

WEB ENABLE E – POST OFFICE SYSTEM FOR SRI LANKAN POSTAL SERVICE

A thesis by

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Abstract

E-Post Office is the shopping portal of the postal service on the Internet and an additional distribution channel. Normally it sells Stamps, Postcards, Packets, and other stationary items and has services like courier, registering for electricity vendors, selling mobile cards etc. Through this web based system many products and services such as tracking domestic mail and parcels, sending E-Post cards can be done.

The system has been design to accept by Sri Lanka postal service and this system has been tested in real postal environment with the people who are related with the system. This system a developed with using SQL database, C# language and with ASP.net platform mainly. As well as in here will use other related tools and this system will developed as web base application.

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any University or equivalent institution, and that to the best of my knowledge and belief, contains no material previously submitted or written by any other person , except where due reference is made in the text of this thesis.

I carried out the work described in this dissertation under the supervision of Dushyanthi Vidanagama

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Abbreviation

EMS - Express Mail Service

EPOS - E-Post Office System

HQ – Head Quarters

IT – Information Technology

TPO – Traveling Post Office

UML - Unified Modeling Language

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Chapter 01

Introduction

1.1 Prolegomena

Web based software development has introduced new-fangled way to handling real world problems. It provides cost effective, accurate, user friendly and reasonable solution for almost all the applications. Among other software technologies, web based software development take significant place, since stakeholders will be able to access the system anywhere at any time. This thesis presents develop a software solution for the domain of postal services in Sri Lanka.

This E Post Office system is designed to manage and store project information which is used in web based applications. Through this project application, controlled access to information and automated distribution of information will be managed by the administrator. Surprisingly, web based E Post Office system can increase performance, productivity and efficiency within an organization. It also helps to decrease human workload and save time. Moreover, through this system stakeholders will be able to getting thing done faster with less expensive, since web based applications are capable of be accessed through any web browser and no desktop installation or updates are required.

In developing so, this chapter consists with the aim and objective of the project, description about current system and its limitations, proposed system and the value of the system are also described. The rest of the thesis aligns with problem in brief, hypothesis, proposed solution, resources, requirement and overview of the structure of the rest of the thesis.

1.2 Aim and Objective

The aim of this project is to develop an accurate, efficient and effective computerized E-Post Office System for Sri Lanka Postal service which can overcome the problems and loose ends of the current mails and parcels receiving and sending, selling products and postcard sending manual system and provide maximum service to users.

The computerized EPOS is an effective tool used to streamline daily activities. It aims to address logistic management issues, reduce delays in delivery, and handle distribution of parcels and mails in a timely manner and the related activities. It connects all post offices which consist with Information technology infrastructure to avoid mismanagement.

This modernization project aims to create an optimal personnel system which satisfies users the necessary means for the fulfillment of broader organizational goals.

The following are the key objectives of the EPOS in order to achieve above aim:

- The system will be able to provide services like sending and receiving mails and parcels and tracking domestic mails and parcels delivery.
- The system will be able to sell products and services such as Stamps, Post Cards, selling mobile cards that are also available in a "normal" branch.
- The system will be able to create E- Post card according to customer requirement.
- System will be able to handle credit card details.

1.3 Background and Motivation

Sri Lanka Posts has been in existence for more than two centuries. Because of its impartial service it has become an essential part of the life of Sri Lankan people. Postal service serves all the urban as well as rural people through 645 main post offices, 3,408 sub post offices, 499 agency, 159 rural agency and 58 estate agency post offices (Slpost.gov.lk, 2015). Apart from exchanging mail and parcels function of the Sri Lankan post office generally had many other services like selling postage stamps, post cards and banking services etc.

Sri Lanka postal service is a one of leading service in Sri Lanka which is handles all the postal services in all over the country. It is a government organization and its main task is to facilitate postal services accurately and efficiency. But also, they handle there logistic function manually. In each post office there is limited number of staff to handle all these functions. Therefore, to manage these function with these limited staff E-Post Office System consist separate procedures. They are,

- **Normal Post Service**

The postage on inland letters and parcel handling is done in this function. For that user need to prepaid by means of postage stamps attached or impressed by a stamping die or stamping machine. For register mail service and parcel service users need to fill forms manually (Slpost.gov.lk, 2015).

- **International Mail Service**

International mail and parcel handling is done this function. Foreign post conveyed by sea or by air between any place in Sri Lanka and any place beyond the limits of Sri Lanka. Customers can send letters, Printed papers, post cards, and literature for the blind, aerogramme, newspapers and magazines and documents through this post (Slpost.gov.lk, 2015).

- **Money Orders**

The Post Offices and Sub-Post Offices in Sri Lanka at which Money Orders are issued and paid such as pensioning. Currently they also handling bill payments, money transfer through online (Slpost.gov.lk, 2015).

- **EMS - Speed Post**

EMS, which is a postal express service for documents and merchandise possible be the quickest postal service. This service is available to most of the countries. New destination countries are added all the time. Customers need to make enquiries from the nearest Post Office for your intended destination (Slpost.gov.lk, 2015).

- **Speed Post Courier Tracking**

Speed Post Courier Tracking is an online service to track article that you sent to someone using speed post courier. By using Speed Post Courier Tracking system people can track whether their articles have been delivered or not (Slpost.gov.lk, 2015).

Current manual system of post office is an incorporated system from these functions designed to manage and monitor all the postal services. There have two main levels in EPOS in Sri Lanka. They are administration level and user level. Administrative processing and record keeping is the main task of administration level and provide operational support is the main task of operational level. Both of these levels main purpose is improve the efficiency of the service and keep a track about their completed tasks.

1.4 Problem in Brief

Sri Lanka postal service currently uses a manual system to manage postal services except bill payments, money transfer, lottery, and speed post courier. Because of the increasing services to all over the country and it becomes more difficult to maintain this manual system. Therefore, there can be many issues can be occurred when entering, storing data and retrieving information through the current system. This is where a computerized EPOS becomes very important.

When consider about letters and parcel delivery services it is not easy to do this process manually because it would become very hectic. They have to record day to day activities like sender details, receiver details, price of parcels and other details regarding to the delivery process. Hence it is recommended to automate the process by developing the relevant software as the world is moving from manual working to information and technology era where computerization becomes important in all part of life. Figure 1.4.1 illustrates the current system limitations.

Furthermore, current system includes the functions such as send post card manually, buy product such as envelops, stamps and post cards by visiting post office. This is also become critical problem today due to busy work with people work. Therefore customers are reluctant to do their postal services through post offices. When we talk about these functions of the system in genuinely following problems can be occur since it is running as traditional file based systems.

- Data entering problems to the files**

When considering about the current logistic system it is a file based system. Therefore, almost all the data should be entered to the files manually. It is much difficult process to maintain all the data entering works.

- Time wasting**

Data recording processing is slower when very large volumes of data entering because it has to be entered manually. Therefore, it wastes the valuable time of the person who records the details to the documents as well as applicant.

- High risk of errors**

There are lots of paper works in the current system. Hence, the work load of one operator is relatively high. It can lead to making errors because of unconsciousness built through the higher work capacity. The risk of errors happens in a very high percentage. Especially in loan management system, there is a high possibility of errors because they are working with financial aspects.

- **Less accessible to the records**

Information is basically less accessible. One user can access at one time with the records. Because the files of records are kept on racks. Therefore, information they contain is not available at all.

- **Quality of output**

The manual system does not generate well-designed and well prepared records. The hand written records are completely useless because it poorly represents the information that user wishes.

- **Bulk of the records**

These manual systems are very bulky to handle and to store records. We could see thousands of files kept on racks and tables. It shows the risk of the important details that include in the files. Because of that to search for a document, they may have to go through several documents.

- **Wasting man power**

A person who records the details in the files should record them one by one. But it is not an efficient work. It is only a waste of man power.

- **Risk of losing files**

When considering the current leaving function, we have to add records per each employee every day. Therefore we have to keep each and every record in files.

- **High cost**

The waste of money is another major problem. A high amount of money should be paid for the files and papers and for printing purposes in the current manual system.

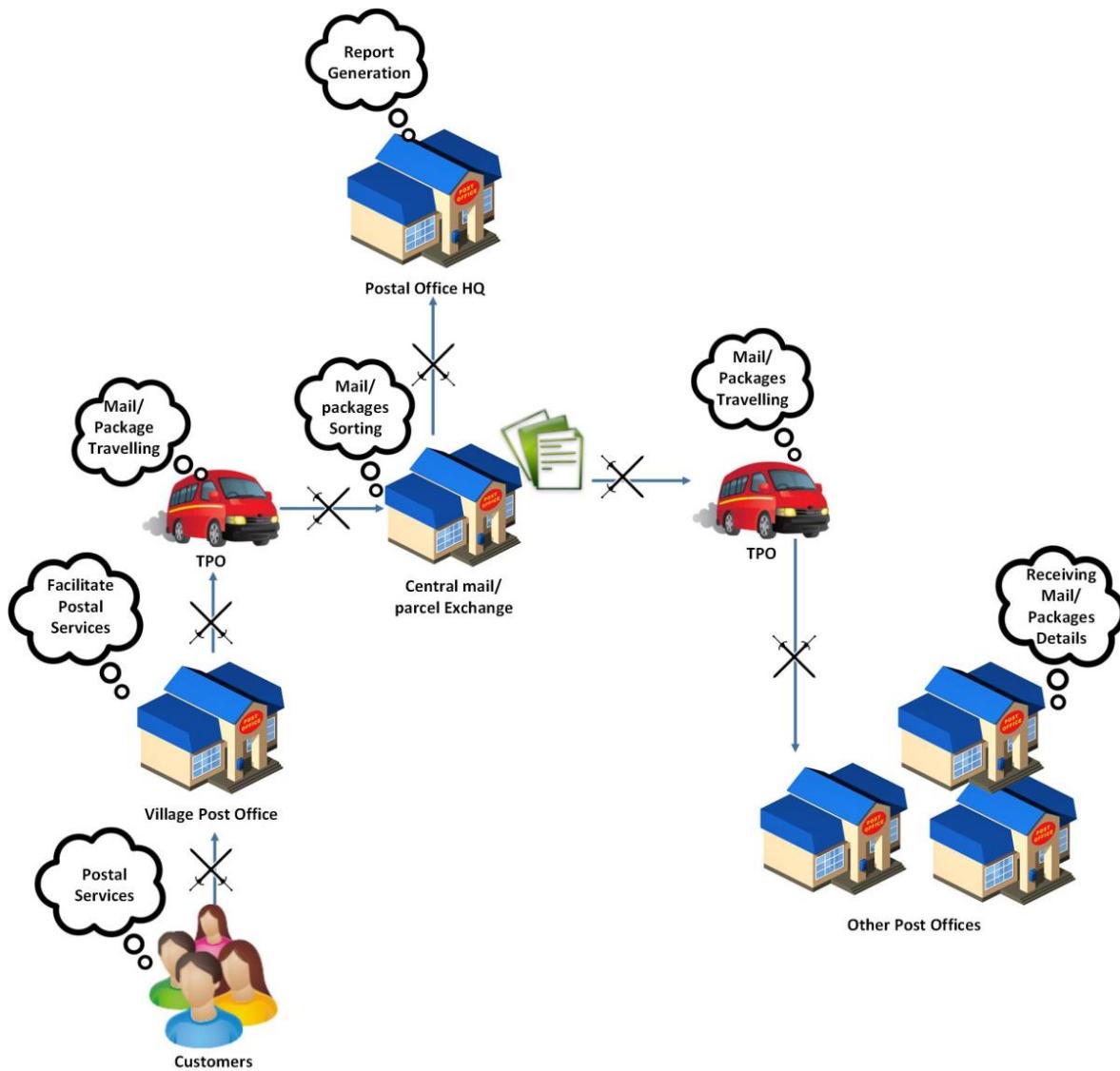


Figure 1.4.1: Current System

Source: Author

1.5 Hypothesis

Software have introduced new way of handling real world problems. Software provides cost effective, accurate, user friendly and reasonable solution for almost all applications. Among other software technologies, World Wide Web is one of the major media used by people nowadays to access information. Hence, web based development systems have been the most widely used development of software application. Therefore, to overcome the problems in the existing system in Sri Lanka Postal Service the new system development try to automate domestic parcel and mail tracking function, shopping cart and E-post card function processes with the database integration approach. Through this automated software development it has been possible to prevent problems in current system and it will help to increase the customer efficiency & satisfaction.

1.6 Software solution for Sri Lanka Postal Service

Considering the problem domain, it is important for Sri Lanka Postal service to develop an EPOS to facilitate the services provided in current system in a better manner and overcoming those identified problems in the current manual system. The EPOS would be built with the use of Web base technology with C# language, to provide integration and inaccessibility for the benefit of the users. The main users of the system would be the Sri Lankan people who seek the postal services for their day to day work and post office administration team who are responsible for system operations.

For now, the scope of the system will only cover mails and Parcels Handling function, E-Post Card Creator Function, and Online Shopping Cart function. But later, the system can be expanded covering all the services in EPOS. This developed system would fulfill any insufficiencies which occurred before and would bring in a flexible approach for the users of the system. Furthermore, this EPOS able to view, store information and coordinate all the activities this system. Every user can send parcel and mails through a common interface. And administration can view reports on each details through interfaces that can be accessed only by them.

Moreover, administration team has access to every interfaces of the system. This system would help to minimize the problems caused in the current system, since a properly reorganized and incorporated system would be implemented through better problem identification by the system developing team. And also, this EPOS able to create reports as per the requirements and it enable a smooth and consistent service to the benefit of its valuable employees.

In addition to providing a low cost, easy handling and high security benefits, the system will have the advantage of having an automatically maintained directory which will update each time. The

system will run as a centralized database system where all clients are connected to EPOS network.

1.8 Resources Requirement

- The application package would develop as it is compatible with any computer which runs on Windows platform such as Windows XP and Windows 7.
- The application package would consist of two main interface types (Client interface and Administrative) which will be developing on C#.net language.
- The database will be implemented with use of SQL.
- The programming of the development will be done using C# language.

1.9 Summary

In this chapter we explain the details about the overview of the project. This gives an idea about the need of EPOS software solution for the domain of postal services in Sri Lanka. And a new system for manage the activities related to domestic mail and parcel tracking. Furthermore through the introduction it presents the objectives, hypothesis and the other required project components. Through this chapter it makes easier the understanding of the project in initial level.

Chapter 02

State of the Art of EPOS

2.1 Introduction

Information technologies are modernizing the way individuals, businesses and other parts of society communicate, work and learn. The Internet has opened up the world. People can send and receive e-mails from anywhere in the world, enjoying instant communication at minor cost. It offers virtually free access to massive amounts of information and expert advice on almost any issue. Communications both inside and outside the organization have also become easier. Organizational efficiency has increased in all departments, such as accounting and marketing, by raising productivity and linking buyers and sellers electronically along the supply chain. IT enables organizations to reduce costs and increase revenues. E-government is capable of delivering government services faster, more effectively and more economically.

According to Universal Postal Union report The Geneva Declaration of Principles (DoP) states that “Under favorable conditions, these technologies can be a powerful instrument, increasing productivity, generating economic growth, job creation and employability and improving the quality of life of all” (Icts, New Services And Transformation Of The Post). The widely believed that information technology is fundamental to an organization’s survival and growth is not surprising.

2.2 Impact of IT to the Postal Sector

Because of the IT uprising, postal sector has had a considerable impact. Most of the government postal enterprises would have commonly been late adopters of IT. However, currently almost all the postal enterprise use IT in order to become more efficient, accessible and profitable.

This paper presents some case studies from postal enterprises which are experience in using IT. The countries in which these projects were implemented are at various stages of economic development and include one industrialized country.

The use of IT in the postal sector has given a marvelous improvement to the growth of the IT industry and services. As well as the impact of IT used by Posts has not been limited to the postal sector. Because of their effect has had an impact on governance and its societal and economic relationships.

2.3 Features of the Retail Network

Retail post offices provide, financial services, Physical acceptance of mail items such as weighting, pricing. And also they provide many other non-postal services. This report compares the key features of retail networks. The main postal functions of the retail network can be categorized in to two categories. Such as, collecting letters and selling stamps. For that retail network can have alternatives ways which are usually cheaper such as, letters can be collected from post boxes and stamps can be sold through vending machines, third party agents and other distribution channels. However the retail post office network does provide the certain primary services such as parcels, insurance, proof of mailing etc.

The retail network is also valued because,

- Supports the local economy, providing individuals with cash to spend on local businesses and services and offering convenient local banking facilities for those businesses
- Mainly in isolated rural areas with few other facilities or shops
- Provides a community important point, particularly in rural communities.

2.4 Functions of E-Post Office

EPOS mainly provides sending mails and receiving mails on behalf of their customers. As sending mail service they mainly provide variety of ordinary and guaranteed services both for delivery of letters and parcels within the country and to international destinations. When receiving mail EPOS provide various options for receiving mails. They also sell Postage stamps such as commemorative stamps and other philatelic items.

And E-Post Offices has provided a wide variety of services throughout their network of branches. They mainly provide services such as Postal services, financial services, banking services, online shopping facilities and many other numbers of services. Those services detailed describe bellow.

2.4.1 Financial Services

- **Branch banking**

Some of EPOS provides personal banking services on behalf of a number of "partner banks" that the Post Office has agreements with. Through EPOS banks handle different services. These may include cash withdrawals, paying in cash and cheques, balance enquiries and cheque encashment and etc.

- **Bill payments**

EPOS also provides a number of bill payments on behalf of a variety of organizations including utilities, local authorities and others. These can be in the form of automated payments (bar-coded bills, swipe cards, key charging) or manual transactions.

