', 'm.med_pharmacy_id=p.pharm_id');
			if($query != '')
			{
				$this->db->like('m.med_item_name', $query);
				$this->db->or_like('m.med_item_type', $query);
				$this->db->or_like('m.med_item_brand', $query);
				$this->db->or_like('m.med_item_image', $query);
				$this->db->or_like('m.med_comments', $query);
				$this->db->or_like('p.pharm_name', $query);

			}
			$this->db->order_by('m.med_item_id', 'DESC');
			return $this->db->get();
		}
```

Figure 4.3-3 Database query to retrieve data for search function

As per the above function, the query is prepared so that it returns results based on any keyword. The steps mentioned under this section are used to implement dynamic search in every module of the OMDP.

4.4 Implementation of Shopping Cart feature

The shopping cart is a critical feature of the system used by both Customer and Pharmacists. The shopping cart is designed to assist online purchase of items. All the data in the cart is held at browser level as cache data. Code igniter has an inbuilt library known as "cart" which enables developers to implement a shopping cart with less code. The figure below shows a shopping cart of a customer.

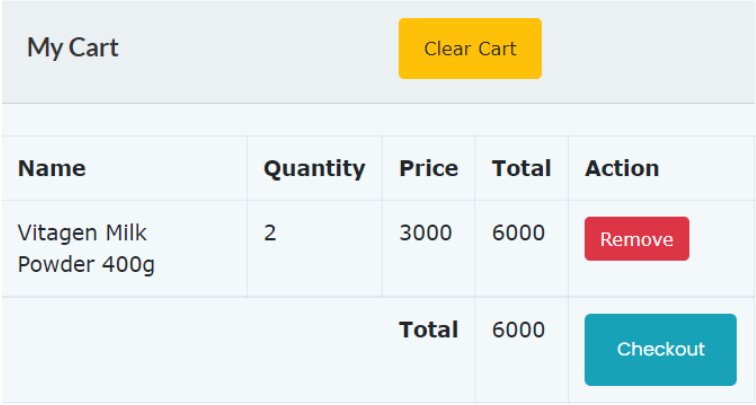


Figure 4.4-1 Customer Shopping Cart

The functionalities of the shopping cart are self-explanatory as in the figure above. Initially the 'cart' library should be called as shown in the line of code.

```
$this->load->library("cart");
```

Figure 4.4-2 Import Cart Library

Items in a shopping cart could be iterated with the help of a simple code block containing a for loop as shown below.

```
foreach($this->cart->contents() as $items)
    {
    $count++;
    $output .= '
    <tr>
    <td>'.$items["name"].'</td>
    <td>'.$items["qty"].'</td>
    <td>'.$items["price"].'</td>
    <td>'.$items["subtotal"].'</td>
    <td id="'.$items["options"]["pharm_id"].'"><button type="button" name="remove"
class="btn btn-danger btn-xs remove_inventory"
id="'.$items["rowid"].'">Remove</button></td>
    </tr>
    ';
```

Figure 4.4-3 Iterate through items in a code igniter shopping cart object

To remove an item from the cart, the below function is called when using clicks on the "remove" link in the shopping cart.

```
public function remove_cart_item()
 {
  $this->load->library("cart");
  $row_id = $_POST["row_id"];
  $data = array(
   'rowid'  => $row_id,
   'qty'  => 0
 );
  $this->cart->update($data);
  echo $this->view_cart();
}
```

Figure 4.4-4 Code Block ; remove item from the shopping cart

To clear cart, the below line of code is executed when "Clear Cart" link is clicked and during user logout of the system.

```
$this->cart->destroy();
```

Figure 4.4-5 clear shopping cart

This line of code discards all information in the current shopping cart. This can be identified as the only object-oriented approach in the implementation of the system.

4.5 Implementation of Prescription and other image uploads

The system offers a functionality to upload and save prescriptions in the system. User is also able to directly upload prescriptions to the selected pharmacies via an html form. This is implemented via a custom constructed function made with the 'upload' library in code igniter. The code block for the upload function is shown below.

```
public function uploadPic($profile){
  // $config['upload_path']        = base_url('uploads/');
        $config['upload_path']        = './uploads/';
        $config['allowed_types']      = 'gif|jpg|png|jppeg|pdf|jpeg';
        $config['max_size']          = 1000;
        $config['max_width']          = 1000;
        $config['max_height']         = 1000;

        $this->load->library('upload', $config);
        $this->upload->initialize($config);

        if ($this->upload->do_upload($profile))
        {
          $info=$this->upload->data();
          $path=base_url("uploads/".$info['file_name']);
        }
        else
        {
   // $path=base_url('uploads/null.jpg');
          $path = $this->upload->display_errors();

        }
        return $path;
       }
```

Figure 4.5-1 Image Uploader Function

The system is able accept any format of images, specified in the "allowed_types" parameter in the above function up to maximum resolution of 1000 pixels in height and width. Request is sent to the above function via the html form submit. It will upload the image to the server's upload location and return the path of the uploaded file as a string. This path will be stored in the database via the insert function shown in code block below.

```
        // add prescription
                public function add_prescription($data){
                        return $this->db->insert('prescription',$data);
                }
```

Figure 4.5-2 add prescription information to table

This method is implemented, due to the convenience in retrieving and storing image data from and to the database. Rather than storing raw image file in database, the above strategy prove to be effective in terms of performance and response time.

4.6 Implementation of in-app notifications and Email Notifications.

The application provides indicators in customer and pharmacist home page whenever the status of an order is updated as shown in the figure below.

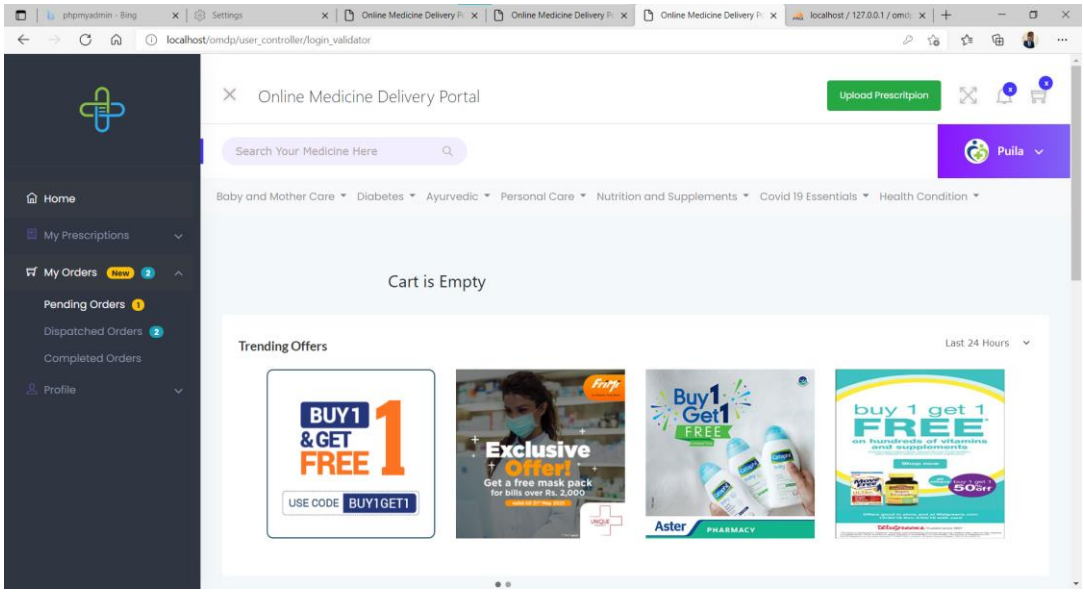


Figure 4.6-1 In app notifications

As shown in the above figure, pending prescriptions or orders are displayed in the side menu elements and indicated as in the figure above. The customer receives email notifications from the point of placing the order to completing the order after delivering the order. The process flow of placing an order will be discussed in the following sub chapter. The following jQuery function is implemented in each user home page to display and indicate order updates as shown in the figure above.

```
  function notifCations(){
// get new orders count
      $.ajax({
        url:"<?php echo base_url(); ?>order_controller/get_current_count_pharm/<?php echo $pharm_id; ?>",
        method:"POST",
        // data:totalReg,
        data:$(this).serialize(),
        success:function(data){
          if(data > 0){

            $('#order_notif').text('New');
            // console.log(data);}
            $('#order_count').text(data);
        }
        else{
          $('#order_notif').text('');
            // console.log(data);}
            $('#order_count').text('');
        }
       }
      });

        // get ongoing orders
      $.ajax({
        url:"<?php echo base_url(); ?>order_controller/get_ongoing_count_pharm/<?php echo $pharm_id; ?>",
        method:"POST",
        // data:totalReg,
        data:$(this).serialize(),
        success:function(data){
          if(data > 0){

            // $('#order_notif').text('New');
            // console.log(data);}
            $('#ongoing_count').text(data);

        }
        else{
          // $('#order_notif').text('');
            // console.log(data);}
            $('#ongoing_count').text('');
        }
       }
      });
   }
```

Figure 4.6-2 Code Block for receiving updates

This function is executed every 5 seconds with the help of a jQuery timer function to send near real time updates to home.

The time interval of 5 seconds is set to have optimum performance, to prevent from the system exhausting resources on the client machine.

Apart from the in-app notification, the system is capable of sending updates regarding orders they have placed via email alerts. The below function, used with the help of 'email' library in CodeIgniter, is used to send emails to users.