2.4.2 Telephony Services

In some countries Post Office operates as a provider of a home landline telephone service and has recently added broadband internet to its collection. Post Office branded prepay phone cards and Mobile cards are available, offering potential savings particularly on international call rates.

2.4.3 Government services

Most of the EPOS are provided their government services also. Because rather than going for particular place it is easier to get those services through their EPOS. Mostly they are used to offer a driving license renewal service, national identity card applying or renewal and passport applying also.

2.4.4 Collecting Stamps

This is the place most people are interested in their leisure time. Through this service they provide the exciting and informative world of stamps & philately. Here customers will discover interesting aspects of these miniature works of art (Swiss Post, 2015).

2.4.5 Other services

- National Lottery games and scratch cards
- Sale and encashment of postal orders
- Foreign currency exchange and Travel Money Card
- Sales of gift vouchers redeemable at certain high street merchants

2.5 Success Stories of Postal Retail Environment

With use of new technology advancement most of the post offices in the world have computerized their all most all the functions. There are so many successful stories of Electronic post office systems. And also the important thing is most of them are significantly contribute to the country economy.

2.5.1 Republic of Korea Postal Service (Koreapost.go.kr, 2014)

The desire to transform its traditional home shopping service into an e-commerce (ePOST) was an important reason for the development of Korea post information systems. E-commerce portal of Korea post was launched in 1999 for the post office shopping mall. The end of 2000, it had been expanded and transformed into the Internet post office. Today Korea people use as the portal to access postal services in as well as for shopping. E-commerce portal of Korea post enabled manufacturers to sell online their products to local consumers and gave customers the opportunity to purchase products in a secure environment throughout the country.

Korea Post has played an important role in the growth of e-commerce in Korea. The operator has established a “platform where as many e-commerce businesses as possible could appear directly or be linked to the e-commerce system of the post office” (Icts, New Services and Transformation of the Post) and has served as “a shopping portal through linkages with several shopping malls and major retailers” (Icts, New Services and Transformation of the Post). It has also established “an independent system for payment and certification service” (Icts, New Services and Transformation of the Post). The government has used Korea Post’s e-commerce venture as a test as developing sound e-commerce practices. According to Icts, traditional home shopping beginning with only eight products in 1986, but today Korea shopping mall offers more than 7,200 items and has an annual turnover of 135 million USD.

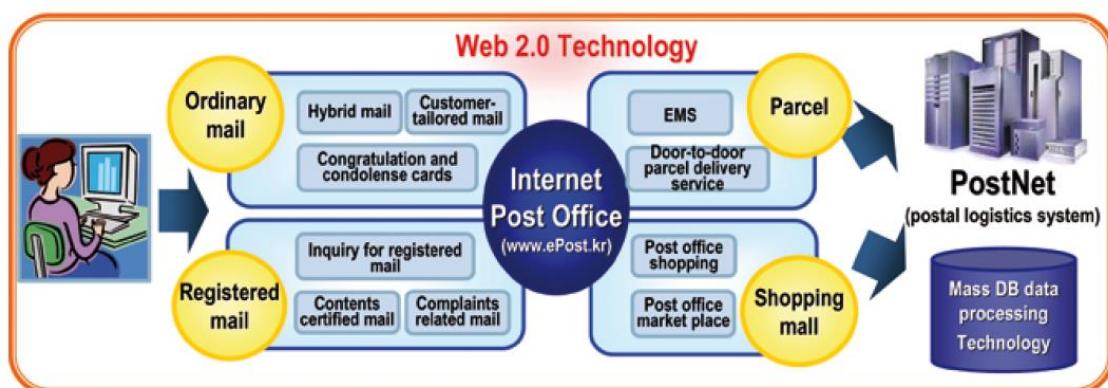


Figure 2.5.1.1: Services provided by ePOST

Source: Icts, New Services and Transformation of the Post

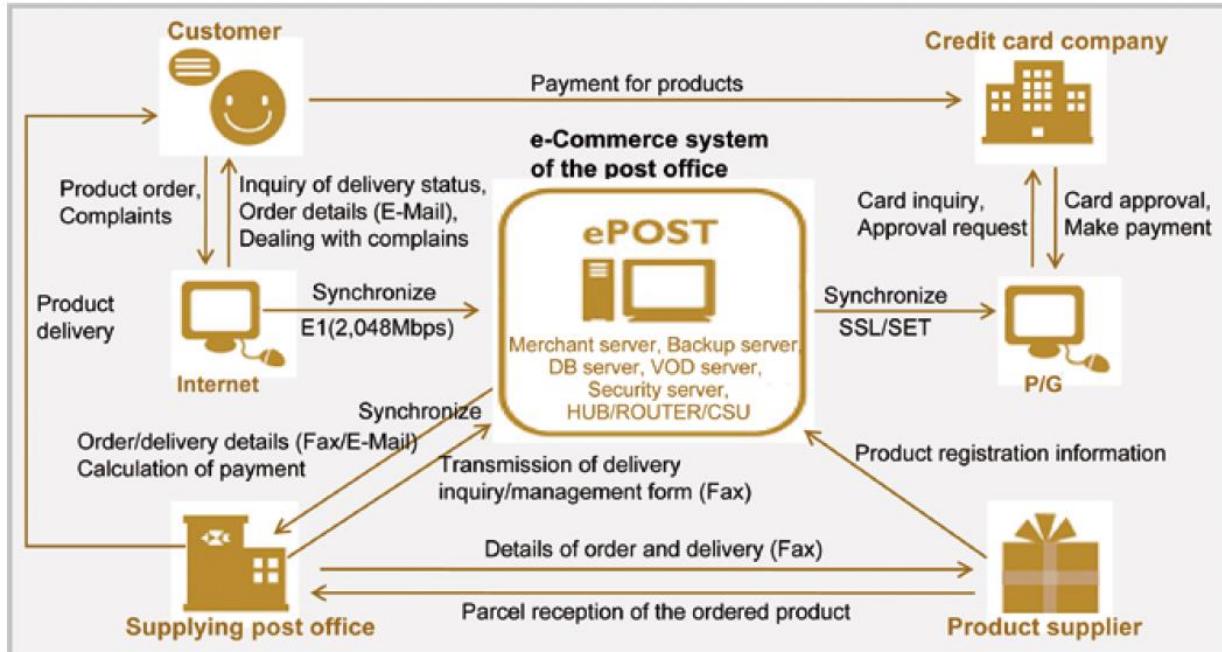


Figure 2.5.1.2: Flowchart of ePOST process

Source: Icts, New Services and Transformation of the Post

Korea Post has also automated the entire mail handling process, with acceptance of delivery. Not only that they set up a web based postal logistics system for track and trace the product. Customers are notified by SMS on their mobile phone about the delivery status of their mail. Currently, Korea Post operations has managed to more efficient mail, banking and insurance services and it has significantly contributed to the country's economic growth and economic development, especially in farming and fishing communities.

In recent years, Korea Post has been providing savings accounts, insurance products, and credit cards aimed at low-income customers. In some remote areas, post offices even provide services like train and airline bookings as well (Foreign Policy).

2.5.2 Italy Postal Service (Posteitaliane.post, 2014)

PosteMobile is one of the early developments that contributed to the growth of mobile commerce in Italy. It was launched in November 2007 and by the end of 2009 it offer basic mobile services such as voice and messages, standard value-added services such as news, entertainment, music and games, and distinctive mobile banking, mobile commerce, mobile payment and mobile postal services(Icts, New Services and Transformation of the Post). PosteMobile use more than 1.2 million customers. And also for a month it transferred Over 8 million euros through PosteMobile.

PosteMobile plans to expand into the mass market. It enables customers to buy products and services using their phones and to send payments overseas. It introduced these services using the latest commercial near-field-communication (NFC) technology, considered to be faster and more secure compared with other technologies, such as Bluetooth. Large investments made by Poste Italiane in technological innovation have “allowed the company to guarantee its customers cutting-edge services, and have made it an important factor in Italy’s general economic growth and modernization”.

Financial services promoted by Italy post played important role. PosteMobile services are expected to integration by offering attractive pre-paid call packages. Currently, entire postal system is governed by a technological infrastructure that is among the most advanced in the world. And it allowing accessed via the Internet, telephone, self-service machines and though DTTV (digital terrestrial TV) to improve its products and services through the simplification and expansion of services (Icts, New Services and Transformation of the Post).

PosteMobile is also helping Italy post to directly contribute to its future development. It has designed and developed a new system infrastructure with a Windows mobile client application which allowing postmen to transfer information about mail delivery by mobile phone. The aim of this application is to improve the delivery process in Italy. Currently, 4,920 postmen use this service on a daily basis.

2.5.3 Australia Postal Service (Auspost.com.au, 2014)

In the last 15 years, Australia Post has expanded its product and service range and invested in technology-based infrastructure programs. Australia Post has been discovering in finding advanced ways to raise revenue and maintain services in remote regions. This provided access to a wide choice of financial institutions via Australia Post personal banking service called Bank@Post. It allows to deposits and withdrawals pay council rates, utility/credit card bills, insurance premiums and fishing/dog licenses at the same time. This largely benefited licensed postal outlets in small communities where there had been no existing face-to-face financial services. And it handle with more than 2,500 manual transactions per year. Because of that in 2010 some 400 licensed postal outlets in rural areas had been automated through this scheme (Post Offices & Local Government Services – An International Literature Review.) Currently, it also operates in three important areas, such as letters and other related services, retail products, agency services and parcels and logistics.

Through Letters and other related services Australia Post collects, processes and distributes letters for the entire Australian community and between Australia and other foreign countries. It also offers majority of mail delivery services for businesses and community organizations and also provides services such as research, advice, consumer list rental, and profiling and segmentation services to help businesses along with other related services. Australia Post operates normal mail delivery as well as an express/courier service through Messenger Post.

Australia Post also act as agency services by connect customers, businesses and government parties and provide services such bill payment services, banking services and identity services among them. As well as they offers personal finance products, such as car and travel insurance and currency conversion. With retail merchandise they provides variety of products, packaging products, collectibles and post office boxes and locked bags are offer across the vast network of Australia Post. Australia Post also collects, processes and distributes parcel deliveries all across Australia and internationally. It also provides complete end-to-end supply chain capabilities, from domestic or international manufacturer to consumer with incorporated logistics services and a broad range of distribution options to track and trace deliveries.

Moreover, Australia Post launch of its Digital Mailbox in 2012. This service allows businesses, government entities and customers to communicate through a secure online portal. And also it provides secure digital delivery service to realize and achieve all their transaction mail. It allow consumer to store important documents available on mobile and desktop.

Australia Post is a government business enterprise. It is committed to providing an accessible, affordable and reliable letter service for all Australians wherever they reside. Australia Post

provides a minimum of 4,000 retail outlets nationally, of which some 2,500 should service rural and remote communities. By mid-2010 there were a total of 4,415 outlets, with nearly 60% in rural or remote areas (2,024 rural and 507 remote) (Post Offices & Local Government Services – An International Literature Review). The corporation reaches more than 10 million Australian addresses and operates 6,990 postal outlets and serves millions of customers in postal outlets every business day.

2.5.4 Brazil Postal Service (Correios.com.br, 2014)

Empresa Brasileira de Correios e Telégrafos (ECT) was one of main Banco Postal project which was intended to provide basic banking services through its retail network. People can do the transaction through this retail network without access to any formal financial network. Banco Postal project successfully combined digital and physical networks and today it improved efficiency, competitiveness and profitability for Posts, and increased employment. Moreover, the facility of new non-postal products through the postal network also adds value to this network with lowers the costs of maintaining universal service and can help to enhance the impact of future failures in basic mail volumes.

ECT project operations has enabled to maintain an interactive website that offers information and allows transactions for the postal and financial services and it has enabled to provide e-commerce and e-government services. Through the network the integration of the physical, electronic and financial networks has significantly enhanced the various national services that are distributed through the ECT network and this network accessible anywhere and anytime at many places. Many of these services provide social and economic value to the Brazil country.

When the Banco Postal project was launched in 2002, it was estimated that over 45 million adults with many small and medium-sized enterprises (SMEs) had limited access to credit, which is critical for business growth. After launched Banco Postal project in 2009, with 6021 Banco Postal branches serving 8.8 million of these individuals. Currently, more than 1.2 million daily transactions are handled by Banco Postal. More than 700,000 loans have been distributed since 2002 and Banco Postal has become an important player in the microcredit market.

The establishment of the Banco Postal has enabled ECT to maintain profitability and strengthen its universal service. Some post offices which were losing money and in risk of being closed now continue to operate because they have become profitable with income earned from Banco Postal services. In some post offices, Banco Postal revenues now exceed postal revenues.

With individuals, municipalities and businesses now keeping their money at the local Banco Postal branch, the bank is able to extend credit to local businessmen and farmers, helping them to expand their activities and increase employment. While there are still communities without financial services, and the Post's attendance in the Banco Postal project has made people's lives easier and the economy encouragement.

2.6 Sri Lanka Postal service (Slpost.gov.lk, 2014)

Sri Lanka Post was established in 1798 by the Dutch rulers in the Maritime Provinces of the country with five post offices. Today it has grown in to a massive organization with more than 19,000 employees. Sri Lanka Post serves a population of more than 20 million populaces in Sri Lanka.

In 2004 Sri Lanka post had Post Office branch for every 2400 people of the country. In other words there was an office for every 14 km radius. Today majority of these branches are well-appointed with lot of equipment to provide an efficient service to Sri Lankan customers.

Currently they have 4,712 Post Offices branches in nationwide. They breakdown as 636 Post Offices, 3407 Sub Post Offices, 448 Post Offices, 156 Rural Agency Post Offices and 65 Estate Agency Post Offices. Through these post offices they provide a variety of services. Table in below describe them more.

Table 2.6.1: Sri Lanka Postal Services (Slpost.gov.lk, 2014)

| | |
|---|---|
| Communications (Posts & Telecom) | <ul style="list-style-type: none"> ▪ Letter mail ▪ Registered Letters ▪ Express Post ▪ Parcel Post ▪ Insured Post ▪ Telegrams ▪ EMS (International) ▪ Speed Post (Domestic) ▪ Tele-Mail ▪ Post-Fax ▪ E-mail (in all three languages) ▪ Internet surfing |
| Philatelic | <ul style="list-style-type: none"> ▪ Postage Stamps & Stationary ▪ Commemorative & Definitive Stamps ▪ First Day & Special Covers ▪ Souvenir (miniature) Sheets |

| | |
|---|---|
| | <ul style="list-style-type: none"> ▪ Stamped Stationary ▪ Stamp Albums ▪ Greeting Cards ▪ Year Packs ▪ Presentation Packs ▪ International Reply Coupons |
| Financial | <ul style="list-style-type: none"> ▪ Money Order Services (Ordinary, Telegraph) ▪ Money–Fax ▪ E-Money Order (Trial Basis) |
| Banking | <ul style="list-style-type: none"> ▪ National Savings Bank Activities (Savings & Fixed Deposits) |
| Social & Obligatory Services | <ul style="list-style-type: none"> ▪ Pension ▪ Charity Monthly allowance ▪ Teachers Salary ▪ Social Security Benefit Insurance ▪ Other Social Payments |
| Agency Services | <ul style="list-style-type: none"> ▪ Motor Traffic Fines ▪ Electricity Bill Payments ▪ Examination Fees ▪ Sale of Internet & Phone Cards (SLT, Lanka Bell, Lanka Internet) ▪ Transacting with Hong Kong & Shanghai Banking Corporation ▪ Postal Insurance - a service in collaboration with Sri Lanka Insurance |
| Postal Facilities | <ul style="list-style-type: none"> ▪ PO Boxes & Mail Bags ▪ Business Reply Cards/Envelops ▪ Certificate of Posting ▪ Bulk Mail (collecting & Delivery) ▪ Business Mail (Trial Basis) ▪ Acceptance of Late Fee Letters |
| Service Communication Locales - Post Shops | <ul style="list-style-type: none"> ▪ Photocopying ▪ Laminating ▪ Book Binding ▪ Computer Type Setting ▪ Sale of Greeting Cards ▪ Sale of Gift Items ▪ Sale of School Items |

- | | |
|--|---|
| | <ul style="list-style-type: none"> ▪ Sale of Packing Materials ▪ Sale of Stationary |
|--|---|

2.7 Importance of EPOS for Sri Lanka

As above mention e-Post Office is the shopping portal of the world-renowned postal service on the Internet and an additional distribution channel. It sells Stamps, Postcards, Packets, and Cartons and has services like courier, registering for electricity vendors, selling mobile cards, etc. Under this website many products and services can be ordered, that are also available in a "normal" branch. The product prices are identical with the prices of their normal branches.

World has faster growing with Information Technology in many fields. The significant point is that any country in the world, regardless of their present state of development, can participate in this revolution and derive economics and social benefits from it. Therefore a developing country like Sri Lanka mainly concern about IT revolution to reduce the gap between developed world and developing world. The growing use of IT in all aspects of everyday life in developed countries has made the IT industry to be one of the fastest growth areas in the world.

In the latest past, Internet and e-mail have transformed the world of communications. It became most popular mail service of people who are with Internet. At the same time, accessibility to email becomes major problems many people who are in the rural areas. As a solution for this problem most of countries introduced E-post recently, to make the assistances of e-mail available to everyone and to link with the digital post office. With this service, customers can send their letters, parcels to any address in their country with a combination of electronic transmission and physical delivery through a network of Post Offices.

In Sri Lanka also have many area where IT is used today. Whether it be education, health, social security, banking, entertainment, travel, tourism, manufacturing industry, defense or scientific research. But in government sector the use of IT is lack than the private sector. IT make it possible for most every kind of information to be stored, accessed, processed and transmitted digitally in electronic form without traditional "Print on paper" media. Therefore, using E-post office system for Sri Lanka will be more efficient, effective and accurate. And also it will be a significant assistance for government sector as well as the country economy (Icts, New Services and Transformation of the Post).

Through the E-Post Office Sri Lanka postal service can be expanded permanently through new products and services in order to offer a product portfolio corresponding to the market. Private customer and business customers can order the selected products of the postal service online

quickly and comfortably. Besides this, the e-Services offer new flexibility through e-Packet, the Pickup order for packages over the Internet as well as the online forwarding order and storage order. For the case of the absence or the move, one can let delegate here the after shipment of the postal service at another address or store the letter shipments. The customers can register themselves and can be served individually.

2.8 Summary

In this chapter we explain our approach to automated solution for EPOS by describing its inputs, outputs, features, processes, users. We also highlighted the uniqueness of our solution with respect to the output. Following our approach the next chapter will described the design the employee work process scheduling system.

Chapter 03

Technology

3.1 Introduction

In this chapter discussed more about technology that used for E-post office system development. For E-post office system development .Net framework as development framework, C# language used SQL Server 2012 as database and DevExpress and Bootstrap used as UI Designer tool for this project. In this chapter consist with details about these technologies.

3.2 .NET Framework Platform Architecture

C# programs run on the .NET Framework, it runs on a virtual execution system called the common language runtime (CLR) and a combined set of class libraries. The CLR is the implementation by Microsoft of the common language infrastructure (CLI) and it helps to create execution and development environments in which languages and libraries work together without any flaw (Msdn.microsoft.com, 2015).

C# source code is compiled into an intermediate language (IL) that conforms to the CLI specification. The IL code and resources such as bitmaps and strings are stored on disk in an executable file called an assembly (Msdn.microsoft.com, 2015). Assembly is typically creating with an .exe or .dll extension. It contains a manifest that provides information about the assembly such as types, version, culture, and security requirements.

When the C# program is executed the assembly is loaded into the CLR. Based on the information in the manifest CLR might take various. When the security requirements are met, the CLR performs just in time (JIT) compilation and convert the IL code to native machine code. CLR also provides other services such as automatic garbage collection, exception handling, and resource management. Following diagram illustrates the compile-time and run-time relationships of C# source code files and the .NET Framework (Msdn.microsoft.com, 2015).

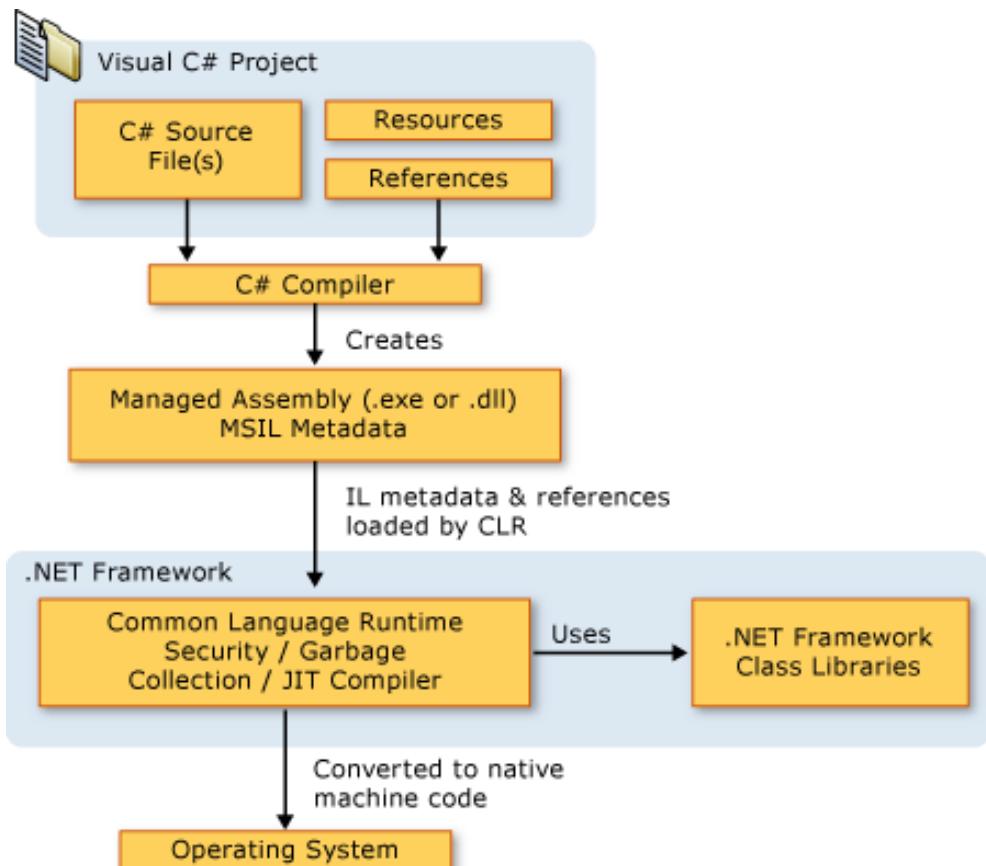


Figure 3.2.1: compile-time and run-time relationships of C# and the .NET Framework

Source: Msdn.microsoft.com

The main key feature of the .NET Framework is language independence. The main reason for that is the IL code produced by the C# compiler conforms to the Common Language. IL code generated from C# can interact with code that was generated from the .NET versions of Visual Basic, Visual C++, or any of more than 20 other development languages. A single assembly can be containing multiple modules written in different .NET languages, and the types can reference each other just as if they were written in the same language (Msdn.microsoft.com, 2015).

In addition to the run time services, the .NET Framework also includes an extensive library of over 4000 classes organized into namespaces which helps to provide a several of useful functionality for everything from file input and output to string manipulation to XML parsing, to Windows Forms controls (Msdn.microsoft.com, 2015).

3.3 C# Language

The programming language C# derives from C and C++ and it is very similar to java language also. Developers who know any of these languages are usually able to begin to work efficiently in C# within a very short time. Even though C# syntaxes are complex, yet it is also simple and easy to learn.

C# syntax simplifies many of the complexities of C and C++ language and it provides powerful features such as nullable value types, enumerations, delegates, and direct memory access, which are not found in Java, added convenience are strict type safety, versioning, garbage collection, and many more (Msdn.microsoft.com).

Moreover, C# language is fully object-oriented language. Therefore, C# supports the object-oriented programming concepts such as encapsulation, inheritance, and polymorphism. All variables and methods including the Main method and the application's entry point are encapsulated within class definitions. A class may inherit directly from parent class, but it may implement any number of interfaces. To override virtual methods in a parent class require the override keyword as a way to avoid accidental redefinition (Msdn.microsoft.com, 2015). Moreover, C# makes it simple to develop software components through several innovative language constructs, including the following:

- Encapsulated method signatures called delegates, which enable type-safe event notifications.
- Properties, which serve as assessors for private member variables.
- Attributes, which provide declarative metadata about types at run time.
- Inline XML documentation comments.

As Microsoft mentioned "If you have to interact with other Windows software such as COM objects or native Win32 DLLs, you can do this in C# through a process called Interop." (Msdn.microsoft.com). It enables C# programs to do anything that a native C++ application can do. C# even supports pointers and the concept of "unsafe" code. Although the default for C# code is safe mode, there are options available for declare certain classes or only methods of classes to be unsafe. Because of that it enables you to use pointers, structs, and statically allocated arrays. Equally safe code and unsafe code run in the managed space (Wille, 2015).

The C# build process is trouble-free compared to C and C++ and more flexible than in Java language. There are no separate header files, and no requirement that methods and types be declared in a particular order.

3.4 SQL Server 2012

Microsoft SQL Server is an application used to construct computer databases for the Microsoft Windows family of server operating systems. Microsoft SQL Server provides an environment used to generate databases that can be accessed from workstations, the Internet, or other media such as a personal digital assistant (PDA) (Anon, 2015).

SQL server is one of best database management or DBMS application used to store data and helps them transform the data into information. SQL server allows to create, update and extract information from their database.

A database is a structured collection of data. SQL Server stores each data item in specific fields. These fields are bundled together to form a single complete unit of data or a record. Each record is made up of a number of fields. There cannot be duplicate two fields with same value.

SQL Server stores records in different tables which are created for the various groups of information. In other words, collection of data tables referred as a database.

Every table consists with a field or a combination of fields that uniquely identifies each record in the table. This unique identifier is referred as Primary Key. The primary key helps to distinguish one record from all other records in a table and it allows the user and the database system to identify, establish and refer to one particular record in the database.

Sometimes all the information of a business operation cannot be stored in single table. SQL Server provides a sustainable solution for this problem. SQL Server makes it very easy to link the data in multiple tables. Therefore, SQL Server also called as a relational database management system or RDBMS. It enables to define relationships between the table and enables to define relationships between those tables.

When one table primary key matches the another table field is referred to as a foreign key. Foreign key is a field or a group of fields in one table whose values match primary key of another table.

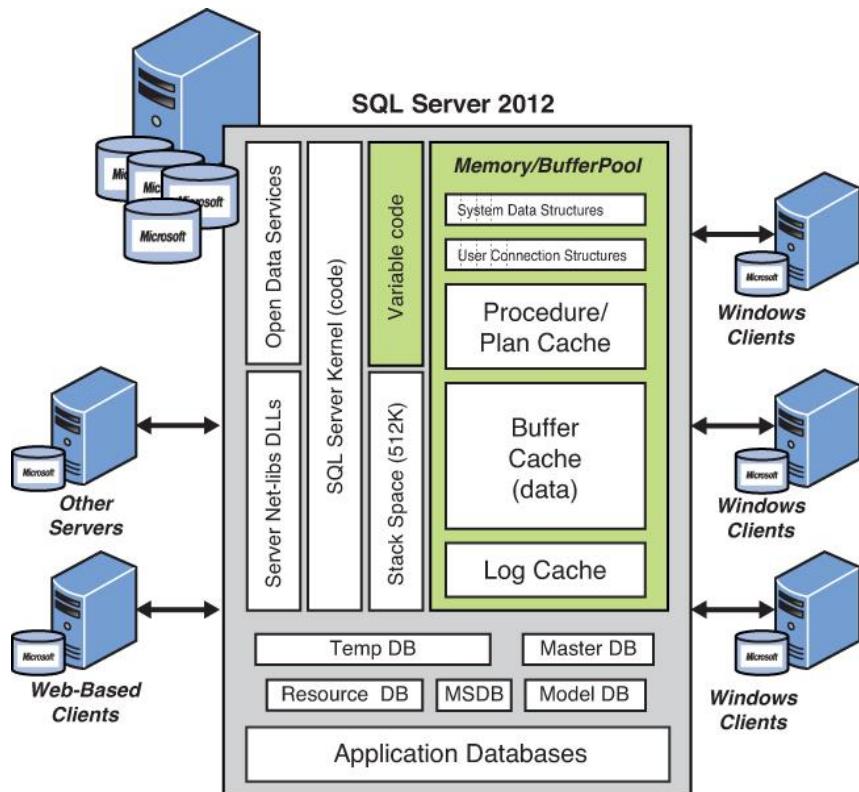


Figure 3.4.1: SQL Server Architecture

Source: Safari Online

3.5 DevExpress

DevExpress is one of most wonderful tool for UI designing. With DevExpress 95+ AJAX Web Forms Controls that ship inside the DevExpress ASP.NET helps to build a functional, elegant and interactive experiences for the web whether target browser or computing device. DevExpress supports all major browsers including Internet Explorer, Microsoft Edge, FireFox, Chrome, Safari and Opera with best possible compatibility.

Most of the time customers expect superior performance, rather than dataset size or information complexity. DevExpress has capability to address these expectations efficiently, without affecting to create highly functional data solution. DevExpress ASP.NET AJAX Controls are powered by a proprietary server-side data processing engine so users can shape and analyze mission critical information at lightning speed.

Moreover, performance is further optimized with Controls and Extensions that use memory efficiently, without any loss of functionality. A comprehensive set of optimizations such as HTML compression, AJAX callbacks, image sprites, resource caching and sharing web application will behave as expected each and every time (DevExpress, 2015).

3.6 Bootstrap

Bootstrap is an open-source framework for developing responsive, mobile first projects on the web. Bootstrap is based on HTML, CSS and JavaScript (W3schools.com, 2014).

In other words, Bootstrap is a set of classes that are defined inside of CSS as well as a set of functionality that's defined inside of a JavaScript library. These functionality makes it easier to layout pages without the use of tables. It simplifies CSS as the bulk of the functionality for the developer and it only requires the addition of classes to HTML elements and a bit of structure.

3.7 Summary

Technology is a key area that should select when developing a system. Consequently in this chapter it has been described about the technological perspective of the proposed software solution. And also, in here it has been included the details about developing tools, Database selection, language selection and framework selection.

Chapter 04

Approach

4.1 Introduction

We have discussed so far about the research problem and the technology to be used in order to give an accurate solution to the problem domain. In third chapter was discussed about the Technology to be used in the development processes. In this chapter we are getting step forward to approach of the development processes. It will be described about the alternative solutions to be used in the development as a solution for the constraints. Furthermore this chapter will be an exposure to discuss about the inputs outputs the stakeholders or the users who will be benefited by this project and its features. In this chapter put forward, our approach to alternative solution. For this purpose this chapter presents the hypothesis and discussion of inputs, outputs, process, user and the features

When gathering the requirements of the task to be performed, it is necessary to studying the existing problem and understands the requirements of the new system. These activities serve as basis of giving the functional specifications and then successful design of the proposed system. Understanding the requirements and functionalities of a new system is more difficult and it requires creative thinking for reengineering process.

4.2 Research Design

Research design mainly connected to accomplish the main objectives, which mentioned in the above. It's talking about the overall strategy different components of EPOS in a clear and logical way. Thereby, effectively address the research area of the system by determining the type of design developers can use. It constitutes the blueprint for the collection, measurement, and analysis of data.

As the research methods of this project developers will use a mix of quantitative and qualitative research methodology. The purposes of these methods are to correctly identify the knowledge, process and communication requirements of the users of a new system.

In this research of developing the E – Post office system for Sri Lanka Postal Service, there are qualitative data as well as quantitative data to be gathered. Data will be gathered directly from the relevant sources or from different places. That is why they use a combination of these two methods to gather requirements.

As quantitative data collection methods there will be interviews which will be face to face ones where developer can ask back to back questions to clarify their doubts. The purpose of the interview is to review the ideas of the interviewees about current system and what they expect from the new system with regards to their functions. And also use questionnaires with open ended and close ended questions which will be on paper-pencil questionnaire. Through quantitative data gathering method helps to gain results that are easy to summarize, compare, and generalize.

As qualitative data collection methods In-Depth Interviews, observation methods and existing document review are used for this research. Through qualitative data collection methods helps to gain information useful to understand the processes behind observed results and assess changes in people's perceptions of their well-being. Furthermore qualitative methods can be used to improve the quality of survey-based quantitative evaluations by helping generate evaluation hypothesis. Here we may have to interview respondents several times to follow up on particular issues, clarify concepts or check the reliability of data. Direct Observations also more helpful to get a good idea about the current system and live performances of the end users.

Agile development methodology offers opportunities to assess a project throughout the development lifecycle. This is achieved through regular times of work which known as iterations. This approach greatly reduce both development costs and time to market. Agile development methodology helps to build the right product (Agilemethodology.org, 2016). The development of the system is graphically shown in following diagram.

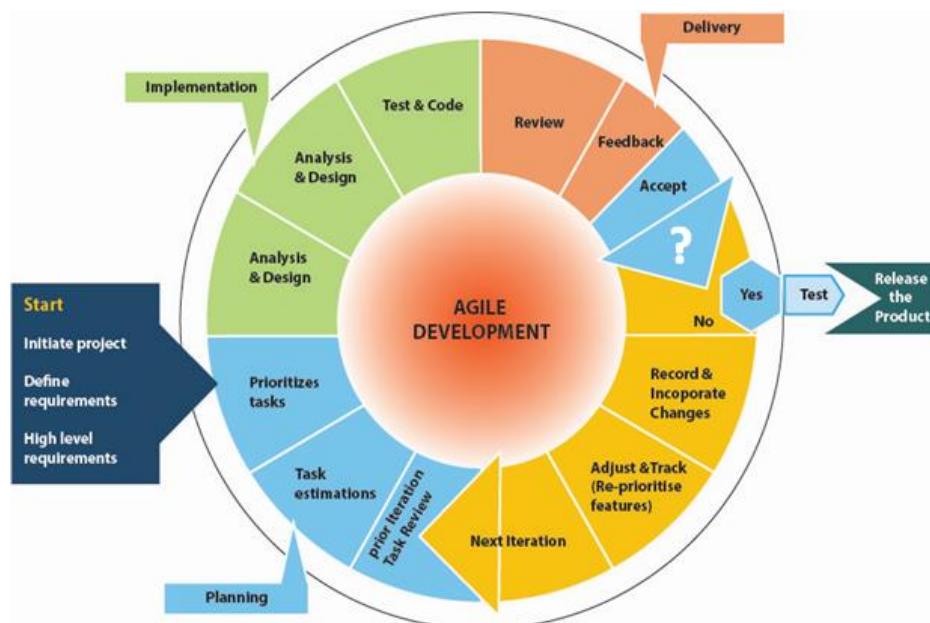


Figure 4.2.1: Agile Development Process

Source: Author

The majority of interviews were held at Postal Headquarters, because Postal Headquarters Senior System Administrator is the most responsible person of managing information technology with the Sri Lanka Postal service. The plan was to make at least 3 interviews with him, and helps to cover all the functions related to EPOS system development.