```
// email function
public function sendEmail($recepient_email,$subject,$message){

 $config['protocol']    = 'smtp';
 $config['smtp_host']    = 'ssl://smtp.googlemail.com';
 $config['smtp_port']    = '465';
 $config['smtp_timeout'] = '7';
 $config['smtp_user']    = 'dulan.dam@gmail.com';
 $config['smtp_pass']    = '92.12.04';
 $config['charset']    = 'utf-8';
 $config['newline']    = "\r\n";
  $config['mailtype'] = 'html'; // or html
  $config['validation'] = TRUE; // bool whether to validate email or not

  $this->load->library('email', $config);
  $this->email->set_newline("\r\n");
  $this->email->from('dulan.dam@gmail.com');
  // $this->email->to($this->input->post('user_email'));
  // $this->email->to($recepient_email);
  $this->email->to($recepient_email);
  $this->email->subject($subject);
  $this->email->message($message);
  $this->email->send();
  // if($this->email->send())
 }
```

Figure 4.6-3 Code block for send email function

The email account defined in the from clause, will act as the sender account. In the case of this implementation, a Gmail account credentials are setup for this purpose. Prior to setting up the Gmail account, default security parameter should be disabled from the Gmail account to enable receiving requests from less secure apps.

4.7 Implementation of over-the-counter order process flow.

The OMDP implements an order process flow so that the customer receives notifications and email alerts on every update made to the order. Due to practical reasons, order items could be placed from one pharmacy. Placing order item from multiple pharmacies is not implemented. In simple layman terms, when the order is submitted to the pharmacy, it will be left in queue before the order is accepted by a logged in pharmacist. Once order is accepted by a pharmacist, the customer will receive and email update an email alert and at the same time will be displayed in the side menu of the user home. When the user.

After accepting only, the pharmacist can start processing the order. Once the order is finished processing, the pharmacist is able to dispatch the order for delivery.

Before placing the order, the customer will provide delivery and payment details. Once the information is provided, the total bill is calculated instantly and shown to the customer before placing the order.

The below jQuery function is provided to calculate the total bill.

```
function calc_bill(){
  var item_total = "<?php echo $this->cart->total(); ?>";
  // console.log(item_total);
  var delivery_charge=$("#invoice_table span.delivery_charge").text();
  var discount_price=parseFloat(item_total)*(0.15);
  // console.log(discount_price);

  // discount_charge
  // $('#delivery_charge').html(discount_price);
  //
  var delivery_charge=$("#invoice_table span.delivery_charge").text();
  $('#discount_charge').html(discount_price);
  // $('#setDelviery').html(delivery_charge);

  var final_total_bill=parseFloat(item_total) + parseFloat(delivery_charge) -
parseFloat(discount_price);

  // grant_total_charge
  $('#grant_total_charge').html(final_total_bill);

  return parseFloat(final_total_bill);
}
```

Figure 4.7-1 Calculate total bill

The diagram below shows the process flow of an order processing when buying over the counter items. A sample calculated bill is shown in the below figure.

My Invoice

Item	Quantity	Price	Total
Nan Opti Pro 400g Bottle	3	500	1500
Himalayan Cystone Tablets 100 tablets	2	650	1300
Total			2800
Discounts		15%	420
Shipping Charges			50
Taxes			0
Final Total			2430
Payment Method			Cash On Delivery

Continue Shopping

Figure 4.7-2 Sample Invoice Bill

The customer is able view the bill and arrive into the decision to whether to place the order to discard the order. If the customer wishes to proceed with the order, they can confirm the order and submit the order to the pharmacy.

A pharmacist can accept a pending order in the order queue. The order is only received by the relevant pharmacy only. A simple CodeIgniter function is used to model this scenario. When the pharmacist accept the order, the status of the order is changed accordingly and an email is sent to the customer email address registered with the order.

The function uniquely identifies the order with an order Id number and the relevant pharmacy id. This pharmacy id helps to associate each order with relevant pharmacy.

When the customer submits the order the above function “calc_bill()” calculates the final bill and updates the total invoice value, discount value of the order and submit to the pharmacy.

The item below shows the accept order function called when the pharmacist accepts the order.

The below function sets the status of the order to ‘preparing’ and sends an email update to email id relevant to the order.

```
// accept order by cashier
  public function AcceptOrder(){

    $orderId=$this->uri->segment(3);
    $order_pharm_id=$this->uri->segment(4);
       // $order_payment_method=$this->input->post('order_payment_method');
       // $order_final_bill=$this->input->post('order_final_bill');
    $order_status='preparing';
    $order_timesatmp= date('Y-m-d H:i:s');
    $this->load->model('order_model');


    if($this->order_model->updateOrderStatus($orderId,$order_status,$order_timesatmp)){
     $this->session->set_flashdata('msg','Your have accepted this order! Click the below link to start preparing the order');
           // send Email
     $recepient_email=$this->order_model->getOrderAll($orderId)->order_email;
     $recepient_name=$this->order_model->getOrderAll($orderId)->customer_fname;
     $order_pharm_name=$this->order_model->getPharmAll($order_pharm_id)->pharm_name;
        // send Email
     $this-
>sendOrderUpdateEmail($recepient_email,$recepient_name,$orderId,$order_pharm_name,$order_timesatmp,$order_status
);
           // destroy shopping cart
        // $this->load->library("cart");
        // $this->cart->destroy();

    }else
    {
     $this->session->set_flashdata('msg','Failed to Accept order');
    }
    return redirect('order_controller/get_current_order_pharm/'.$order_pharm_id);
  }
```

Figure 4.7-3 Accept order function

After accepting the order, the pharmacist is able to start preparing the order. The order tray utility is implemented for the pharmacist to assist prepare and process an accepted order. When the "start preparing" links clicked by pharmacist, the current list of order items will be displayed in the order tray. A function is used to retrieve the order fetched by the pharmacist to the order tray. The query used to fetch the order items is shown below.

```
// fetch_ongoing_order_pharm
        public function fetch_ongoing_order_pharm($pharm_id){
                $this->db->select("*");
                $this->db->from("orders");
                $data = array('order_pharm_id' => $pharm_id,
                        'order_status' => 'preparing');
                $this->db->where($data);
                $this->db->order_by('order_timesatmp', 'DESC');

                return $this->db->get();

        }
```

The data resulted from the above function is used to populate the current item set of the order tray. An email alert will also be triggered when the order is accepted and dispatched. A sample email alert will be attached in the appendix.

4.8 Implementation of Management Dashboard

The Management Dashboard, as shown in the figure below, was implemented using Chart.js library available in JavaScript. The data that is required for specific charts are fetched using code igniter functions which execute queries against the transaction data in the system. Ajax functions are used to call the above-mentioned functions and the fetched data is populated to the charts using jQuery. The code segment below shows the CodeIgniter function used to fetch top selling items.

```
// get top sold items
public function getBarChartItems(){
  $this->load->model('admin_model');
  $pharm_id=$this->input->post('pharm_id');
  $query= $this->admin_model->getBarChartItems($pharm_id);

  $data = array();

  foreach($query->result() as $row)
  {
    $data[] = array(
      'item_name'    =>  $row->item_name,
      'total'     =>     $row->total,
      'color'     =>  '#' . rand(100000, 999999) . ''
    );
  }
     // echo json_encode($query->result());

  echo json_encode($data);
```

Figure 4.8-1 Code Igniter function Fetch top selling items

The below segments of the codes are used to call the above function and populate the fetched data in the relevant chart data.

```
var pharm_id="<?php echo $pharm_id; ?>";
      $.ajax({
        url:"<?php echo base_url(); ?>admin_controller/getBarChartItems",
        method:"POST",
        data:{pharm_id:pharm_id},
        dataType:"JSON",
        success:function(data){
          var item_name = [];
          var total = [];
          var color = [];

          for(var count = 0; count < data.length; count++)
          {
            item_name.push(data[count].item_name);
            total.push(data[count].total);
            color.push(data[count].color);
          }