According Senior System Administrator's time schedule pre-plan was planned. Therefore, all the interviews were held at actual date. Interview Questionnaire shownen in Appendix A.

Table 4.2.1: Pre Plan and Actual Plan (Author)

| Pre Plan And Actual Plan | | | | |
|---------------------------------|-----------------------------|---------------------|-----------|--|
| No | Respondent | Place | Date | Topics |
| 1 | Senior System Administrator | Postal Headquarters | 4/3/2015 | <ul style="list-style-type: none"> • Discuss about the current system. • Identify functions of the current system. |
| 2 | Senior System Administrator | Postal Headquarters | 11/3/2015 | <ul style="list-style-type: none"> • Describe the proposed system. • Identify users of the current system. • Discuss the process of shopping cart function. |
| 3 | Senior System Administrator | Postal Headquarters | 22/7/2015 | <ul style="list-style-type: none"> • Discuss the process of Domestic parcels and mails tracking function. • Discuss the process of E – Post card function. |

4.2 Hypothesis

To overcome the problems in the existing system the new system development try to automate domestic parcel and mail tracking function, shopping cart and E-post card function processes with the database integration approach. Moreover, through this system following activities are provided.

- User friendly application with various controls.
- Much easier and flexible.
- There is no risk of data mismanagement.
- It provides high level of security with different level of authentication.
- Users from any part of the world can make use of the system.
- New system will process accurate results.
- New system will be much better in performance as compared to existing one.

4.3 Input

Inputs facilitate the entry of data into the computer system. The main objective during the input design is the selection of the best strategy for getting data into the computer system at the right time and as accurately as possible. Following figures are describing required inputs from users for each module.

Input design must capture all the data that the system needs. According to the above figures there are two types of system inputs, such as external inputs and internal outputs.

External inputs are the prime inputs for this system. These inputs enter by the external customers of the system, such as

- Customer requests sign in to system
- Customer enters his or her personal details, user id and password
- Customer requests the product search
- User requests the shopping cart product description
- Enter shipping & billing details
- Enter tracking number to track domestic mail or parcels through the system
- Customer requests sending postcards through the system

Internal inputs are support to user communications with the system. These inputs enter by the admin or an employee within the organization. Through these inputs external customers are able to be aware of the system and they can easily gather information what they want. For this system internal inputs can enter by admin or delivery employees of the organization, such as

From Delivery person

- Enter domestic mails or parcel delivery details

From Administrator

- Add shopping cart product details
- Add post cards details
- Assign delivery orders to delivery person
- Admin requests for product catalogs, delivery orders, employee details, customer details and post card orders etc.

After take the inputs for system it will process and validate the data and give outputs for users of the system. As well as authentication and authorization is another essential criteria for validate each and every transaction of the system. Authentication is the process of confirming the user id of a user or a machine that is trying to log on or access to the system. And authorization is the process that verifies the user and gives correct privileges and rights to access the requested resource. Every time authentication occurs first and then authorization occurs. Below describes some access controls and identifiers for data which require user authentication in the E-post system.

4.3.1 Password Authentication

Most network operating systems require that a user be authenticated in order to log onto the network. The user identification is that which is required by the server for access to its file system. This can be done by entering a user name and password.

Password authentication is the most familiar authentication for users. Therefore, E-post system password authentication is used. To log onto the system, users should enter a user name and the password. This password is checked with database that contains all authorized users and their passwords. Password should contain a combination of letters, numeric characters and symbols. Having strong password will helps to maintain the security of the network also.

4.3.2 Data Validation

And also each and every field checks that each value is unique. Data validation is also helps to provide assured well-defined guarantees for accuracy and consistency for any of various kinds of user input into an automated system. There are lots of data validations rules which are used to develop this system. Most of the time these validations are designed and deployed as part of a user-interface, as a set of programs or business-logic routines in a programming language and as a set of stored-procedures in a database management system.

4.3.3 Error Avoidance

At this stage system ensure that input data remains accurate form. Through error avoidance system check whether the recorded up to the correct format and the data is accepted by the system.

4.4 Process

After take the inputs for system it will process and data and give outputs for users of the system. Figure 4.4.1 shows an overview diagram is a high-level IPO chart which summarizes the inputs, processes or tasks performed by the system to produce outputs from a module. System flow charting is used to identify the physical devices that generate the inputs and accept the outputs. Arrows show the primary input and output data flows.

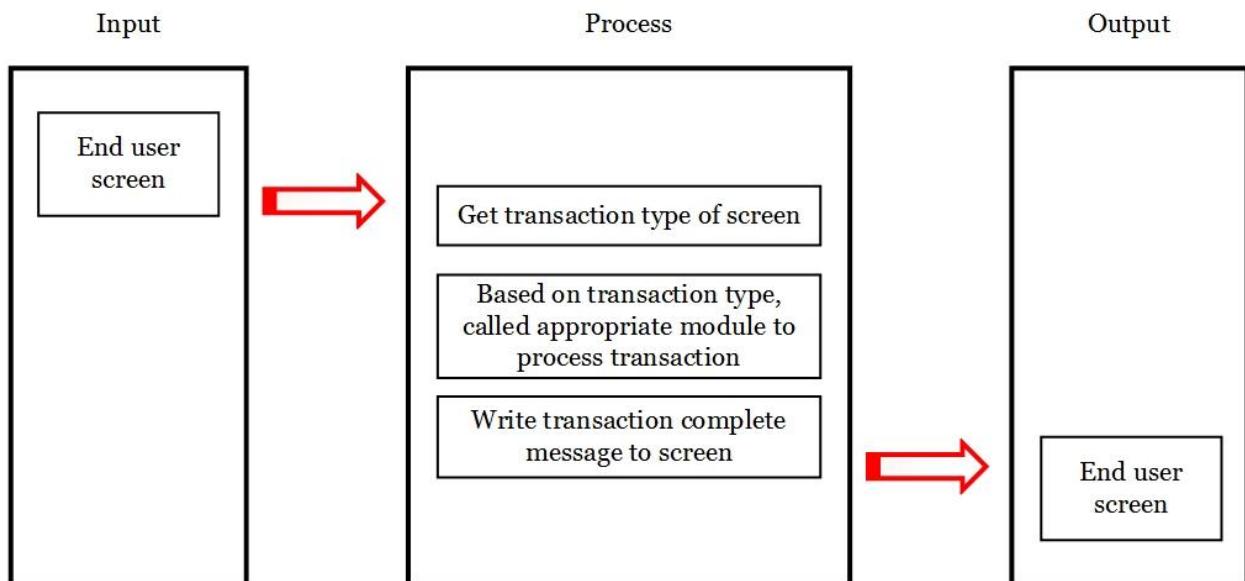


Figure 4.4.1: Overview Diagram for Process

Source: Hit.ac.il

Each step in process can be described as follows. Every specific input and output data elements or data structures are linked to specific processes.

The process steps are written in pseudocode. The first step of system processing is get transaction type of screen. It writes a menu to the user screen and input data. Second step read inputs from form screen and select input type. Switch case can be used for select process. After that as a final step it writes a transaction complete message to the user screen.

4.5 Output

Outputs from this system are required first and foremost to deliver the right information to the right people in the right format at the right time (Uky.edu, 2015). And most of the time output information used to provide a permanent copy of the results for later consultation. There can be various types of outputs in a system. Such as Internal outputs, External outputs and various reports.

Internal outputs are mostly supported to the system users and managers to stay inside the system. For an example provide next button for continue the system process. This will be helping them to understand and familiar with the new system accurately.

External outputs leave the system to trigger actions on the part of their recipients or confirm actions to their recipients

Turnaround outputs are those which are typically implemented as a report eventually re-enters the system as an input

Moreover, detailed reports and exception reports also will be the outputs of this system for top management inquiry. Through this system admin or top managers are able to generate reports as per their wish with little or no filtering or restrictions. Detailed reports confirm and document the successful as well as pending processing of transactions.

Through this system exception reports also can be generated. Exception reports represent the summary of detail reports. It can filter data before presented to the manager as information. These reports can be used to predict future conditions or patterns.

Keeping in view the above description this system able to generate main outputs desired according to the requirement specification are:

- Customer personal and order details.
- Employee personal and worked details.
- Delivery and order details.
- Tracking product details.
- E- Post card order details.
- Shopping cart product catalog details.
- Payment details.

The outputs were needed to be generated as a hot copy and as well as viewed on the screen. The standard printer is needed to be used to keeping in view these outputs as hard copies.

4.6 Users

This system primarily targeted for Sri Lankan sub post offices. The post officers will be required. It can also be accessed by system username and passwords for their login to the system. For this system there are 3 main users, such as Admin, Delivery person and customer. Admin has privilege access to all the administration features within a single site. Delivery person has privilege access to publish and manage the domestic parcels and mail delivery details. Customer has privilege access to only manage their profile.

Other than these roles, system will be able to handle higher authorities and system operators. Higher authorities have privilege to see generated reports through the system. And operators have system maintain privileges.

4.7 Features

The build a successful EPOS, requirements are identified in several perspectives such as Functional, Non-Functional, Technical, Usability. They are described more as follows.

4.7.1 Functional Requirements

- **Customer point of view:**
 - System shall be able to view customer details and update their details.
 - System shall be able to order products online.
 - System shall be able to create post cards online.
 - System shall be able to track domestic parcel and letter delivery details.
 - System shall be able to view parcel and letter delivery details.
 - System shall be able to communicate with post office using new system.
- **System administrator and Operating staff point of view:**
 - System shall be able to entering, modifying, and managing clients contact details.
 - System shall be able to maintain details of delivery items continuously.
 - System shall be able notify letters and parcel delivery to next destination.
 - System should be able to handle the customer credit card details.
 - Alerts should be go the particular person relevant using E-mails.
 - Administrator shall be able to view details
 - System shall be able to generate reports.
- **Common:**
 - System shall provide user accounts for each user of the system.
 - System shall be able to view, edit and delete their user profile.

4.7.2 Non-Functional Requirements

- **Performance**
 - The system should enable to access multiple users simultaneously.
 - The system should be able to reduce the time that take to process a record than in the current system.
 - The system shall allow the data stored to be available for later analysis.
 - The system shall enable efficient management with search and retrieval of data record
- **Security**
 - The system shall not allow unauthorized accesses.
 - The system shall not allow users to access pages which are not relevant to them.
 - The system shall not allow more than 3 wrong login attempts within 30 minutes of time.
- **Reliability**
 - The system can be accessed anytime which has internet connection.
 - The system shall be able to protect from data losses.
- **Usability**
 - The client interface would be user friendly and adapt to it quickly.
 - The designs will be created with appropriate themes, colors and font sizes.

4.8 Summary

In this chapter we explain our approach to automated system for postal service in SL. by describing its input, Output, process, users and features. We also highlighted the uniqueness of our solution with respect technology. Following our approach next chapter will describe design of the E – Post Office.

Chapter 05

System Analysis and Design

5.1 Introduction

In this chapter mainly discussed about the Overall Architecture, Software Architecture, Module Architecture, Interface Design and Database Design of EPOS. The system architectural procedure describe through Overall Architecture of the system. It can divide into three layers. They are Presentation Layer, Application Layer and Data Layer. Software Architecture represents all the modules, sub modules and all the components of the system. The modules such as Shopping cart, Domestic parcel and mail tracking module, E- posts card creator module are described through graphic representations in this chapter. Moreover, Module Architecture represents the interaction between user and the database. And also it represents the response of each level on the flow. Mainly reflects how data is stored in the database and how data is retrieved from the database. When considering about the Database Design, it includes the Entity Relationship Diagram to show the relationship between users and modules of the system. And also use normalization to represent data without redundancy. Furthermore, Interface Design is for each module also describe in this chapter. It gives some knowledge to the user how to work with this system.

Appendix A provides the diagrammatical representation of the process flow of the proposed system using UML techniques such as use case diagrams, activity diagrams and sequence diagrams. Following diagram represent the overall system of the proposed EPOS.

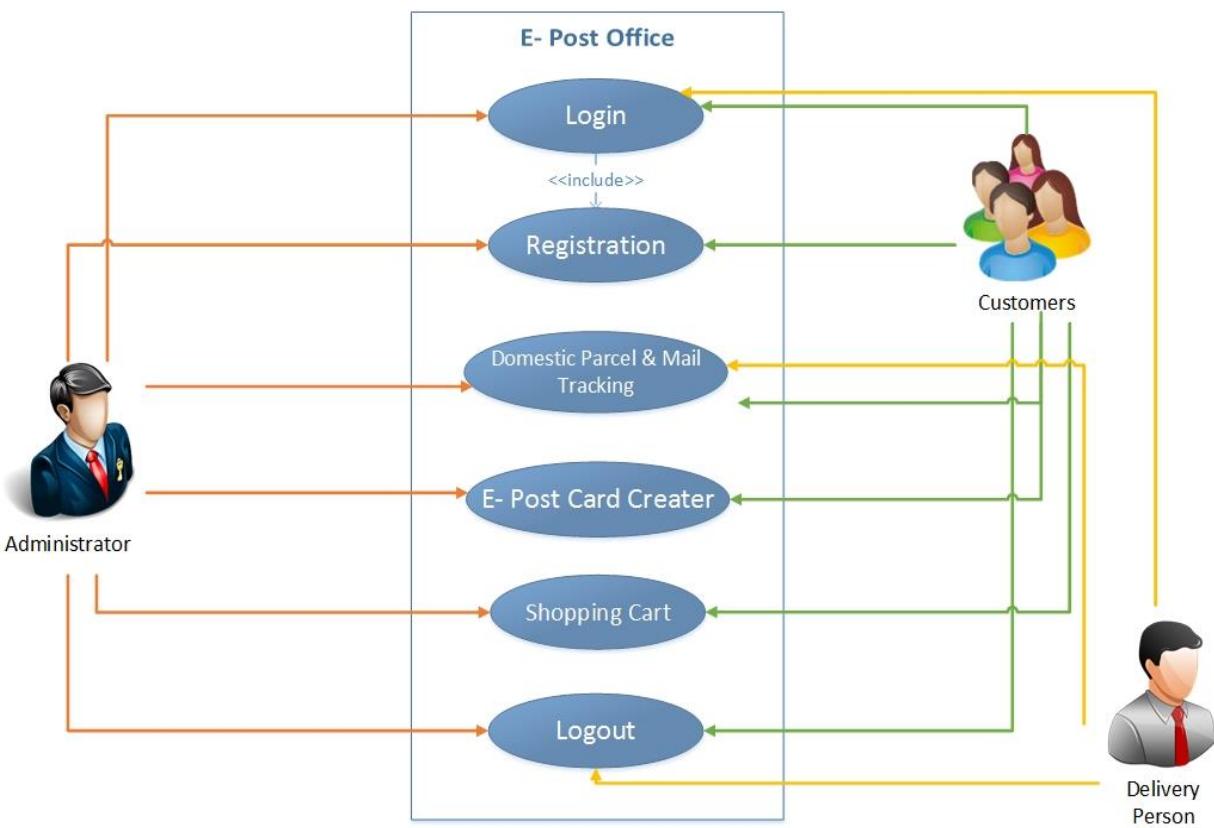


Figure 5.1.1: Use Case Diagram for Overall EPOS

Source: Author

5.2 Overall Architecture

Architectural design represents the overall structure of the EPOS which develops to manage and maintain the information in several functions. It gives some impression about how suitable this software with this architecture and what is the parameter that the database should be covered within the architectural design. The functions and the components are separately model for each function which represent by the layers such as presentation layer, application layer and data link layer.

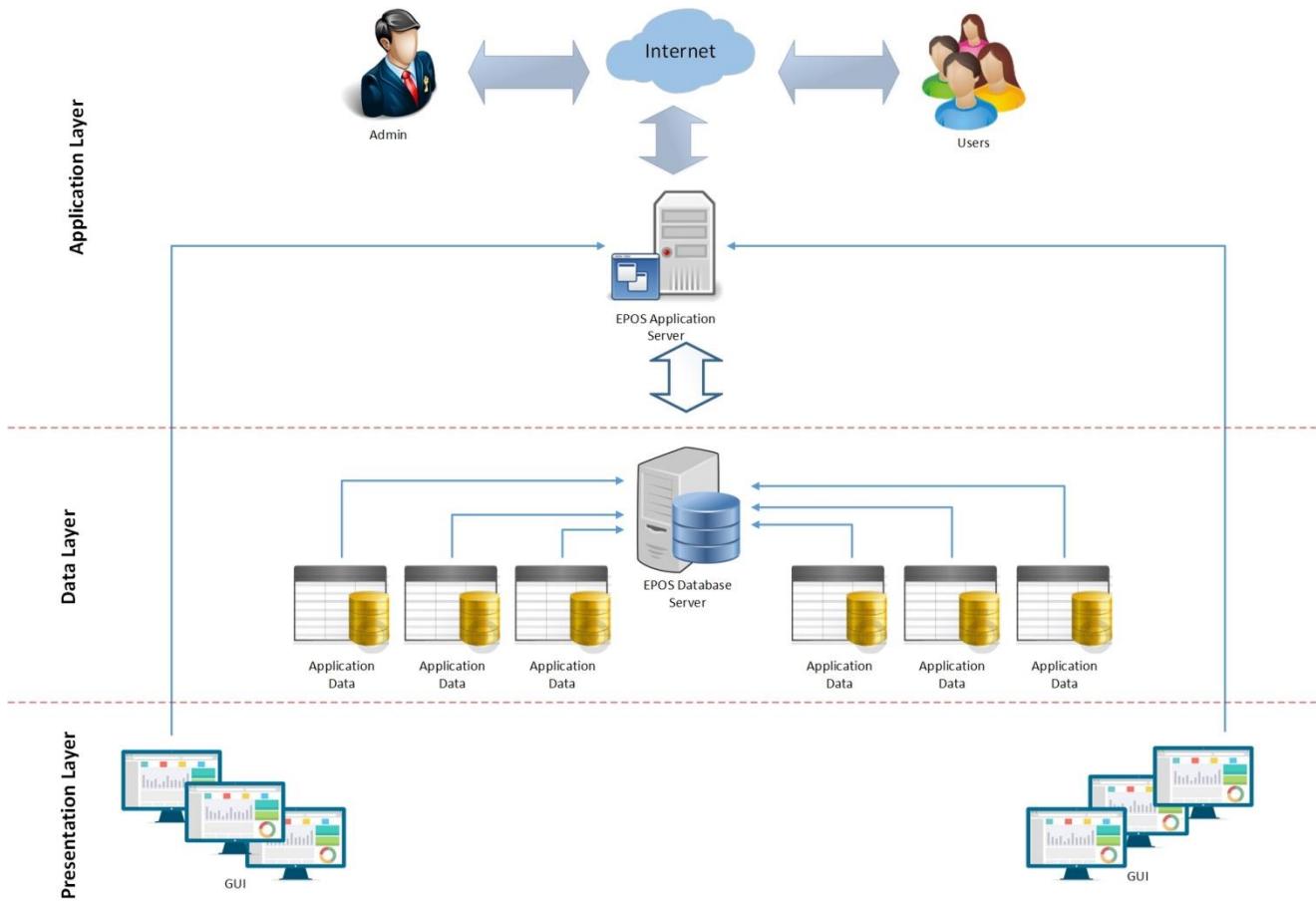


Figure 5.2.1: Overall Architecture

Source: Author

5.2.1 Presentation Layer

The interaction process of the EPOS is run on this layer. Internal users and External users can interact with the system through the graphical user interface. Main activities of the external users are fill the personal details in personal detail management module, select items from shopping cart, order products, order E-post cards and track their mails or parcels. According to the given details, application layer manipulate them in an order. And also the admin or operator, deliver person and higher authorities are the other parties who interact with the presentation layer. These parties are mostly interacting with this layer to maintain the entering details with interact with the system. And the other major aspect of this layer is the connection of the Local Area Network (LAN) and the Internet. This LAN connects between the presentation layer and the application layer. Users on the presentation layer and the server which installed the software connect through the Internet.

5.2.2 Data Layer

The overall details which input to the system are stored in this data link layer. The all the operations are stored in database and database applications are running on this layer. Data Layer defines the relationship between the entities of the database. Proposed EPOS will be implemented with a database server which is used to store all the required information which is need to process with the system functionalities. Data layer always have the connectivity to the application as well as the presentation layer of the overall system architecture. Storage space will be used effectively in order to maintain efficiency of the data processing of the system. Data which is gathered by the user (inputs) is designed to store at the database after the data manipulation done in the application layer. And also data layer facilitate the retrieval of data from the database, deletion and updating of records which is saved at the database.

5.2.3 Application Layer

The web services component will be built with the ASP.NET frame work. Application layer is responsible of designing the logical architecture of the proposed system. Functionalities of the system are proposed according to the architectural design of the system. Basically functionality, efficiency, accuracy, productivity of the system based on the logic which is designed at the application layer. When users sign-in to the system, they have to enter the user name and password, logic of verifying the user name and password occurs. Then the application layer will connect with the data layer in order to check the user authentication. There will be process validation logic in the web service to ensure data integrity before the data is saved to the database.

5.3 Software Architecture

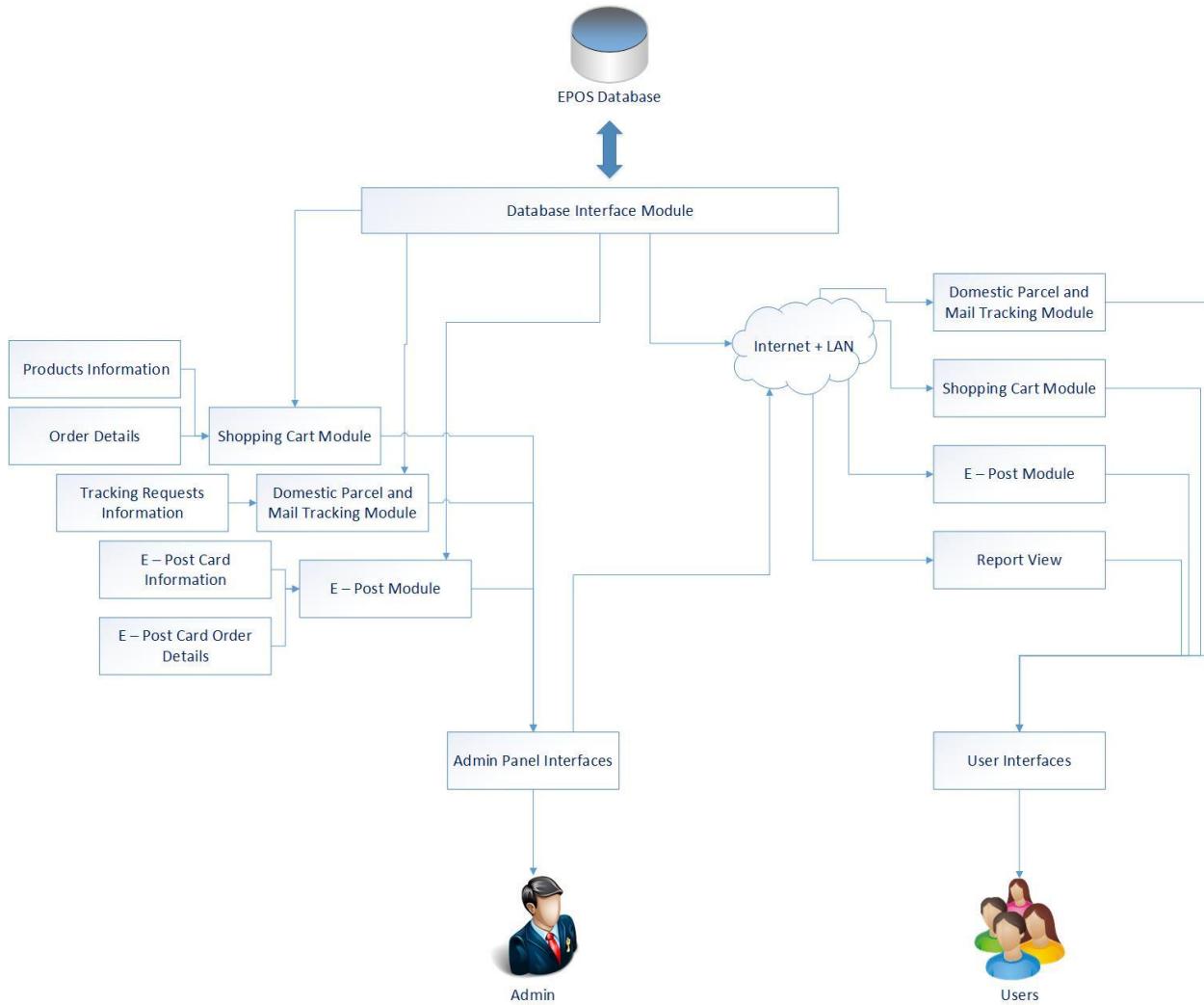


Figure 5.3.1: Software Architecture

Source: Author

This software architecture will explain about the complete process of EPOS. Above diagram illustrates the details about main modules of this EPOS. The database handling will be done by the administration of Sri Lanka Postal Head Quotes using their interface. Customers only can see their details, buy items and track their domestic mails and parcels after successfully logging to the system through WAN. The data is gathered in to a central database and the entire system is then run though this database. The web service is then connected to the database information module and the system is then linked up the database information module and the web service. The server base HRM database interface mainly divided in to five modules. Such as personal

details management module, loan module, Performance management module and the resignation management module. Personal details module and the loan management module directly link with the database. These two modules only edit by the admin panel. Operators enter details about the staff members to the data base. Then the staff members can view any kind of details related to that particular person using KDU network. If any member wants to apply loan, leave or resignation he/she need to use this system and apply using the web server.

5.4 Module Architecture

Under this section discussed about the detail description of separate modules incorporated with EPOS.

5.4.1 Login Module

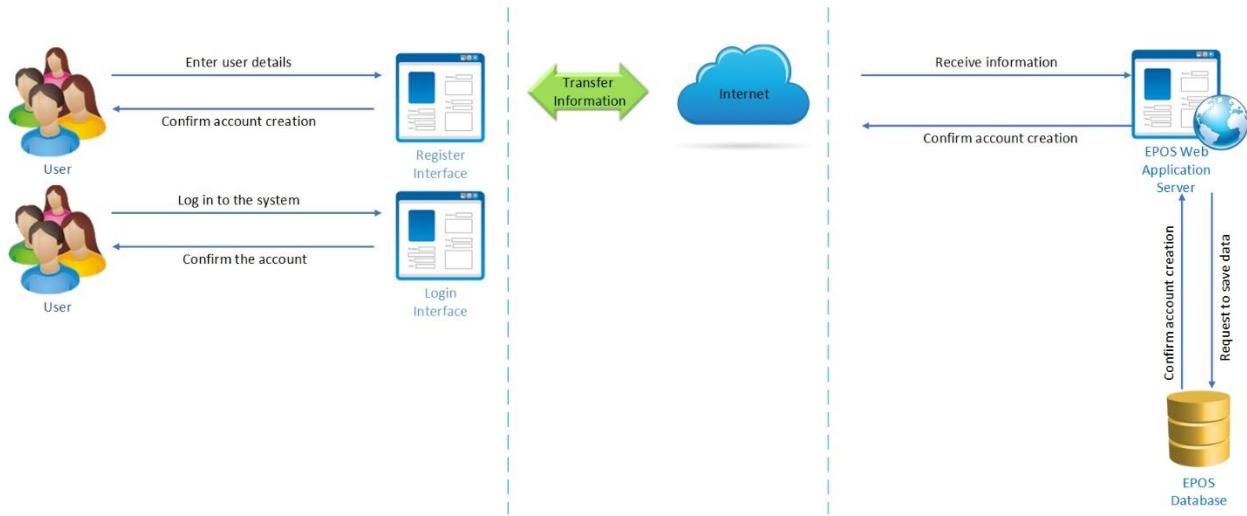


Figure 5.4.1.1: Login Module

Source: Author

This module enables users of the system to log in and use the services provided from the system. This module has many access levels such as administrator, delivery person, customers and different authority levels. Every administrator, delivery person and different authority levels must have unique username and password to login to the system. Customers not always need the username and password, but if they want to do any online money transaction, they required the unique username and password. After entering the username and password is checked with the data stored in users table and as well as the user access level. If customer is new user he/she need to register with the system. The user is higher authority, operator or a delivery person,

admin has to create user accounts for them after defining user privileges. According to these information, the system will provide user interfaces.

5.4.2 Domestic Parcels and Mails Tracking Module

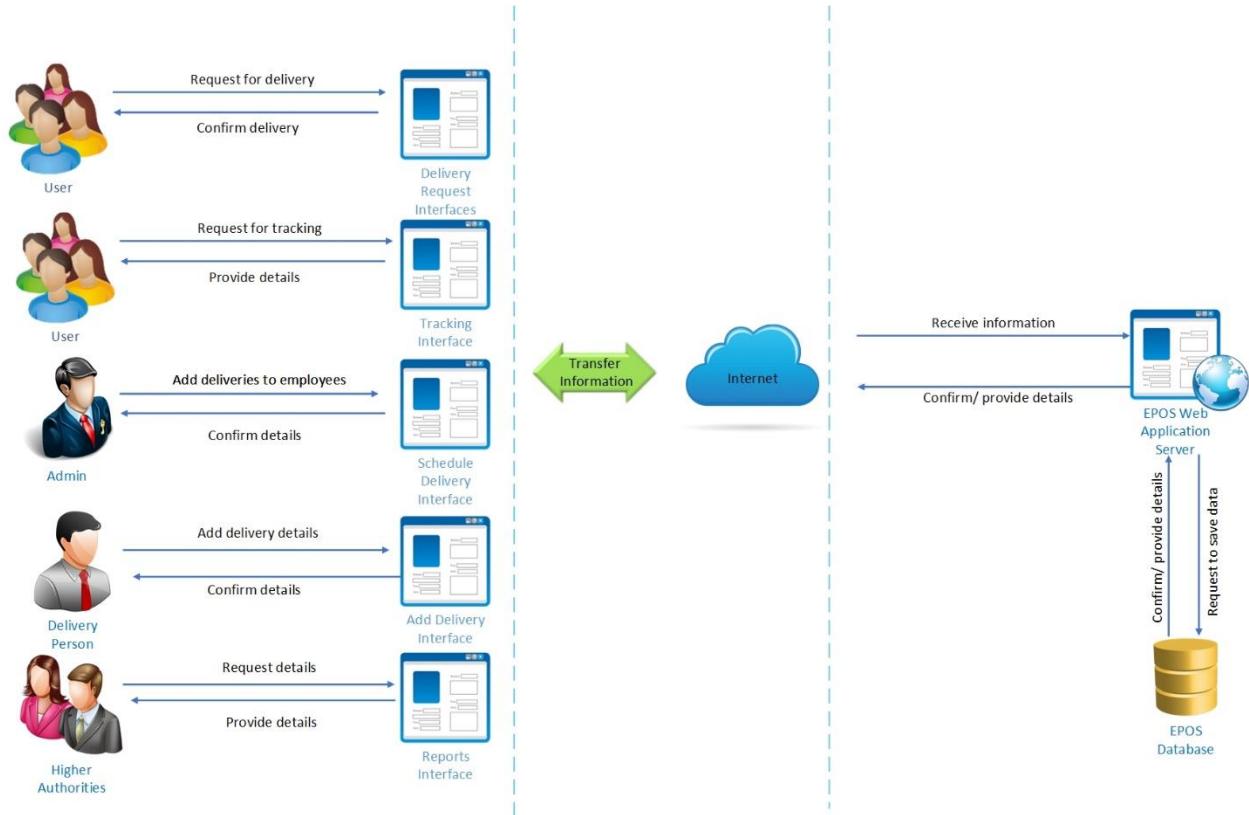


Figure 5.4.2.1: Domestic Parcels and Mails Tracking Module

Source: Author

When customer wants to track domestic mail or parcel they can use the tracking number which provided by the post office. Without login customers who are not registered with the system are able to use this option. If it is a registered customer he can able to see all the details of his/ her mails and parcels. After collecting the parcel or mail from the nearest post office branch customers are able to track the parcel or mail through the system. They can view their domestic letter or parcel delivery progress. Delivery persons are responsible for add progress details of domestic parcel and mails.

5.4.3 Shopping Cart Module

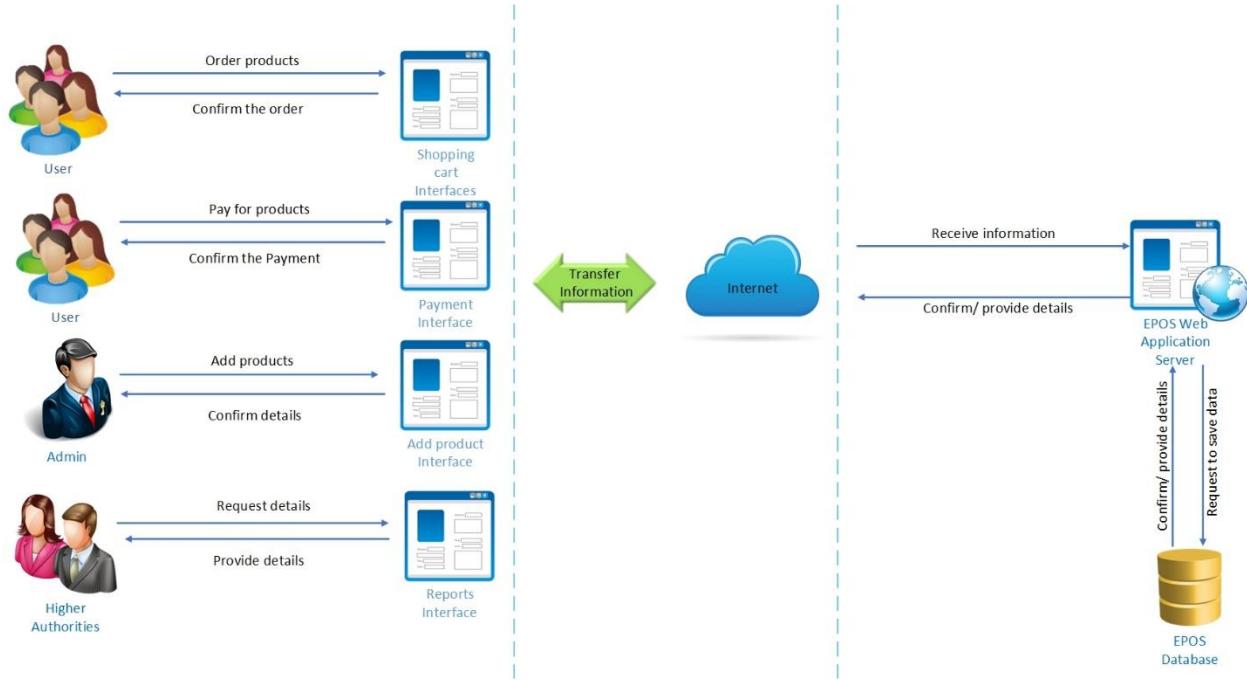


Figure 5.4.3.1: Shopping cart Module

Source: Author

Through this module customers are able to buy products which are sell from the post shops, such as gift items, stamps, envelops, post cards etc. When customers order products system will confirm the order after checking availability of the system. Then customers should fill the payment details for online payments. After doing payments system also checks whether payment is safe or not. Then the post offices are responsible to deliver product to the customer location. If a customer wants to buy products through the EPOS he must register with the system. Admin has privileges to add, edit and delete product details to cart. And also this module will be able to generate reports for higher authorities according to the system data.