          var chart_data = {
            labels:item_name,
            datasets:[
            {
              label:'Number of Items',
              backgroundColor:color,
              color:'#fff',
              data:total
            }
            ]
          };
```

Figure 4.8-2 Ajax call to get top seller items

The above call is made every 5 seconds using a jQuery timer function, to populate data in the dashboard every 5 seconds. Hence it is not required to manually refresh the browser. The figure below shows the Management dashboard for the pharmacy manager.

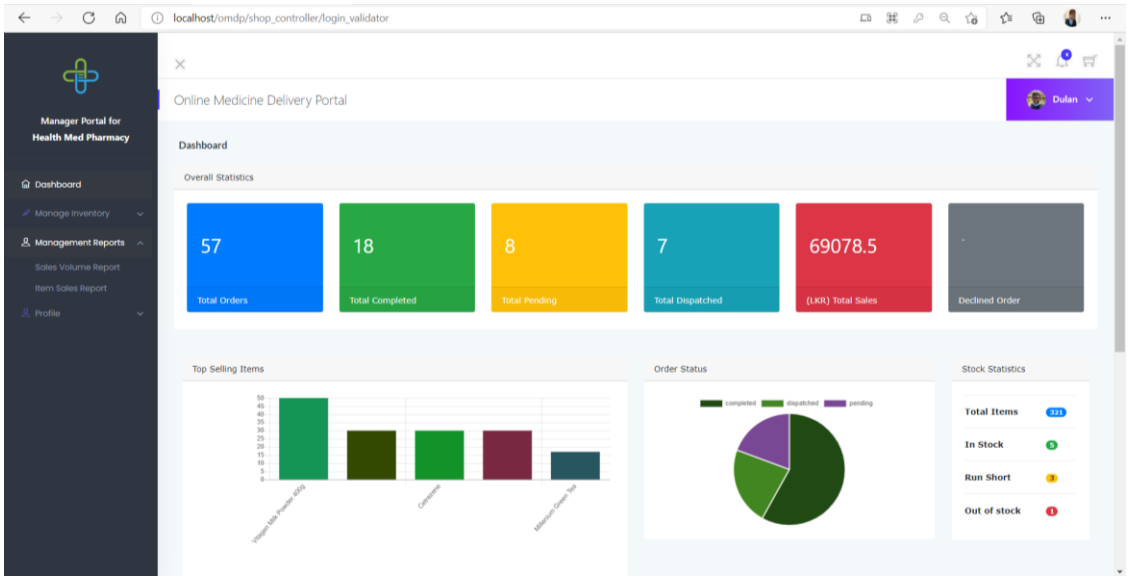


Figure 4.8-3 Management Dashboard for Pharmacy Manager

5 Testing and Evaluation

This section describes the testing an evaluation of various quality aspects of the OMDP system. Testing can be identified as the procedure of determining whether the system is functioning as expected in the initial staged of the study.

5.1 Test Plan

The OMDP system embraces many test strategies at various levels. Although the OMDP is designed, developed and implemented in single PC, when the system is deployed for production multiple users will attempt use the system concurrently. Hence, determining the level of data consistency and functional accuracy of the system is important when dealing with a larger number of concurrent users.

The study is taking every possible scenario of interaction into consideration, to make sure OMDP behaving in the expected way.

The test strategies employed for testing OMDP are listed below.

1. Database and Data Integrity testing.
2. Function testing.
3. User Interface testing.
4. Performance profiling.
5. Load Testing.

At this point, the system has completed implementing all the use cases. The study determines the following factors as motivation for performing software testing.

- Identifying and fixing errors and bugs in the system.
- Identifying major issues and evaluate perceived quality risks.
- Verifying requirement specification.
- Evaluating and confirming the use case realizations.

The test plan is expected to cover user interface, php functions, jQuery functions and MYSQL database.

5.2 Testing Approach

Based on the nature of the system and the functionalities catered by the system, the following testing techniques were used. The test plan and test cases are derived based in the below software testing methods.

5.2.1 Database and Data Integrity testing

The database components are subjected to test as individual subsystems. The test is carried out without using user interface components.

The OMDP can be identified as a system which involves high number of database transactions. Hence it is important to maintain consistency and integrity even when a high volume of users is using the system. Following test procedure is suggested for database testing.

Objective of technique	Testing and evaluate database functions and php functions accessing database to observer incorrect functioning or data corruptions. Php functions refer to functions which access database directly.
Testing process	Call each database functions and php functions by providing valid, invalid and out of bound requests as data. Retrieve the data and investigate whether correct data has been populated as expected. Review data returned by select functions, to ensure that logically correct data is provided to the database.
Fundamentals	Unit Testing is followed to test the database components. In this approach, for each individual function several test cases are written and executed. The resulting data are tested using assertions, whether expected outcome is retuned. Each function is tested with • Valid inputs, • Invalid inputs • Errors and exceptions Since the unit testing is fully automated, it is possible to have a series of test cases sequentially.
Required tools	Test automation tool phpUnit, is integrated with an IDE to view the output sequentially. MYSQL Database Php myadmin console

Success criteria	The testing method supports testing of all key database functions and php access functions. If all test methods return 'Pass', it can be concluded that the above access methods are performing properly.

Table 5.2.1-1 Test Plan for Database and data integrity testing

5.2.2 Function Testing

The OMDP contains use cases which are targeted to 4 main user types. Therefore, it is necessary to confirm that the use cases are implemented as intended by the study of OMDP. This test is performed on functional requirements which can be directly traced to use cases and key business functions of the OMDP. The objectives of function testing are to verify proper process flow of business data and implementation of business logic. This type of testing follows a Black Box testing technique. Because it includes testing of business functionality via the user interface without investigating the internal processes of the system. These results are analysed to determine desired output is received. The following table shows the test plan outline.

Objective of technique	Perform validations, component navigations, data input and data retrieval to perform errors logged by the system when actions are performed
Testing process	Execute each use-case scenario's individual use-case flows or functions and features, using valid and invalid data, to verify that: • The expected results occur when valid data is input to the system The relevant error or warning messages are displayed when • Invalid data is used • Every single business rule is properly applied • In case of erroneous operations, the database remains in a consistent state.
Fundamentals	Using the user interface testing features provided by SELENUIM IDE, it's possible to define the expected inputs to the system, expected processing time and expected outputs. Then these test cases may be executed each time the system is modified. Hence, this feature can be used to throughout the project iteratively. If the system does not provide the expected outcome, then the testing framework shows the failure of test cases.