5.4.4 E-Post Card Module

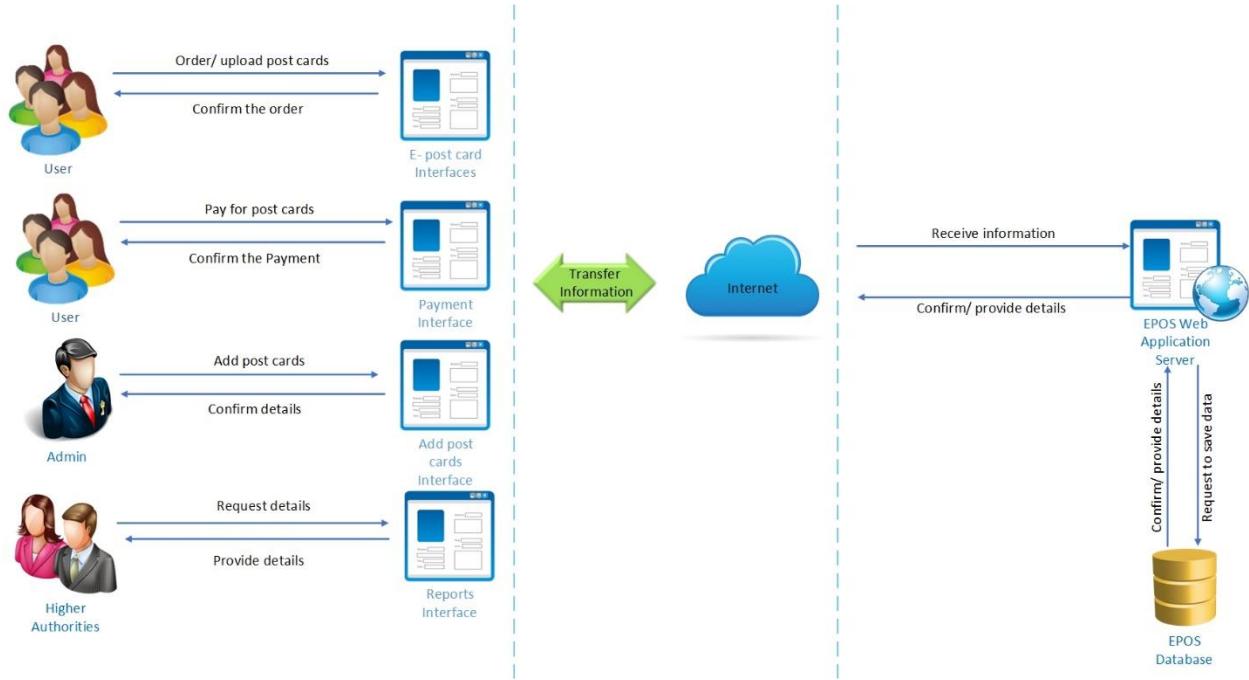


Figure 5.4.4.1: E – Post Card module

Source: Author

This module provides two main functions for the customers. Such as using own image for post card or use the existing post card. Customers should fill the sender's details to sending the post cards through the system. After fill the form successfully system will confirm the order. This module also requires the customer system registration to sending post cards. Administrator can add, edit and delete details of post cards and view all the available orders for post cards. This module will be able to generate reports for higher authorities according to the system data.

5.5 Data Design

Data Design represents the Entity Relationship Diagram, normalized set of table structure in order to give a clear idea about the structure of the database with the minimum data redundancy and reducing data anomalies.

5.5.1 Conceptual Data Model

Figure 5.5.2.1: Conceptual Data Model

Source: Author

5.5.2 Logical Data Model

Figure 5.5.2.1: Logical Data Model

Source: Author

5.6 Interface Design

Proposed EPOS is implementing with two interface categorizations, namely user interface and the administrator interfaces. All the interfaces are accessible by the user through the web. Interfaces are designed in order to meet the target of user friendliness and the efficiency in using the system.



Figure 5.6.1: System Login

Source: Author



Figure 5.6.2: Home Page

Source: Author

ePost Home PostShop View Tracking Login Register

Registration

| | | | |
|------------------|---|--------------|----------------------|
| First Name * | <input type="text"/> | Address No * | <input type="text"/> |
| Last Name * | <input type="text"/> | Street 1 * | <input type="text"/> |
| Birthday * | <input type="text"/> | Street 2 | <input type="text"/> |
| Gender * | <input type="radio"/> Male <input type="radio"/> Female | Street 3 | <input type="text"/> |
| Contact Number * | <input type="text"/> | Address * | <input type="text"/> |
| Email | <input type="text"/> | Postal Code | <input type="text"/> |
| Nearest Branch * | <input type="text"/> | | |

Set Password

| | |
|--------------------|----------------------|
| User Name * | <input type="text"/> |
| Password * | <input type="text"/> |
| Confirm Password * | <input type="text"/> |

Register **Cancel**

Figure 5.6.3: Customer Registration

Source: Author

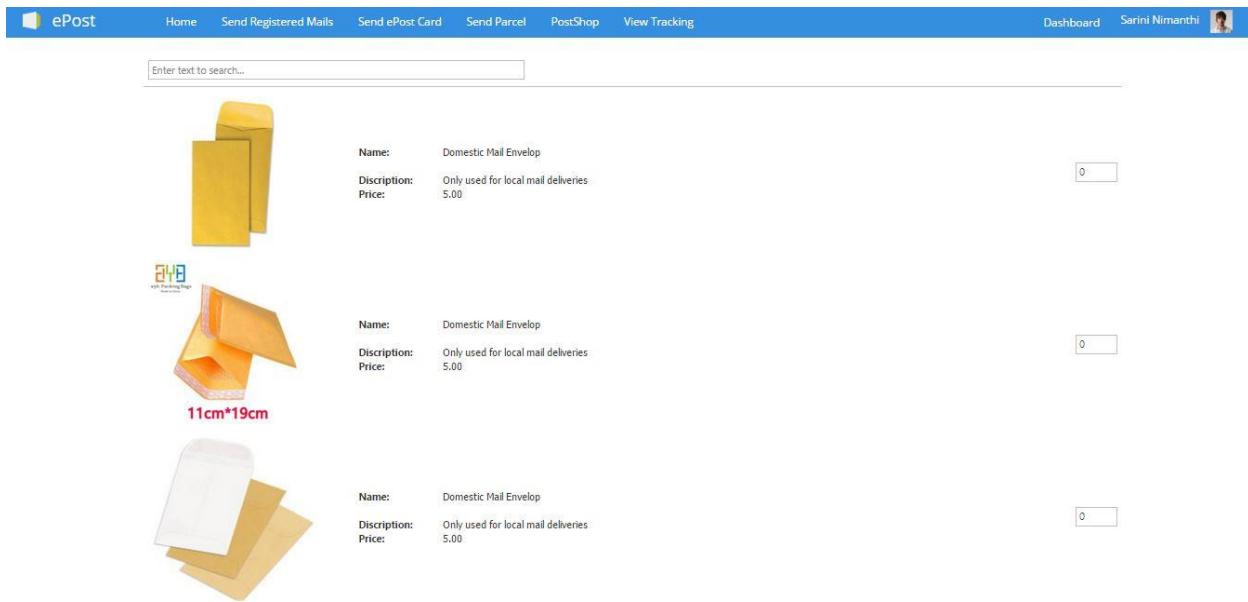


Figure 5.6.4: Shopping Cart

Source: Author

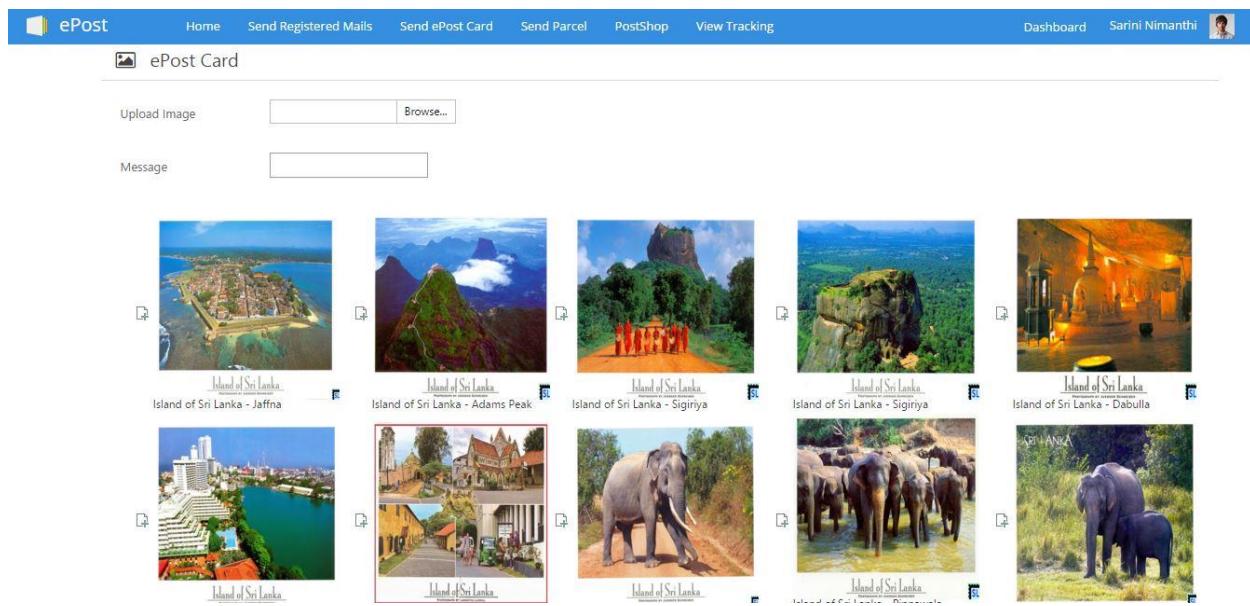


Figure 5.6.5: E- Post Card View

Source: Author

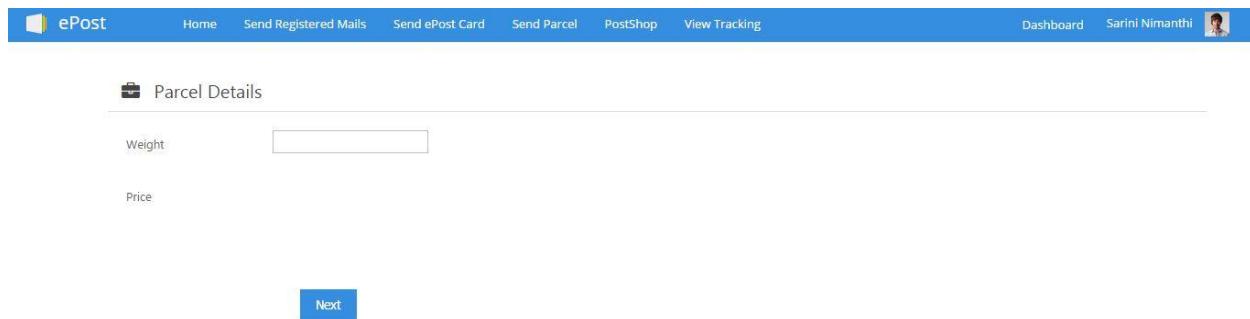


Figure 5.6.6: Sending Parcel Details View

Source: Author

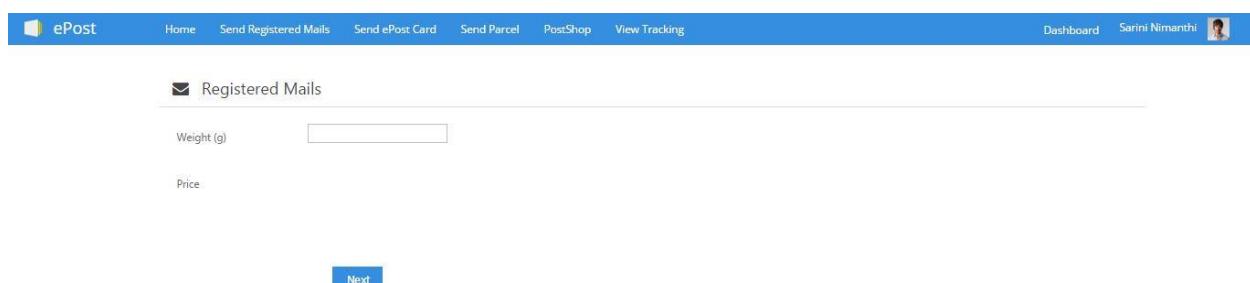


Figure 5.6.7: Sending Registered Mail Details View

Source: Author

Dilivery Details

| | |
|-------------------------|---------------------------|
| Sender's Details | Reciever's Details |
| Full Name * | <input type="text"/> |
| Contact Number * | <input type="text"/> |
| Address No * | <input type="text"/> |
| Street 1 * | <input type="text"/> |
| Street 2 | <input type="text"/> |
| Street 3 | <input type="text"/> |
| City * | <input type="text"/> |
| Postal Code | <input type="text"/> |

Next

Figure 5.6.8: Add Delivery Details

Source: Author

Payments

| | |
|------------------|---|
| Price | 12,000 |
| Payment Type | <input type="radio"/> Visa Card <input type="radio"/> Master Card <input type="radio"/> PayPal <input type="radio"/> Cash |
| Card Holder Name | <input type="text"/> |
| Card Number | <input type="text"/> |
| CCV2 | <input type="text"/> |
| Expiry Date | <input type="text"/> |

Proceed Payment

Figure 5.6.9: Payment

Source: Author

Your Tracking Number

TN0005055

Tracking Barcode

TN0005055



[Finish](#)

Figure 5.6.10: System Generate Tracking Number & Barcode

Source: Author

ePost Home Send ePost Card PostShop View Tracking Dini Gamage

| Tracking Number | Delivery Name | Delivery Address |
|-----------------|---------------|---------------------------------------|
| TH0003042 | Mihini Kumari | No. 7, Rukmale rd., Galembindunuwewa |
| TH0003042 | d Silva | No.41, Rukmale rd., Kottawa |
| TH0005042 | d Silva | No.7, Rukmale rd., Galembindunuwewa |
| TH0005043 | Mihini Kumari | No.4, School Lane., Kottawa |
| TH0005044 | Mihini Kumari | 23A, Rukmale rd., Galembindunuwewa |
| TH0005045 | Mihini Kumari | No.41, School Lane., Galembindunuwewa |
| TH0005046 | Kalum Perera | 23A, School Lane., Colombo |
| TH0005047 | Mihini Kumari | 234, School Lane., Colombo |
| TH0005048 | Kalum Perera | No. 7, Rukmale In., Colombo |
| TH0005049 | Sadun Kumari | No. 7, Rukmale rd., Colombo |

Page 1 of 2 (15 items) 1 2

⚠

PICKED UP IN TRANSIT ARRIVED AT DESTINATION LOCATION DELIVERED

| Date & Time | Activity | Current Location | Longitude | Latitude |
|----------------------|------------|--------------------------------|-----------|-----------|
| 2/9/2016 11:23:20 PM | Picked up | Modera Post Office, Colombo 15 | 79.849527 | 6.9651523 |
| 2/9/2016 11:23:32 PM | In transit | Modera Post Office, Colombo 15 | 79.849577 | 6.9657523 |

[Map](#) [Satellite](#)

The map displays a network of roads in the Colombo area, with a red dot indicating the current location of the package near the intersection of Colombo and Wattala. Other locations labeled include Negombo, Veyangoda, Gampaha, Kegalle, Marawila, Dedugala, Gamoda, Ranawella, Arastawella, and Gangathenna.

Figure 5.6.11: Tracking Details View for Registered User

Source: Author

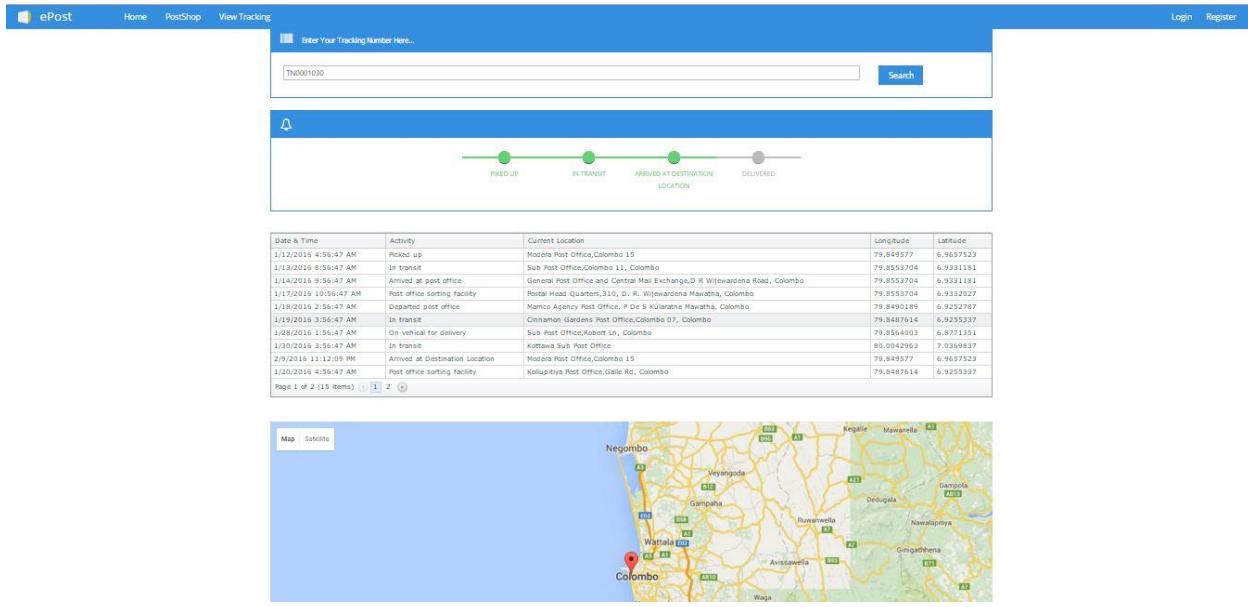


Figure 5.6.12: Tracking Details View for Unregistered User

Source: Author

| # | Full Name | Date of Birth | Address | Branch Name | Phone | User Level |
|----|-----------------|------------------------|---|--|------------|-------------|
| 1 | Aravi Srimal | 12/24/1991 12:00:00 AM | 23, Street1, , Homagama | Postal Head Quarters, D. R. Wijewardena Mawatha, Colombo 01000 | 0719339342 | Super Admin |
| 2 | Sarini Nimanthi | 12/29/1991 12:00:00 AM | 780, Street1, , Wellampitiya | Moder Post Office,Colombo 15 | 0719279829 | Admin |
| 3 | Isuru Deminda | 12/24/1991 12:00:00 AM | 23/A, Street1, , Homagama | Sub Post Office - Mattakkuliya,Ferguson's Rd, Colombo | 0719287489 | Customer |
| 4 | Nipuni Nushi | 12/23/1991 12:00:00 AM | 897, Street1, , Homagama | Post Office,Colombo 14, Colombo | 0718309342 | Operator |
| 5 | Bishan Eranda | 12/24/1991 12:00:00 AM | 897C, Street1, , Kottawa | Post Office,Colombo 13, Colombo | 0719338042 | Admin |
| 6 | Senuri Dilanga | 12/22/1991 12:00:00 AM | 20A, Kotikawatta rd, , Kelaniya | Post Office,Colombo 14, Colombo | 0721812902 | Operator |
| 7 | Sithum Sanjula | 1/13/2016 12:00:00 AM | 43/2, 4th Lane, Galle Road, , Wellawaththa | Wellawatte Post Office,Galle Rd, Colombo | 0712399874 | Customer |
| 8 | Kasun Perera | 3/18/1987 12:00:00 AM | 43A, koswatta, , Nawala | Moder Post Office,Colombo 15 | 0113723282 | Operator |
| 9 | Damitha Ruksana | 6/20/1990 12:00:00 AM | 398, Kotikawatta, , Kelaniya | Moder Post Office,Colombo 15 | 0727398721 | Operator |
| 10 | Dinu Gamage | 2/4/1986 12:00:00 AM | No.43, 4th Lane, Galle Road, , Wellawaththa | Sub Post Office,Robert Ln, Colombo | 0712399874 | Customer |

Figure 5.6.13: Add User Details

Source: Author

Add Products

| Product Code | Description | Product Name | Category | Unit Price | Discount | Image |
|--------------|---|-----------------------|--------------------------|------------|----------|---|
| PC0000001 | Only used for local mail deliveries | Domestic Mail Envelop | Packaging & Sending mail | 5.00 | 0% |  |
| PC0000002 | Only used for local mail deliveries | Domestic Mail Envelop | Packaging & Sending mail | 5.00 | 0% |  |
| PC0000003 | Only used for local mail deliveries | Domestic Mail Envelop | Packaging & Sending mail | 5.00 | 0% |  |
| PC0000004 | Only used for international mail deliveries | Air Mail Envelop | Packaging & Sending mail | 5.00 | 0% |  |
| PC0000005 | Only used for local mail deliveries | Colored Mail Envelop | Packaging & Sending mail | 5.00 | 0% |  |

Page 1 of 4 (19 items) | [1](#) [2](#) [3](#) [4](#) [0](#)

Product Name * Product image * Browse...

Product Code * Unit Price *

Figure 5.6.14: Add Product Details

Source: Author

ePost

- Home
- Send Registered Mails
- Send ePost Card
- Send Parcel
- PostShop
- View Tracking
- Dashboard
- Sarini Nimantha 

Add Product Category

| Category Code | Category Name | Description | # |
|---------------|--------------------------|-------------|---|
| C002 | Gift Cards | Gift Cards | |
| C003 | Packaging & Sending mail | Envelopes | |
| C004 | Computer & Multimedia | Pencils | |
| C001 | Mobile & Phones | Pens | |
| C007 | Stationery Items | Erasers | |
| C008 | Living & Household | Tshirt | |
| C009 | Gifts Items | Stamps | |
| C010 | Stamps | Stamps | |

Category Name *
Category Code *
Category Description

Save **Reset** **Delete**

Figure 5.6.15: Add Product Category Details

Source: Author

ePost

- Home
- Send Registered Mails
- Send ePost Card
- Send Parcel
- PostShop
- View Tracking
- Dashboard
- Sarini Nimalni

Manage Product Stock

| Stock ID | Product Code | Product Name | Stock Qty | Re Order Level |
|----------|--------------|---|-----------|----------------|
| 3 | PC0000001 | Domestic Mail Envelop | 12 | 50 |
| 5 | PC0000037 | Maroon T - Shirt | 23 | 200 |
| 6 | PC0000003 | Domestic Mail Envelop | 44 | 50 |
| 7 | PC0000004 | Air Mail Envelop | 45 | 60 |
| 8 | PC0000005 | Colored Mail Envelop | 155 | 50 |
| 9 | PC0000018 | Vesak 2559 | 32 | 7 |
| 10 | PC0000003 | Domestic Mail Envelop | 27 | 50 |
| 1010 | PC0000012 | 10 Years Anniversary of Sri Lankan Stamps | 80 | 10 |
| 1012 | PC0000014 | 14 Years of Asian Athletic Championship | 70 | 30 |
| 1013 | PC0000001 | Domestic Mail Envelop | 112 | 50 |

Page 1 of 3 (27 items) [1](#) [2](#) [3](#) [4](#)

Product Name *

Stock Quantity *

Branch * Modern Post Office, Colombo

[Save](#) [Reset](#) [Delete](#)

Figure 5.6.16: Add Product Stock Details

Source: Author

ePost

- Home
- Send Registered Mails
- Send ePost Card
- Send Parcel
- PostShop
- View Tracking
- Dashboard
- Sarini Nimalni

Add Postcards

| Code | Postcard Name | Description | Unit Price | Discount | Image |
|--------|----------------------------------|----------------------------------|------------|----------|-------|
| P00001 | Island of Sri Lanka - Jaffna | Island of Sri Lanka - Jaffna | 10.00 | 0% | |
| P00002 | Island of Sri Lanka - Adams Peak | Island of Sri Lanka - Adams Peak | 10.00 | 0% | |
| P00003 | Island of Sri Lanka - Sigiriya | Island of Sri Lanka - Sigiriya | 10.00 | 0% | |
| P00005 | Island of Sri Lanka - Sigiriya | Island of Sri Lanka - Sigiriya | 10.00 | 0% | |
| P00006 | Island of Sri Lanka - Dabulla | Island of Sri Lanka - Dabulla | 10.00 | 0% | |

Page 1 of 5 (23 items) [1](#) [2](#) [3](#) [4](#) [5](#) [6](#)

Postcard Code * Discount *

Postcard Name * Postcard Image * [Browse...](#)

Description

Unit Price *

[Save](#) [Reset](#) [Delete](#)

Figure 5.6.17: Add Post Card Details

Source: Author

The screenshot shows the ePost application's interface. On the left is a sidebar with navigation links: Orders, Shop, ePost Cards, Domestic Tracking, Users (Administrator, Employees, Customers), Reports, and Settings. The main content area has a title 'Add Post Office Branch' with a checked checkbox. It contains four input fields: 'Branch Name' (empty), 'Email' (empty), 'Longitude' (empty), and 'Latitude' (empty). Below the fields are two buttons: 'Save' (blue) and 'Cancel' (grey).

Figure 5.6.18: Add Post Office Branch Details

Source: Author

The screenshot shows the ePost application's interface. The sidebar includes: Branch (Manage Branch Details), Domestic Tracking (Manage Tracking Details), ePost Card (Manage Post Card Details), Reports (Stock qty Vs. Reorder Level, Product Detail Report), Settings (File Manager), Shopping Cart (Manage Product Stock, Manage Product Category, Manage Product Details), and User. The main content area has a title 'Add User Privileges' with a checked checkbox. It features a dropdown menu 'User Level' set to 'User'. Below it is a grid of checkboxes grouped into three columns:

| | | |
|--|--|---|
| <input type="checkbox"/> Manage Branch Details | <input type="checkbox"/> Manage Tracking Details | <input type="checkbox"/> Manage Post Card Details |
| <input type="checkbox"/> Stock qty Vs. Reorder Level | <input type="checkbox"/> Product Detail Report | <input type="checkbox"/> File Manager |
| <input type="checkbox"/> Manage Product Stock | <input type="checkbox"/> Manage Product Category | <input type="checkbox"/> Manage Product Details |
| <input type="checkbox"/> Manage User Privilege | <input type="checkbox"/> Manage User | |

 At the bottom are 'Save' and 'Reset' buttons.

Figure 5.6.19: Add User Privileges

Source: Author

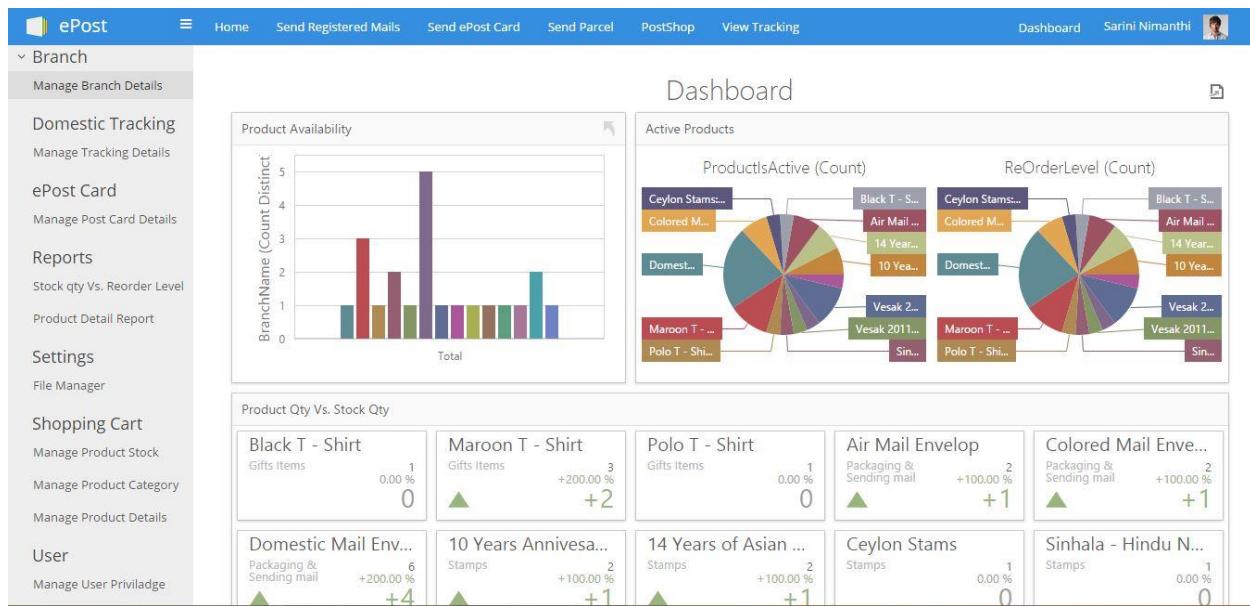


Figure 5.6.20: Shopping Cart Details Dashboard

Source: Author

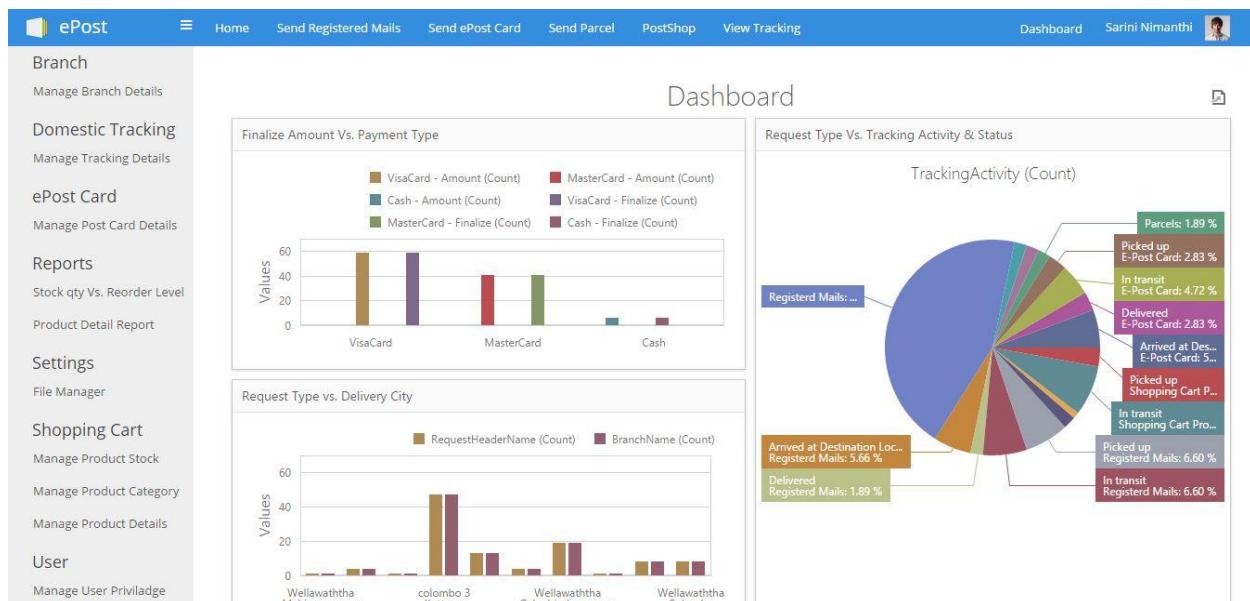


Figure 5.6.21: Tracking Details Dashboard

Source: Author

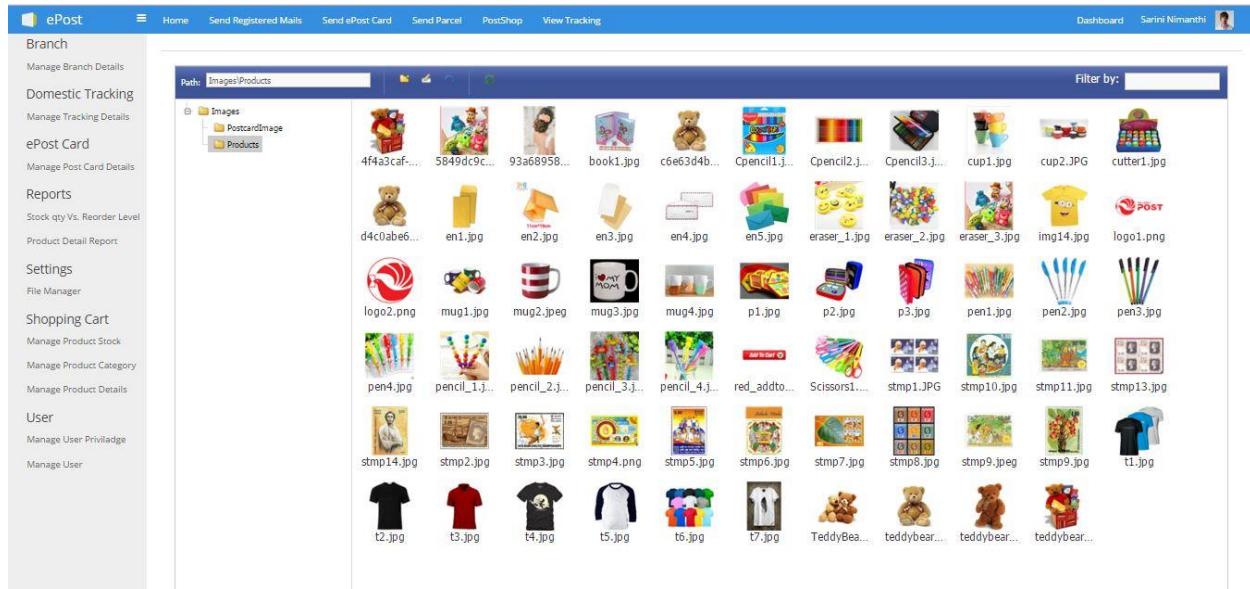


Figure 5.6.22 File Manger

Source: Author

This screenshot shows a detailed product stock report. The left sidebar has the same navigation as Figure 5.6.22. The main window features a toolbar with print, export, and search functions. Below the toolbar is a table titled 'Product Stock' with columns for Product Name, Unit Price, Description, Stock Qty, and Reorder Level. The table lists several items, including Domestic Mail Envelopes, Maroon T-Shirts, Air Mail Envelopes, Colored Mail Envelopes, and Vesak 2559.