Required tools	• Test Script Automation Tool- phpUnit and Selenium IDE • Microsoft Edge Browser (for Selenium IDE)
Success criteria	Test cases return 'Success'.

Table 5.2.2-1 Test Plan for function testing

5.2.3 User Interface Testing

User interface testing verifies the user interaction with OMDP. The system provides 4 different user interfaces for the 4 user types. The goal of this test is to ensure that the user interfaces provide appropriate navigation through the function of the system. In addition, interface testing ensures that the objects within the interface function as expected and conform to corporate or industry standard

Objective of technique	Determining process by navigating through all the user interface components of the business function. Verifying the sizing, position, state and focus of window objects in each business process.
Testing process	Create or modify tests for each window to verify proper navigation and object states for each application window and object in the OMDP.
Fundamentals	Use of automated user interface testing framework Using test methods (such as function unit testing), the sequence of operations for a window are stated. Then test is run. If the user interface adheres to the sequence that is stated in the test definition (the expected user interface behavior). Hence the test is determined as passed. The testing framework is integrated with phpUnit testing framework. Hence the testing process is fully automated and the test results will be displayed in a graphical mode.
Required tools	• phpUnit • SELINUIM web driver • Microsoft Edge Browser.
Success criteria	The technique supports the testing of each major window that will be used extensively by the end user. If all the test cases are passed (as indicated in the output window), the test is passed.
Special comments	The tests should exercise all possible input and control combinations and check whether the expected error messages are shown to the user.

Table 5.2.3-1 Test Plan for user interface testing

5.2.4 Performance Profiling

Performance profiling is a performance test in which response times, transaction rates, and other time-varying requirements are measured and evaluated. The goal of performance profiling is to verify performance requirements have been achieved. Performance profiling is implemented and executed to profile and tune OMDP performance behaviors as a function of conditions such as workload or hardware configurations.

Objective of technique	To simulate the behaviors for designated functional transactions or business functions under the following conditions to observe and log target behavior and application performance data: • Typical anticipated workload • Anticipated worst-case workload
Testing process	Using Test Procedures developed for Functional Testing. Modifying data files to increase the number of transactions or the scripts to increase the number of iterations that occur in each transaction. Scripts are run on one machine (best case to benchmark single user, single transaction) and should be repeated with multiple clients.
Fundamentals	If test results of performance profiling is within the acceptable region of values for that parameter (for example the response time of database querying is less than the value defined in the software architecture report), then the performance of the system is accepted. If not the test fails.
Required tools	NetBeans profiler.
Success criteria	• Single Transaction or single user: Successful emulation of the transaction scripts without any failures due to test implementation problems. • Multiple transactions or multiple users: Successful emulation of the workload without any failures due to test implementation problems.
Special comments	The tests should exercise all possible input and control combinations and check whether the expected error messages are shown to the user.

Table 5.2.4-1 Test Plan Performance profiling

5.3 Sample Functional Test cases and Results

Each test scenario is modelled using a Test case which comprises of a sequence of with condition or variables. These conditions and variables are input to the system and the actual output is compared with the expected output. The criteria are necessary for the program to pass the test and actual result is recorded.

The following test cases were derived in order to test different functionalities of the system.

5.3.1 User Registration Test

Test Case ID	001
Test Case	User should visit the user registration page by clicking on the Sign Up link in the
Initial Condition	The user should be registered in the system. The user should click on the Sign In button in the Landing of OMDP and enter the login page
Input Data	Username : test.surname@hnb.lk Password : mit123
Test Steps	Input username, password and press Enter or Click on Sign In
Actual results	Login is Successful.
Post conditions	User is redirected to the Home Page
Status (Pass/Fail)	Pass

Table 5.3.1-1 Test case id :001

5.3.2 Login System Test

Test Case ID	002
Test Case	A registered user Login to the System.
Initial Condition	The user should be registered in the system. The user should click on the Sign In button in the Landing of OMDP and enter the login page
Input Data	Username : test.surname@hnb.lk Password : mit123
Test Steps	Input username, password and press Enter or Click on Sign In
Actual results	Login is Successful.
Post conditions	User is redirected to the Home Page
Status (Pass/Fail)	Pass

Table 5.3.2-1 Test case id 002

5.3.3 Login to the system with incorrect credentials

Test Case ID	003
Test Case	A registered user Login to the System with wrong credentials
Initial Condition	The user should be registered in the system. The user should click on the Sign In button in the Landing of OMDP and enter the login page
Input Data	Username : test.surname@hnb.lk Password : mit124
Test Steps	Input username, password and press Enter or Click on Sign In
Actual results	Invalid Email or Password! Clear
Post conditions	User should be redirected back to the login page with the above message
Status (Pass/Fail)	Pass

Table 5.3.3-1 Test case id :003

5.4 Usability Evaluation

Usability testing is referred to as a process that involves people as testing participants who represent the target audience to evaluate the degree to which OMDP application meets specific usability criteria. This section explains the strategies followed to perform usability test and data collection.

5.4.1 Test approach

The approach for the study is single case study done with observation, semi structured interviews and questionnaire. The target crowd used for this analysis is customers, pharmacists and pharmacy managers. For pharmacists and pharmacists, observation and interviews are performed while a questionnaire and an online interview is provided to the customers.

Interviews are performed as Zoom or Skype interviews and sessions are recorded for data collection purposes. A semi-structured questionnaire is prepared as a google from is submitted as an email to system users. Google forms are used due to the ease of extracting data and analyzing them.

5.4.2 Participants

The key participants are pharmacists from client organization identified in "1 Introduction" Chapter. For this test, two types of participants are introduced. They are the customers and pharmacists. Three pharmacists are chosen from each client and four personnel who participated in the initial requirement analysis are randomly chosen as customers. The details of participants of the test are show in the table below. The private details of the users are not entered in the below table to privacy reasons.

Participant ID	Role	Organization
Pharm 01	Pharmacist	Client 1
Pharm 02	Pharmacist	Client 1
Pharm 03	Pharmacist	Client 1
Pharm 04	Pharmacist	Client 2
Pharm 05	Pharmacist	Client 2
Pharm 06	Pharmacist	Client 2
Cust 01	Customer	N/A
Cust 02	Customer	N/A
Cust 03	Customer	N/A
Cust 04	Customer	N/A
Cust 05	Customer	N/A
Cust 06	Customer	N/A

Table 5.4.2-1 Usability Test Participants

All the participants are provided are chosen as volunteers after a clear disclosure of the test rules and regulation are provided.

The participants' role will be to attempt to complete a set of functional task scenarios presented to them in a given time frame, and to provide feedback regarding the usability and acceptability of the OMDP user interfaces.

The participants will be directed to provide honest opinions regarding the usability of the application, and to participate in post-session subjective questionnaires and or interviews.

5.4.3 Procedure

Due to the risk of spreading COVID-19, the usability test was held as an online test over Zoom and Skype. Participants who are participating as customers are allowed to use their own PC to access the OMDP web site and follow the pre-defined set of scenarios. Pharmacists are asked to take part in the test from their pharmacy premises. Only to facilitate test purposes, laptops are provided to each pharmacist taking part in the test. All the participants, customers and pharmacist will connect remotely to the test over Zoom client. Invigilation process will also carried out remotely.

The examiner will brief the participants on the OMDP application and instruct the participant that they are evaluating the application, rather than the facilitator evaluating the participant. All

the test will be held over Zoom and examiner will acknowledge all participants that and all session will be recorded.

The examiner will explain that the amount of time taken to complete the test task will be measured. At the start of each task, the participant will read aloud the task description from the printed copy and begin the task. Time-on-task measurement begins when the participant starts the task. Participants will complete an initial background information questionnaire prior to starting the test.

The examiner will instruct the participant to 'think aloud' so that a verbal record exists of their interaction with the OMDP application. The examiner will observe and enter user behavior, user comments, and system actions in the zoom session is recorded.

After each task, the participant will complete a questionnaire and elaborate on the test session with the examiner. After all task scenarios are attempted, the participant will complete the post-user satisfaction questionnaire.

5.4.4 Usability tasks and scenarios

The following sequence of tasks should be completed by the test participants during the usability test time period of 1 hour. These tasks and selected so that high priority use case scenarios are tested for usability when using OMDP. The tasks presented are identical for each user category. For example, tasks presented for pharmacists are identical for other pharmacists as well.

The test setup is arranged so that 4 users of each category reach the OMDP landing page and log into the system using pre provided credentials. Two pharmacists and managers log into one pharmacy.

Scenarios for customers.

The following set of scenarios are provided for customers.

1. Reach the landing page http://localhost/omdp/ .
2. Register into the system as a customer, using a provided email address.
3. Login to the system using the registered credentials.
4. Choose 4 items by searching and place an order to any of the pharmacies logged in previous section above.
5. Upload a prescription and 'Save'.
6. Upload a prescription and place an order to any of the pharmacies above.
7. Accept a prescription quotation sent by pharmacist.
8. Choose 4 items by browsing through the categories and place an order to any of the pharmacies logged in previous section above.
9. Logout of the system.

Scenarios for pharmacists

The following set of scenarios are provided for the pharmacists.

1. Reach the landing page http://localhost/omdp/ .
2. Login to the system using the pre-shared credentials.
3. Accept an order placed by customers in above scenarios.
4. Start processing an order and dispatch placed by customers in customer scenarios.
5. Accept and review prescription sent by customers in customer scenarios.
6. Start preparing an accepted prescription order sent by customer.
7. Dispatch the order prepared in above scenario 6.
8. Logout of the system.

5.4.5 Usability Metrics

The following measurements are collected to evaluate the usability of the OMDP to study whether the system has achieved usability goals.

Scenario Completion

All scenarios will require, the participant inputs specific data that would be used in course of a typical task. The scenario is completed when the participant indicates the scenario's goal has been obtained (successfully or unsuccessfully) or the participant requests and receives sufficient guidance as to warrant scoring the scenario as a critical error.

Critical Errors

Critical errors occur at completion from the targets of the scenario. Obtaining or otherwise reporting of the wrong data value due to workflow followed by participant is a critical error. Participants may or may not be aware that the task goal is incorrect or incomplete.

Independent completion of the scenario is a universal goal; help obtained from the other usability test roles is cause to score the scenario a critical error. Critical errors can also be assigned when the participant initiates (or attempts to initiate) and action that will result in the goal state becoming unachievable. In general, critical errors are unresolved errors during the process of completing the task or errors that produce an incorrect outcome.

Non-critical Errors

Non-critical errors are errors that are recovered from by the participant or, if not detected, do not result in processing problems or unexpected results. Although non-critical errors can be

undetected by the participant, when they are detected, they are generally frustrating to the participant.

These errors may be procedural, in which the participant does not complete a scenario in the most optimal means (e.g., excessive steps and keystrokes). These errors may also be errors of confusion (ex., initially selecting the wrong function, using a user-interface control incorrectly such as attempting to edit an un-editable field).

Noncritical errors can always be recovered from during the process of completing the scenario. Exploratory behavior, such as opening the wrong menu while searching for a function, [will, will not (edit Procedure)] be coded as a non-critical error.

Subjective Evaluations

Subjective evaluations regarding ease of use and satisfaction will be collected via questionnaires, and during debriefing at the conclusion of the session. The questionnaires will utilize free-form responses and rating scales.

Sample usability test questionnaire and interview questionnaire are provided in the Appendices chapter.

5.5 Usability evaluation results

The table below shows results for critical use cases in the usability test conducted under "Testing approach" section.

Metric	**Metric**	**Value**
Frequency of occurring errors during prescription upload	Critical	5 % of customers experienced errors when uploading prescription.
	Non-Critical	10% of customers experienced errors when uploading prescription.
	Average Time to complete	300 milliseconds
Submitting Orders	Critical	No errors occurred during order placing
	Non-Critical	
	Average Time to complete	280 milliseconds
Adding Items to Cart	Critical	No errors occurred during order placing
	Non-Critical	
	Average Time to complete	586 milliseconds
Preparing Order (Pharmacist)	Critical	No errors occurred during order placing
	Non-Critical	
	Average Time to complete	1000 milliseconds

Table 5.4.5-1 Usability test results for critical use cases

The study requires to evaluate the usage different tools used by customer when placing orders. The diagram below shows the usage of Search utility, Browse categories and Both of the above feature.

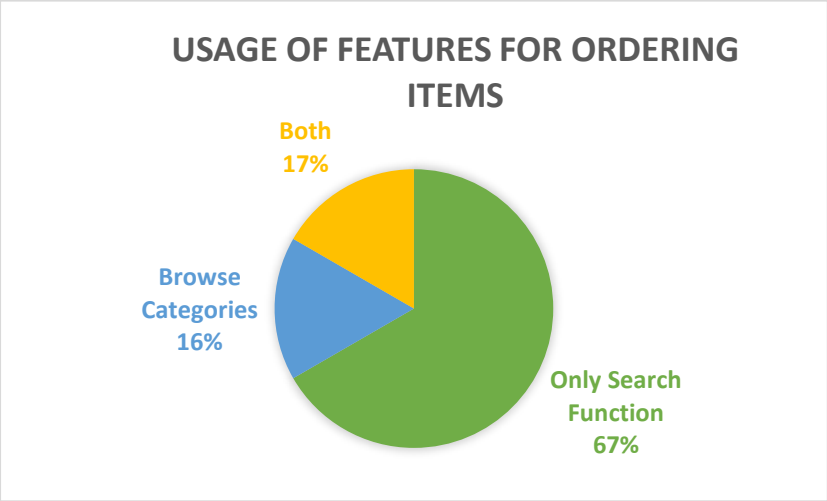


Figure 5.5-1 Usage of search features when placing orders - customers

The above diagram clearly shows that, nearly 70% of the users use the universal search functionality when locating items to place orders. Hence studying the user satisfaction level on the Search functionality was recognized to be interesting.

The results of subjective evaluation of each key functionality of the system are shown below. The below pie chart shows the user satisfaction level of customers on the universal search functionality provided by OMDP. The below interpretation is based on the customer user responses on the degree of responsiveness and accuracy of search functionality.

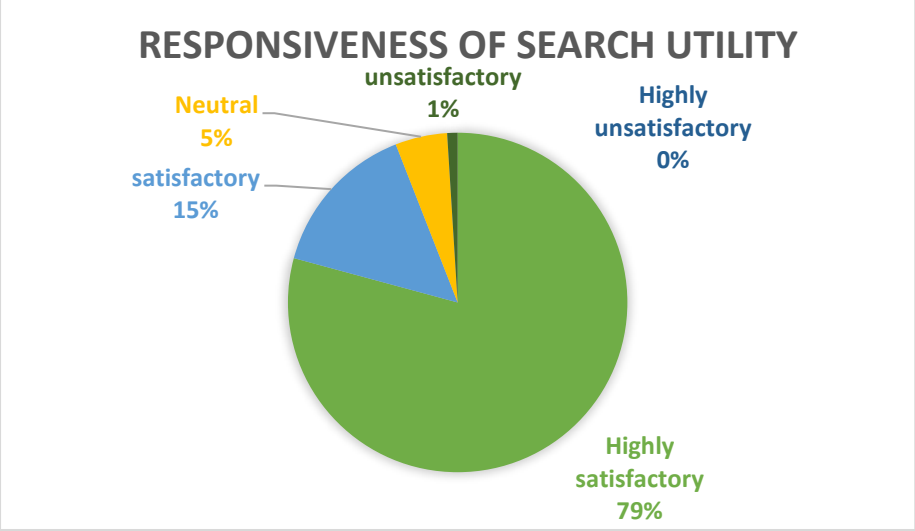


Figure 5.5-2 Customer satisfaction on responsiveness of Item Search Utility

According to the above diagram a total of 84% of the customer users are satisfied with accuracy and responsiveness of the search utility offered by the OMDP. Hence it can be concluded that the search functionality of one of the key components of the user-experience in the OMDP.

The usability study was carried out on customers and client pharmacists to validate whether the project OMDP is able to achieve its objectives and aims discussed in "Chapter 1". The following diagram interprets the overall results of the user satisfaction of both pharmacist and customer on order tracking feature.

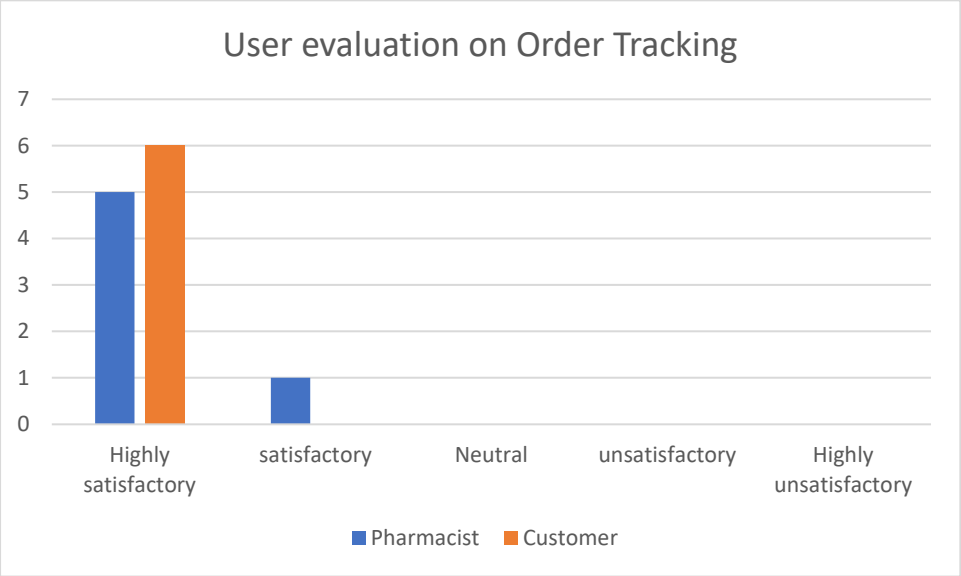


Figure 5.5-3 User satisfaction on Order tracking feature

According to above stacked bar chart, almost all the users have identified the feature important and a usable feature in the OMDP. The above scenario represents only an over-the-counter purchase of an item(s). The OMDP is expected to deliver a transparent process when customer is submitting a prescription to online pharmacy in the OMDP. Based on the results of the usability evaluation test carried out on the client pharmacies, the following table can be constructed.

	Pharmacist	Customer
Highly satisfactory	6	6
satisfactory		0
Neutral	0	0
unsatisfactory	0	0
Highly unsatisfactory	0	0

Table 5.4.5-2 User evaluation results of Transparent Order tracking

From the above table, a 100% user satisfaction can be observed for the transparent order tracking feature introduced by the OMDP. This systematic process of ordering via a prescription consists of submitting the prescription to the pharmacy, verify the prescription by pharmacist, receive a value quotation before confirm the order to the pharmacy. The diagram in the following page interprets the results in a more depictive manner.

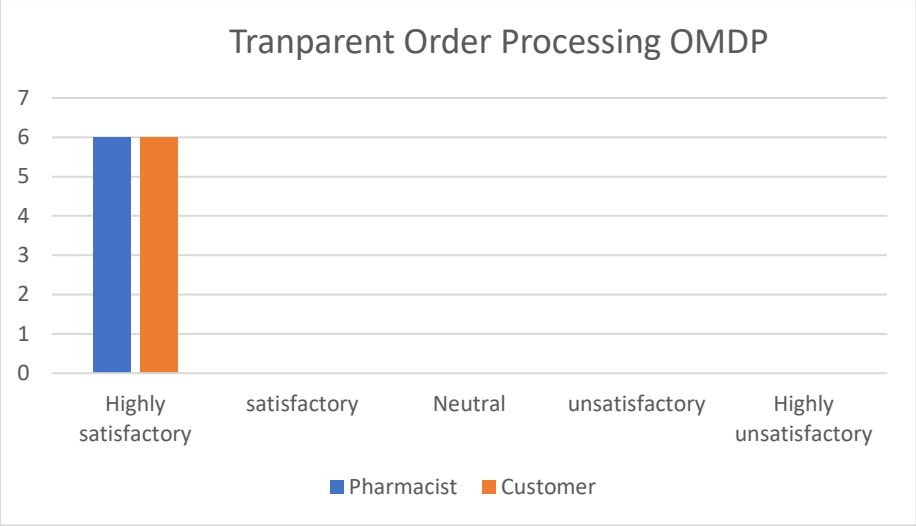


Figure 5.5-4 Usability evaluation results on OMDP transparent order tracking

To interpret the overall user evaluation results of the OMDP order tracking function, both the results from Figure 5.5-3 and Figure 5.5-4 are combined to present the diagram as shown below.

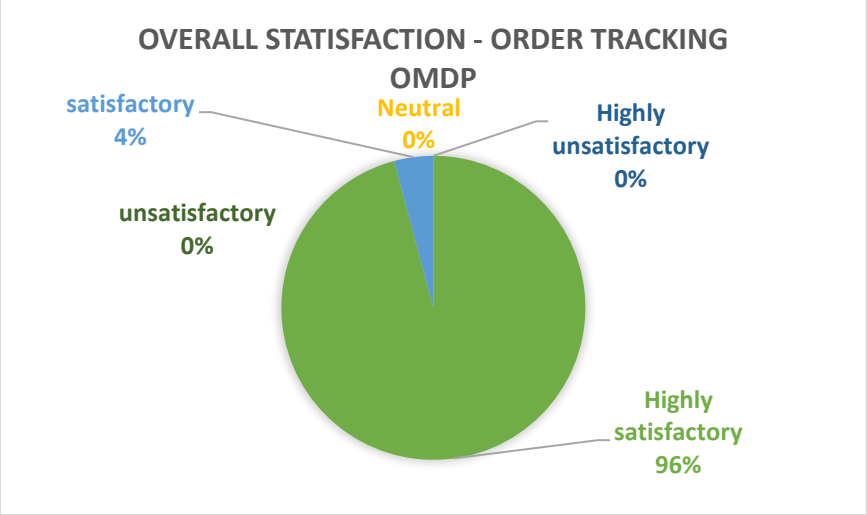


Figure 5.5-5 Overall Usability - Order Tracking Feature OMDP

6 Conclusion

6.1 Introduction

The aim of the project OMDP is to provide an online pharmacy solution which connects pharmacies and customers, and addressing the drawbacks and inefficiencies in the brick-and-mortar pharmacy in Sri Lanka. The key clients of the projects "The Nawinna Pharmacy" and "The New Pharmacy" are using a manual, time consuming processes to dispense items over the counter or by receiving prescriptions. This conventional retail pharmacy process exhibits a variety of common problems such as inconvenience for customers, time wastage in order processing, human errors etc. The current pandemic situation has contributed to intensify the above problems due to restrictions in gathering crowds, health regulations and travel restrictions. The concept of the OMDP solution enables users to compare and select items from either of the client pharmacies, submit the order online, make the payment securely and receive the items. The customers are able to upload the prescription with a special comment to both the pharmacies, analyse the item quotations received from the pharmacies and continue ordering the pharmacy which offers the most optimum value in terms of price and quality.

From the results of the usability test, it is identified that the average time taken for customer to place an order via OMDP is around 500 to 600 milliseconds. The average time taken for a pharmacist to prepare a typical order is around 1000 to 1500 milliseconds.

It is evident that ordering and purchasing items over OMDP is highly effective, efficient and time saving than purchasing items physically at a pharmacy store. The above advantage is also experienced by the client pharmacists. This process, provides the client pharmacies with the opportunity to continue business even amidst a pandemic situation. The OMDP eliminates the requirement of physically accommodating customers for both clients. Hence it strongly demonstrates that the OMDP acts as key platform for the clients to continue business in the new normal.

The key benefit received by the OMDP customers over typical online pharmacies is that the ability to compare items prices between multiple pharmacies; in the context of the project the client pharmacies. The system is capable of handling multiples orders, owing to the order tracking mechanism of OMDP. The success of this feature is evident from the usability study results in the section "5.5 Usability test results".

Considering the observations and results of the study conducted based on the key clients, it can be concluded that the OMDP has been able to achieve the project objectives, while delivering the client requirements and specifications.

6.2 Future work

The study revealed that with the growth of mobile computing, the system OMDP has to extend the functionalities partially or completely to a mobile application. With the development of mobile components and technologies of the OMDP, the designers will be able to implement location-based feature such as locating nearby pharmacies to the users. The OMDP also will be able server its clients with location-based suggestions.

The introduction of mobile application for OMDP enables itself to integrate with possible IOT devices and smart devices. Also, a possible integration with hospital and laboratory services will further enhance the OMDP in terms of value addition and functionality.

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7 Appendices

7.1 Appendix A Sample Email message sent by OMDP

The figure below shows a sample email notification sent via the system.

dulan.dam@gmail.com
to me

Mon, Aug 30, 8:35 PM (3 days ago)

Dear Dulan,

Thank you for using OMDP to buy your Pharamacy Items!

handed over to our delivery personnel.Your order with Pharmacy Health Med Pharmacy is currently on the way. Please wear a face mask and sanitize yourself before and after receiving the oder.

Order Id	7292
Total Value	LKR
Order updated on	2021-08-30 17:05:47
Pharmacy Name	Health Med Pharmacy
Order Status	**on the way**

Best Regards,

OMDP Team

Figure 7.1-1 Sample Email Notification

7.2 Appendix B User Evaluation Form – New User

The form below shows a software evaluation from questionnaire presented to system users who are juvenile to the system.

OMDP usability rating

I am of age group								
	18-25		26-30		40-50		50-60	
I am using this system for myself/I am a care taker.								
	I am using for myself				I am ordering for someone else			

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am satisfied with the ease of using the system					
The system simple to use.					
The system is easy to learn.					
The user interface is user friendly and consistent.					
The search functionality is easy to use.					
The interface is clear and pleasing.					
It is easy to register with the system.					
It is easy to order medicine from OMDP.					
I enjoy using the system.					
OMDP made buying medicine convenient and easy for me.					
It is easy to find information in the OMDP					
I am likely to recommend OMDP to a friend of mine.					
I overall enjoy using OMDP					

Table 5.4.5-1 User evaluation questionnaire for new users

7.3 Appendix C User Evaluation Form – Regular User

The below form shows an evaluation questionnaire presented to regular users every six months.

How long have you been with OMDP?								
	6 months		1 year		2 year		More than 2 years	
I always user OMDP to order medicine online/rarely use								
	I regularly use		occasionally use		I rarely use			

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
System is easy to use					
OMDP secures and respects my private information					
I get better offers and discount from using OMDP					
OMDP has all the features and capabilities I expect.					
OMDP customer support is overall satisfactory.					
OMDP delivery service is satisfactory and up to standards.					
I order my regular clinical doses from OMDP					
OMDP is an effective and safe means of Pharmcying during Pandemic season					
OMDP is provisions secure payment for orders.					
OMDP throws error messages that guide me how fix them.					
I feel that buying medicine is far more enjoyable than it used to be .					
Overall system performance and reliability is satisfactory.					
I overall enjoy using OMDP					
Please add any other comments and improvements you expect					

7.4 Appendix D User Evaluation after a new feature, release or major component upgrade

User Evaluation form when new feature is added.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I find the new feature xxxxxx useful to me.					
Takes using OMDP to a different level					
Provides value addition to customers.					
New feature xxxx improves safety and reliability of the system					
Please add any other comments and improvements you expect					

7.5 Appendix E - OMDP User Manual

7.5.1 Reaching OMDP Home Page

Open your browser on a PC with a working internet connection and type in http://localhost/omdp in the URL box and hit enter. The landing page will be loaded is shown below.

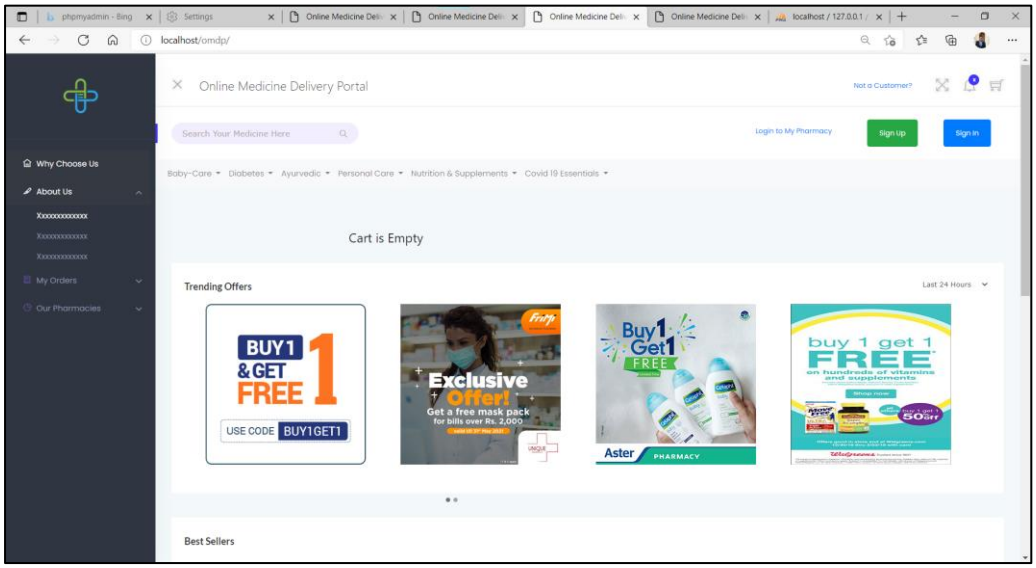

Figure 7.5-1 Landing page of OMDP

7.5.2 Register as a new Customer

In the above page, click on the “sign up” link and find the customer registration from as shown in the figure below. Fill in the relevant fields and click on the submit button. User will receive an account activation. Click on the activation link sent to user email and start using the system.

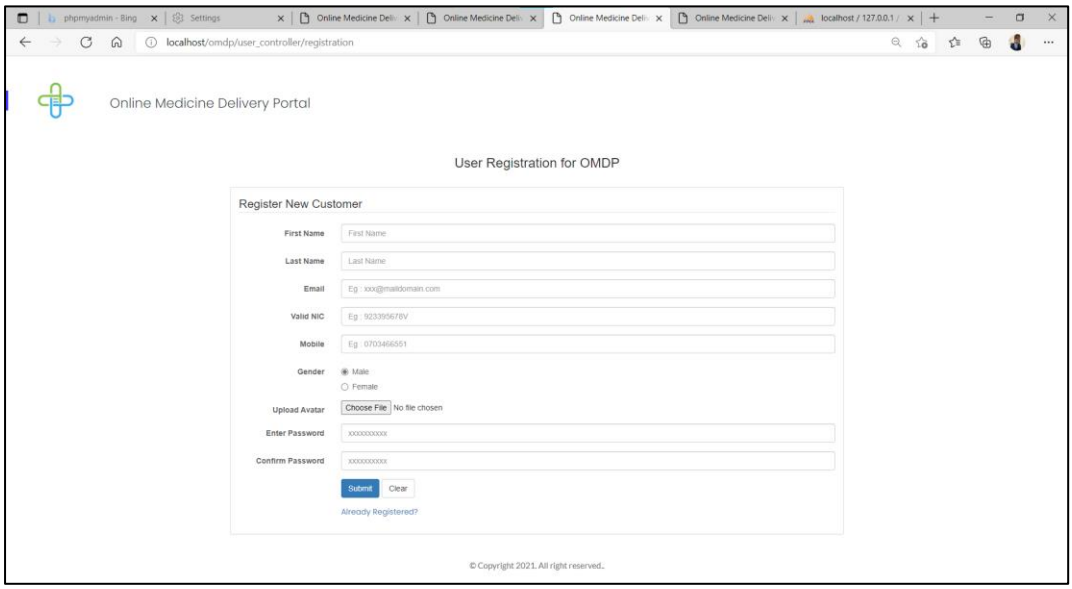

Figure 7.5-2 Customer registration Portal

Please note that the registration of non-customer users such as Pharmacists, Managers and administrators has to be registered via the admin portal of the OMDP. It will be discussed in the later sessions.

7.5.3 Logging in to the system using registered credentials

Click on the Sign In link in the landing page or in the registration page link, click on the already registered link. In the login page enter the credentials and proceed to the home page.

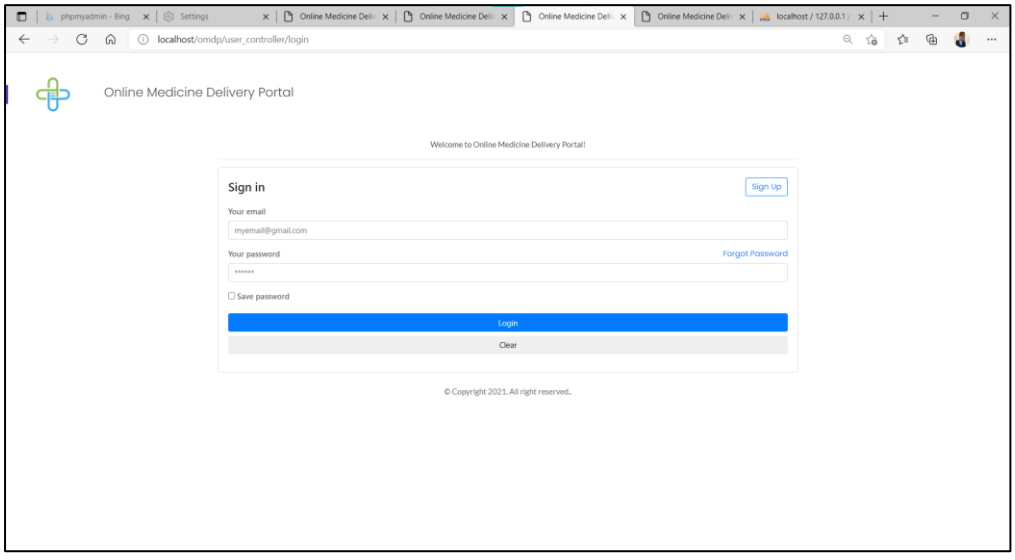

Figure 7.5-3 Login Page for customer.

For the login of Pharmacy users, go to the landing page and click on “Login to My Pharmacy” Link beside the sign in and sign up buttons in the navbar menu.

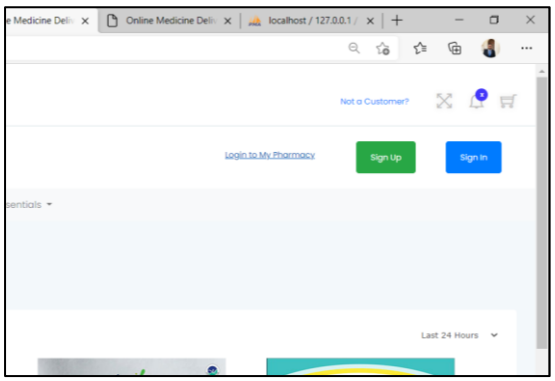

Figure 7.5-4 Navigate to Pharmacy User Login

Enter the login credentials and select the relevant role of the user and click on the Login Button.The login page for pharmacy users is shown below.

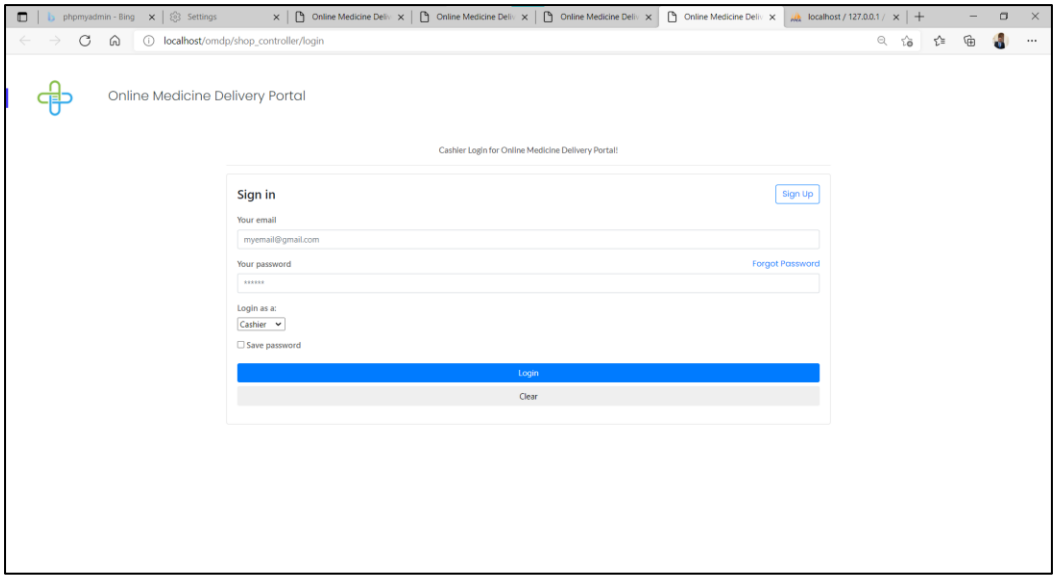

Figure 7.5-5 Pharmacist and Manager Login Page

7.5.4 Search an order item in the customer home page.

Login to the OMDP as customer, and user will be redirected to a Home Page. To search items, type any desired keyword and the results will be dynamically resulted in the inner part of the home page as shown in the figure below.

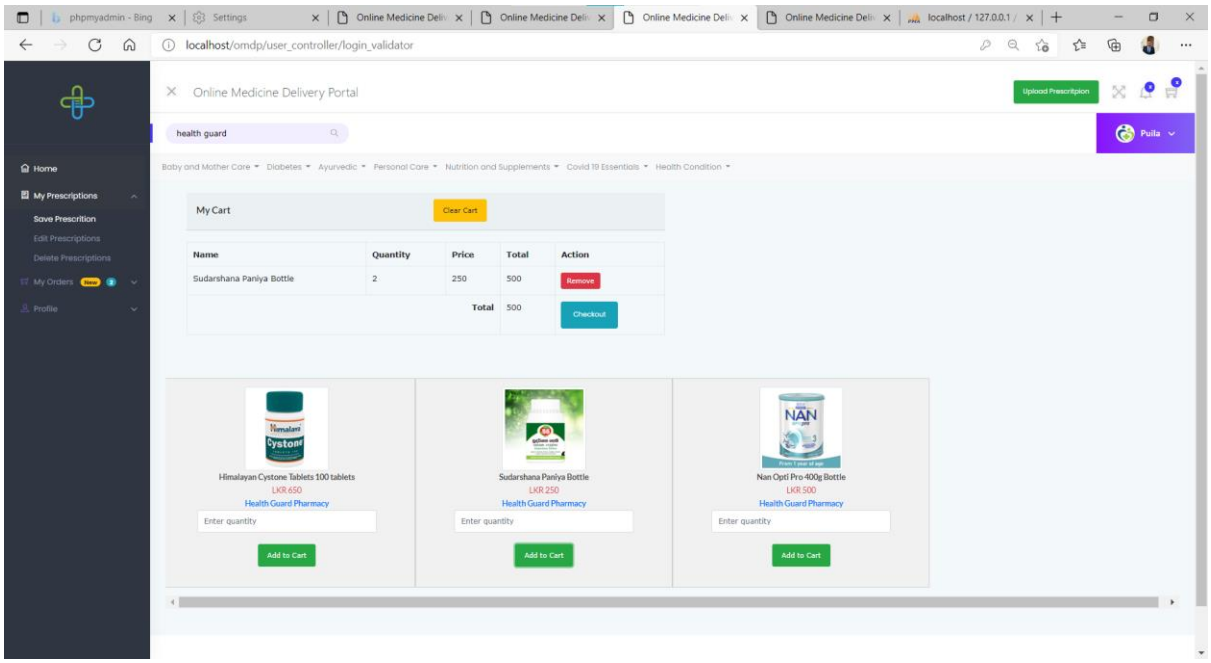

Figure 7.5-6 Search and add Items to Cart

To add any item to the cart, enter the required quantity of the item in the input field and click “Add to Cart”. Then the item will be added to the cart and the item will be displayed in the cart as shown below.

7.5.5 Checkout and Submit an Order

In the previous section, click on the “checkout” button in the shopping cart to go to the below page , where user has to enter all the delivery details.

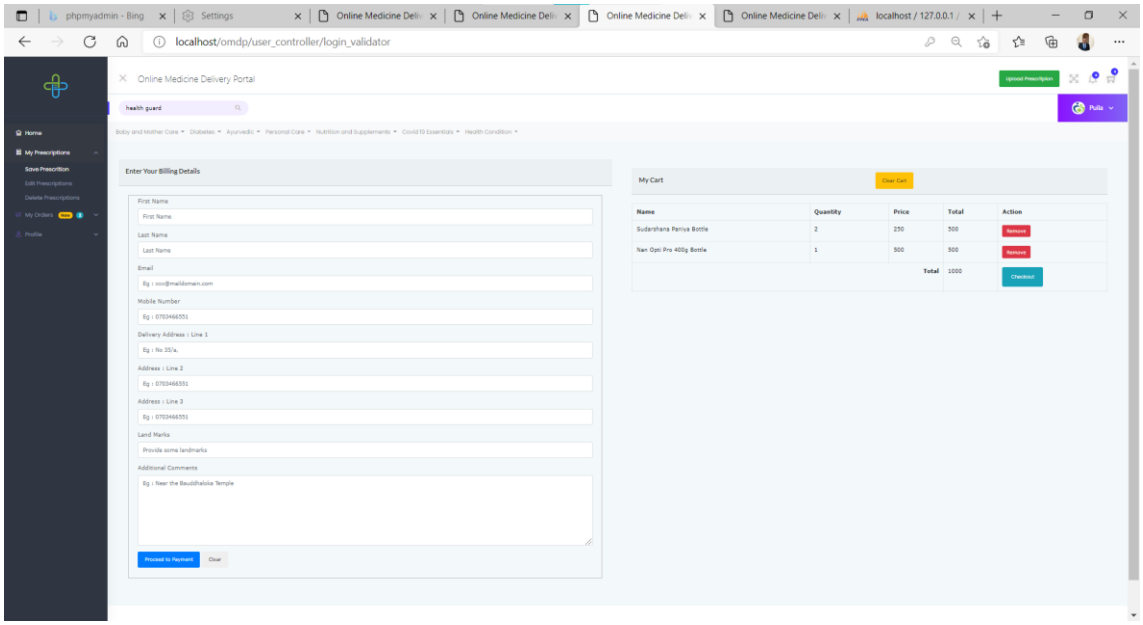

Figure 7.5-7 delivery information page

Fill in the relevant information of the page and click on the “Proceed to Payment” button to navigate to the final page of the order placement process in OMDP. In the next page pick the payment method and enter the payment details before submitting the order. The final invoice is automatically calculate the same page as shown below.

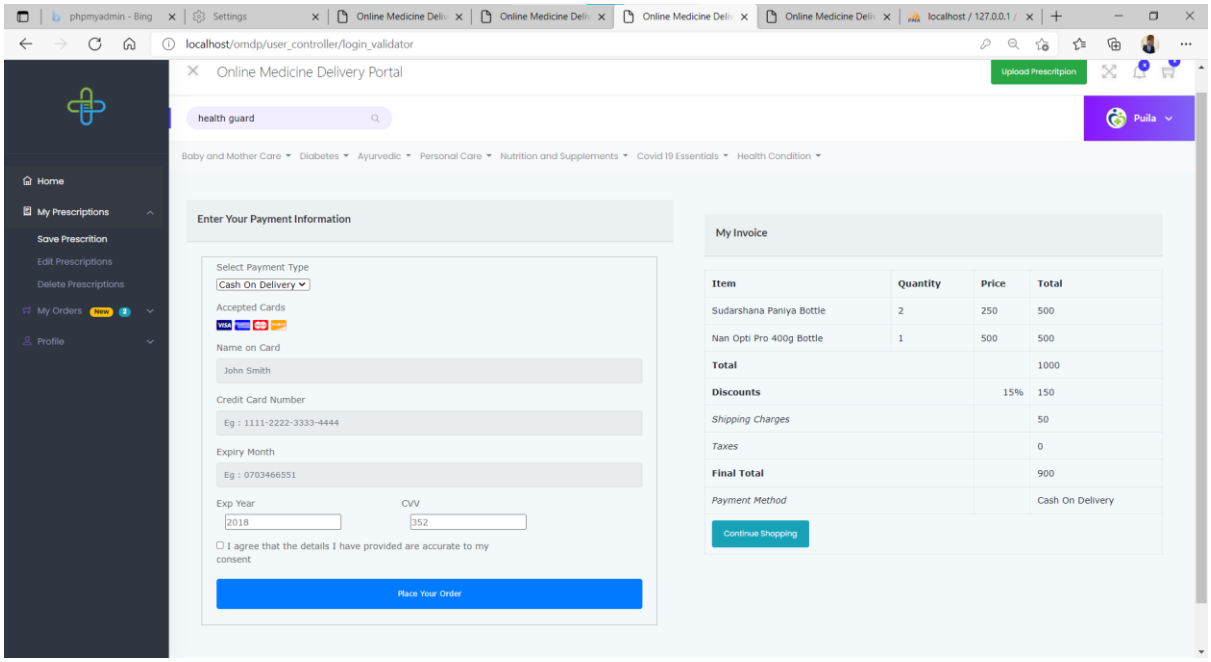

Figure 7.5-8 Payment information page

To place the order click on the “Place the Order” and confirm on the dialog box that appears. User will be redirected to the Home page after successful placement of the order, user will receive and email alert as shown in the image below.

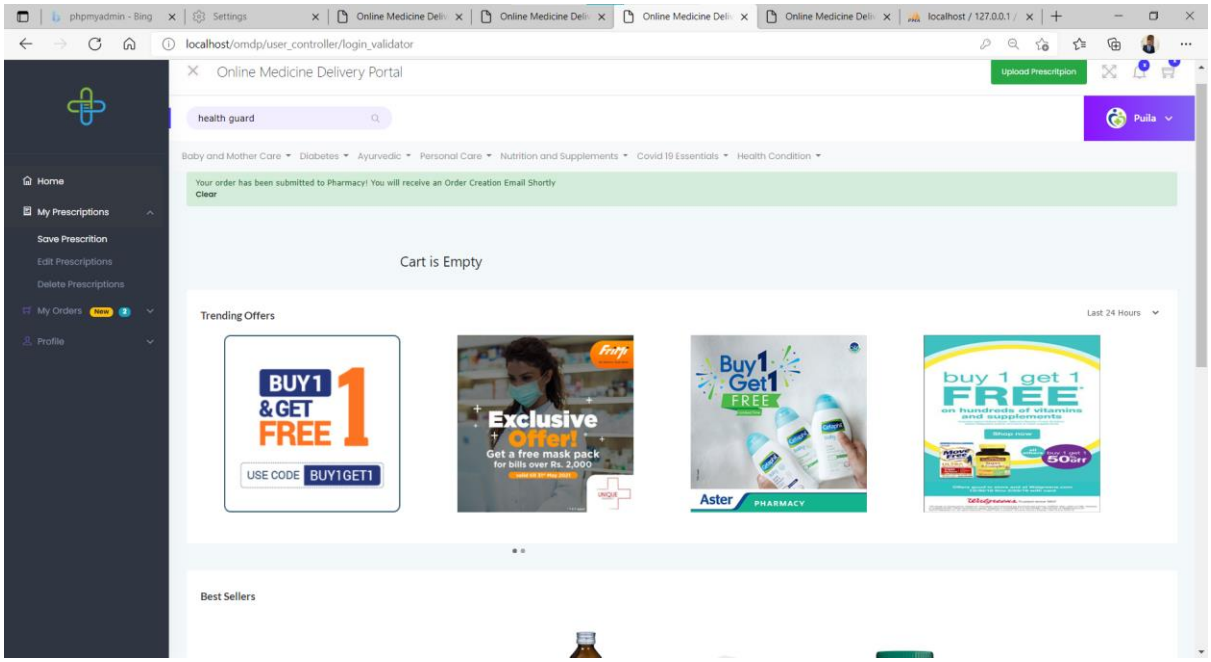

Figure 7.5-9 place an order OMDP

7.5.6 Viewing customer notifications in the OMDP

As shown in the figure above, indicators shown in the left side menu indicate there are new notification for pending, dispatched or completed order. To view the order status, click on the menu of the item My Order and click on any sub menu item as shown in the figure below.

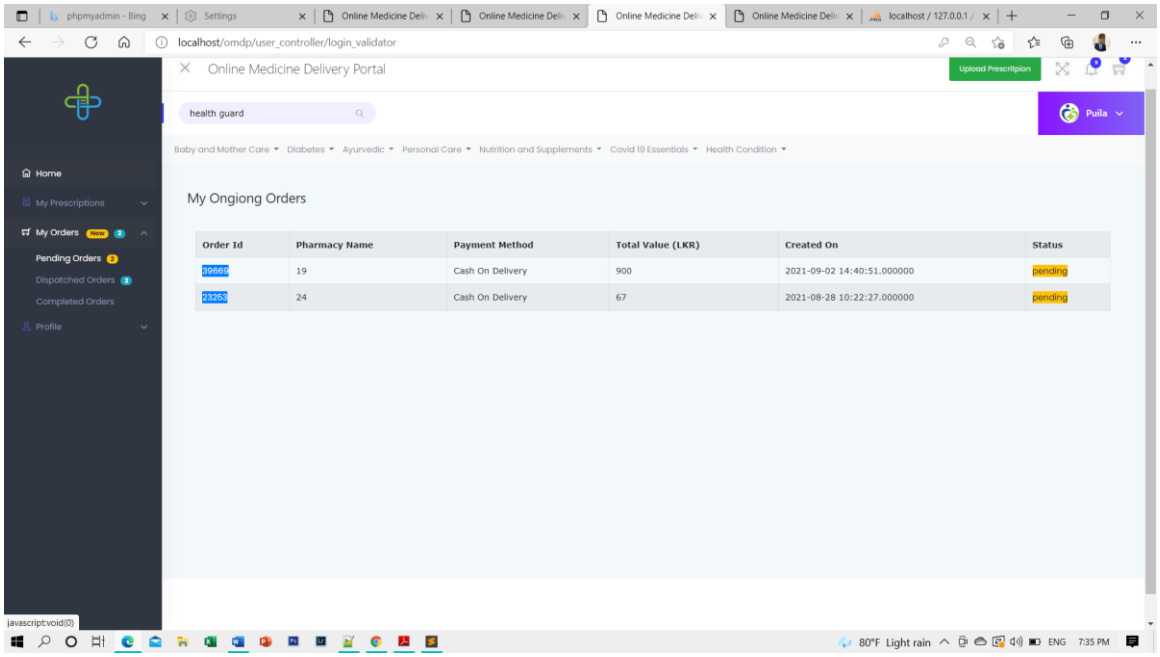

Figure 7.5-10 Viewing notifications regarding orders.

7.5.7 Uploading and Saving prescriptions Customer

In the Customer Home Page, Expand the menu item “My prescription” and click on “save prescription” to access the prescription saving form. The below figure shows the prescription saving portal.

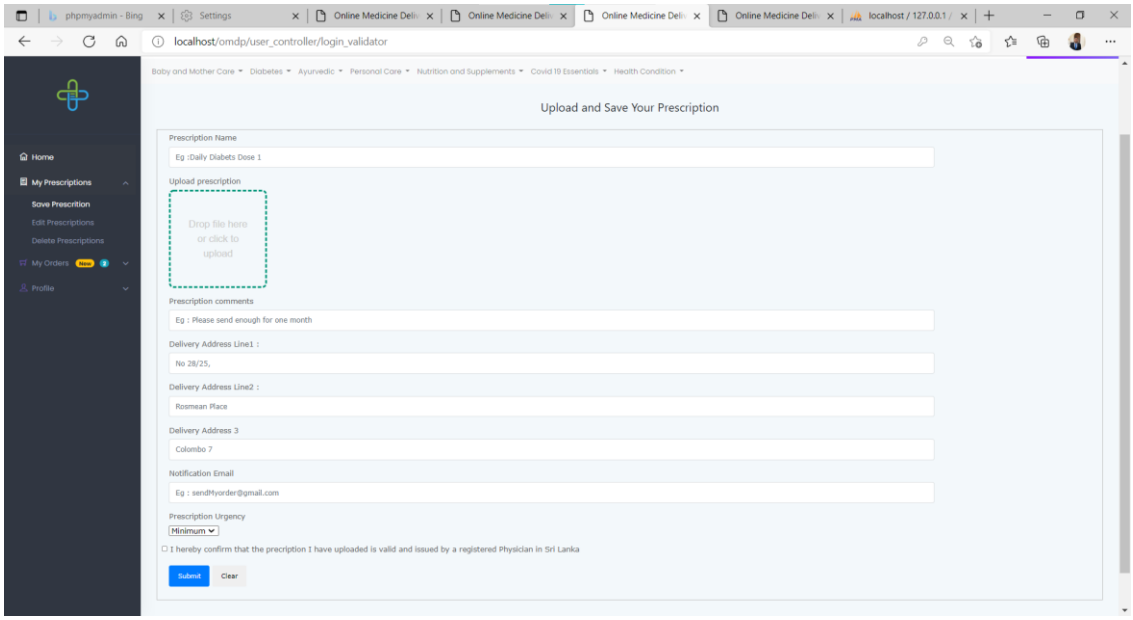

Figure 7.5-11 Upload prescription utility

Fill in the relevant details and drag and drop an image file of the valid prescription to the upload box. Click on the Submit button to save the prescription to the profile. To edit, delete or view prescriptions click on Edit Prescription and Delete Prescription menu items.

Another utility is provided to quickly upload and place an order to the relevant pharmacy. To access the utility, click on the “Upload Prescription” link on the title bar of the home page. Fill in the form and upload an image of the prescription , select the pharmacy and click on submit to send the prescription to the pharmacy review.

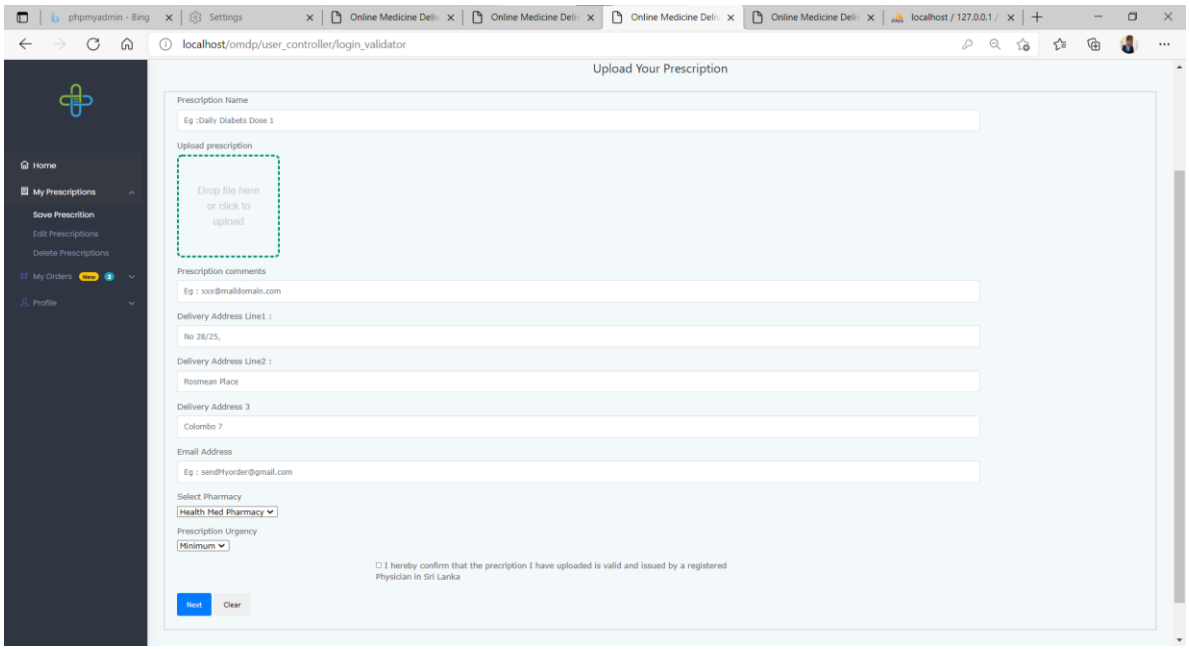

Figure 7.5-12 upload and place the order