| Product Name | Unit Price | Description | Stock Qty | Reorder Level |
|------------------------|------------|---|-----------|---------------|
| Domestic Mail Envelope | Rs.5.00 | Only used for local mail deliveries | 12 | 50 |
| Maroon T - Shirt | Rs. 999.00 | New season arrival | 23 | 200 |
| Domestic Mail Envelope | Rs.5.00 | Only used for local mail deliveries | 44 | 50 |
| Air Mail Envelope | Rs.5.00 | Only used for international mail deliveries | 45 | 60 |
| Colored Mail Envelope | Rs.5.00 | Only used for local mail deliveries | 155 | 50 |
| Vesak 2559 | Rs.200.00 | Sheet with 20 stamps of LKR. 10.00 | 32 | 7 |

Figure 5.6.23: Detail Reports

Source: Author

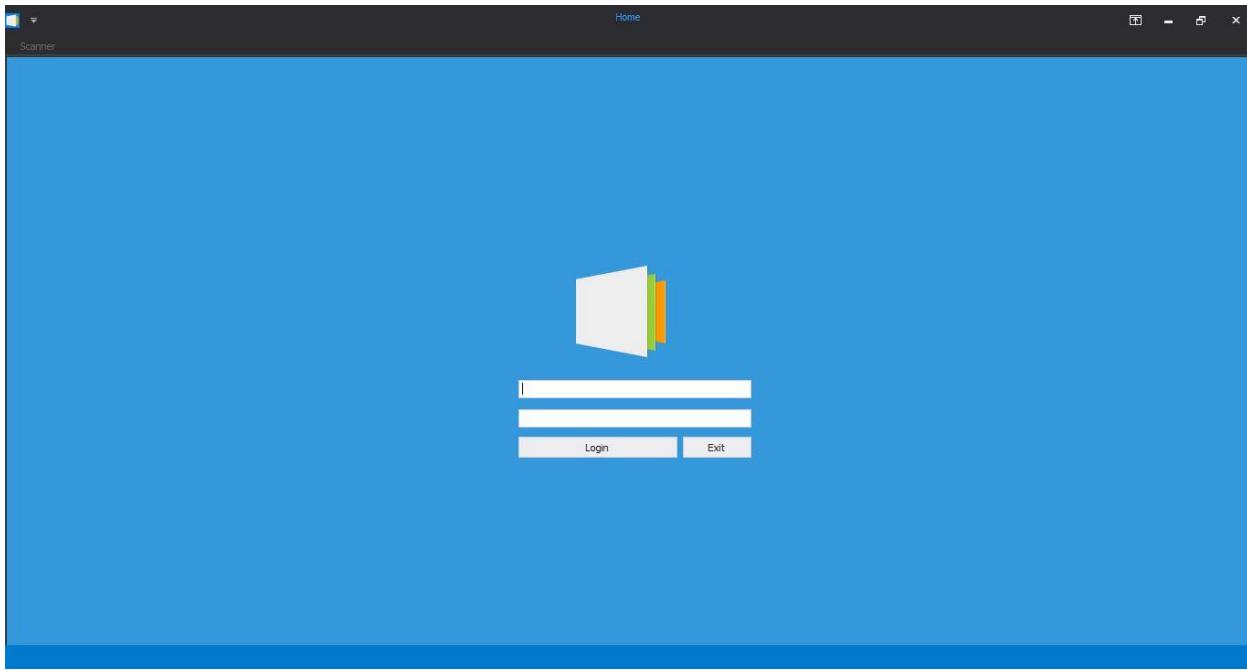


Figure 5.6.24: Windows Application Login

Source: Author

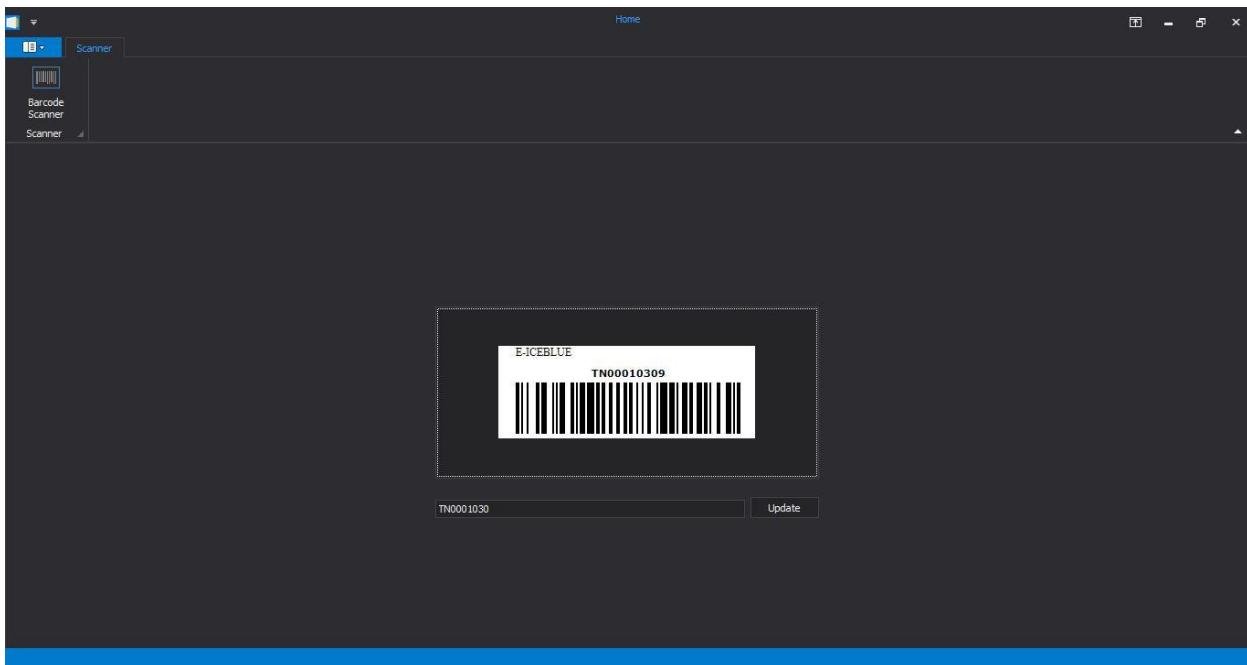


Figure 5.6.25: Windows Application for Barcode Scanner

Source: Author

5.7 Database Design

Product Category Table

| | Column Name | Data Type | Allow Nulls |
|---|---------------------|---------------|-------------------------------------|
| ▶ | CategoryID | int | <input type="checkbox"/> |
| | CategoryName | nvarchar(250) | <input type="checkbox"/> |
| | CategoryDescription | nvarchar(MAX) | <input checked="" type="checkbox"/> |
| | | | <input type="checkbox"/> |

Figure 5.7.1: Category Table

Source: Author

Branch Details Table

| | Column Name | Data Type | Allow Nulls |
|---|-------------|---------------|--------------------------|
| ▶ | BranchID | int | <input type="checkbox"/> |
| | BranchName | nvarchar(250) | <input type="checkbox"/> |
| | Longitudes | nvarchar(MAX) | <input type="checkbox"/> |
| | Latitudes | nvarchar(MAX) | <input type="checkbox"/> |
| | Email | nvarchar(250) | <input type="checkbox"/> |
| | | | <input type="checkbox"/> |

Figure 5.7.2: Branch Details Table

Source: Author

Stock Details Table

| | Column Name | Data Type | Allow Nulls |
|---|-------------|-----------|--------------------------|
| ▶ | StockID | int | <input type="checkbox"/> |
| | StockQty | int | <input type="checkbox"/> |
| | ProductID | int | <input type="checkbox"/> |
| | | | <input type="checkbox"/> |

Figure 5.7.3: Stock Table

Source: Author

Payment Details Table

| Column Name | Data Type | Allow Nulls |
|----------------|---------------|--------------------------|
| PaymentID | int | <input type="checkbox"/> |
| PaymentType | nvarchar(250) | <input type="checkbox"/> |
| CardholderName | nvarchar(MAX) | <input type="checkbox"/> |
| CardNo | nvarchar(250) | <input type="checkbox"/> |
| Amount | nvarchar(250) | <input type="checkbox"/> |
| Finalize | bit | <input type="checkbox"/> |
| CardExpDate | datetime | <input type="checkbox"/> |
| | | <input type="checkbox"/> |
| | | <input type="checkbox"/> |

Figure 5.7.4: Payment Details Table

Source: Author

Post Card Details Table

| Column Name | Data Type | Allow Nulls |
|---------------------|---------------|-------------------------------------|
| PostcardID | int | <input type="checkbox"/> |
| PostcardName | nvarchar(250) | <input type="checkbox"/> |
| PostcardImage | nvarchar(250) | <input type="checkbox"/> |
| PostcardUPrice | money | <input type="checkbox"/> |
| PostcardDescription | nvarchar(MAX) | <input checked="" type="checkbox"/> |
| PostcardDiscount | nvarchar(250) | <input checked="" type="checkbox"/> |
| PostcardStatus | nvarchar(250) | <input type="checkbox"/> |
| PostcardIsActive | bit | <input type="checkbox"/> |
| | | <input type="checkbox"/> |

Figure 5.7.5: Post Card Details Table

Source: Author

Delivery Details Table

| Column Name | Data Type | Allow Nulls |
|-----------------------|---------------|-------------------------------------|
| DeliveryID | int | <input type="checkbox"/> |
| RequestID | int | <input checked="" type="checkbox"/> |
| DeliveryName | nvarchar(250) | <input checked="" type="checkbox"/> |
| DeliveryAddNo | nvarchar(250) | <input checked="" type="checkbox"/> |
| DeliveryAddStreet_1 | nvarchar(250) | <input checked="" type="checkbox"/> |
| DeliveryAddStreet_2 | nvarchar(250) | <input checked="" type="checkbox"/> |
| DeliveryAddStreet_3 | nvarchar(250) | <input checked="" type="checkbox"/> |
| DeliveryAddCity | nvarchar(250) | <input checked="" type="checkbox"/> |
| DeliveryAddPostalcode | nvarchar(250) | <input checked="" type="checkbox"/> |
| DeliveryContactNumber | nvarchar(250) | <input checked="" type="checkbox"/> |
| FromName | nvarchar(250) | <input checked="" type="checkbox"/> |
| FromAddNo | nvarchar(250) | <input checked="" type="checkbox"/> |
| FromAddStreet_1 | nvarchar(250) | <input checked="" type="checkbox"/> |
| FromAddStreet_2 | nvarchar(250) | <input checked="" type="checkbox"/> |
| FromAddStreet_3 | nvarchar(250) | <input checked="" type="checkbox"/> |
| FromAddCity | nvarchar(250) | <input checked="" type="checkbox"/> |
| FromAddPostalcode | nvarchar(250) | <input checked="" type="checkbox"/> |
| FromContactNumber | nvarchar(250) | <input checked="" type="checkbox"/> |
| TrackingNo | | <input checked="" type="checkbox"/> |

Figure 5.7.6: Delivery Details Table

Source: Author

Request Header Table

| Column Name | Data Type | Allow Nulls |
|---------------------|-----------|--------------------------|
| RequestID | int | <input type="checkbox"/> |
| UserID | int | <input type="checkbox"/> |
| PaymentID | int | <input type="checkbox"/> |
| RequestHeaderTypeID | int | <input type="checkbox"/> |
| | | <input type="checkbox"/> |

Figure 5.7.7: Request Header Table

Source: Author

Request Header Type Details

| | Column Name | Data Type | Allow Nulls |
|---|---------------------|---------------|--------------------------|
| ▶ | RequestHeaderTypeID | int | <input type="checkbox"/> |
| | RequestHeaderName | nvarchar(250) | <input type="checkbox"/> |
| | Unit | nvarchar(250) | <input type="checkbox"/> |
| | CostPerUnit | money | <input type="checkbox"/> |
| | | | <input type="checkbox"/> |

Figure 5.7.8: Request Header Type Details Table

Source: Author

Request Details

| | Column Name | Data Type | Allow Nulls |
|---|------------------|---------------|-------------------------------------|
| ▶ | RequestID | int | <input type="checkbox"/> |
| | ProductQty | int | <input checked="" type="checkbox"/> |
| | EPostcardMessage | nvarchar(MAX) | <input checked="" type="checkbox"/> |
| | EPostCardImage | nvarchar(250) | <input checked="" type="checkbox"/> |
| | Wight | nvarchar(250) | <input checked="" type="checkbox"/> |
| | | | <input type="checkbox"/> |

Figure 5.7.9: Request Details Table

Source: Author

Product Details Table

| | Column Name | Data Type | Allow Nulls |
|---|--------------------|---------------|-------------------------------------|
| ▶ | ProductID | int | <input type="checkbox"/> |
| | ProductName | nvarchar(250) | <input type="checkbox"/> |
| | ProductDiscount | nchar(50) | <input type="checkbox"/> |
| | ProductDiscription | nvarchar(250) | <input checked="" type="checkbox"/> |
| | ProductUnitPrice | money | <input type="checkbox"/> |
| | ProductImage | nvarchar(250) | <input type="checkbox"/> |
| | CategoryID | int | <input type="checkbox"/> |
| | ProductStatus | nvarchar(250) | <input type="checkbox"/> |
| | ProductIsActive | bit | <input type="checkbox"/> |
| | Size | nvarchar(250) | <input checked="" type="checkbox"/> |
| | Color | nvarchar(250) | <input checked="" type="checkbox"/> |
| | | | <input type="checkbox"/> |

Figure 5.7.10: Product Details Table

Source: Author

Tracking Details Table

| | Column Name | Data Type | Allow Nulls |
|----|------------------|---------------|-------------------------------------|
| PK | TrackingID | int | <input type="checkbox"/> |
| | DeliveryID | int | <input type="checkbox"/> |
| | TrackingNo | nvarchar(250) | <input type="checkbox"/> |
| | TrackingActivity | nvarchar(250) | <input type="checkbox"/> |
| | TrackingStatus | nvarchar(250) | <input checked="" type="checkbox"/> |
| | Location | nvarchar(250) | <input type="checkbox"/> |
| | EnteredDate | datetime | <input type="checkbox"/> |
| | | | <input type="checkbox"/> |
| | | | <input type="checkbox"/> |

Figure5.7.11: Tracking Details Table

Source: Author

User Details Table

| | Column Name | Data Type | Allow Nulls |
|----|-----------------|---------------|-------------------------------------|
| PK | UserID | int | <input type="checkbox"/> |
| | Fname | nvarchar(250) | <input type="checkbox"/> |
| | Lname | nvarchar(250) | <input type="checkbox"/> |
| | UserLevelID | int | <input type="checkbox"/> |
| | Phone | nchar(10) | <input type="checkbox"/> |
| | AddressNo | nvarchar(250) | <input type="checkbox"/> |
| | AddressStreet_1 | nvarchar(250) | <input type="checkbox"/> |
| | AddressStreet_2 | nvarchar(250) | <input checked="" type="checkbox"/> |
| | AddressStreet_3 | nvarchar(250) | <input checked="" type="checkbox"/> |
| | AddressCity | nvarchar(250) | <input type="checkbox"/> |
| | PostalCode | nvarchar(50) | <input checked="" type="checkbox"/> |
| | BDay | datetime | <input type="checkbox"/> |
| | Gender | nvarchar(50) | <input type="checkbox"/> |
| | Username | nvarchar(250) | <input type="checkbox"/> |
| | Password | nvarchar(250) | <input type="checkbox"/> |
| | BranchID | int | <input type="checkbox"/> |
| | Email | nvarchar(MAX) | <input type="checkbox"/> |
| | | | <input type="checkbox"/> |
| | | | <input type="checkbox"/> |

Figure5.7.12: Tracking Details Table

Source: Author

User Privileges Details

| | Column Name | Data Type | Allow Nulls |
|---|-------------|-----------|--------------------------|
| ▶ | UserLevelID | int | <input type="checkbox"/> |
| | FormID | int | <input type="checkbox"/> |
| | | | <input type="checkbox"/> |

Figure 5.7.13: User Privileges Details Table

Source: Author

User Lever Table

| | Column Name | Data Type | Allow Nulls |
|---|-------------|---------------|-------------------------------------|
| ▶ | UserLevelID | int | <input type="checkbox"/> |
| | UserLevel | nvarchar(250) | <input checked="" type="checkbox"/> |
| | | | <input type="checkbox"/> |

Figure 5.7.14: User Level Table

Source: Author

Application Form Table

| | Column Name | Data Type | Allow Nulls |
|---|-------------|---------------|-------------------------------------|
| ▶ | FormID | int | <input type="checkbox"/> |
| | Form | nvarchar(250) | <input checked="" type="checkbox"/> |
| | DisplayName | nvarchar(250) | <input checked="" type="checkbox"/> |
| | | | <input type="checkbox"/> |

Figure 5.7.15: Application Form Table

Source: Author

Chapter 06

Development

6.1 Introduction

In this chapter mainly discussed about the development order of the project. The development order was selected which begins with interface designing to develop the proposed EPOS. According to the Top- down approach once the interface modules are completed development moves down to the next set of components of the software design as shown below.

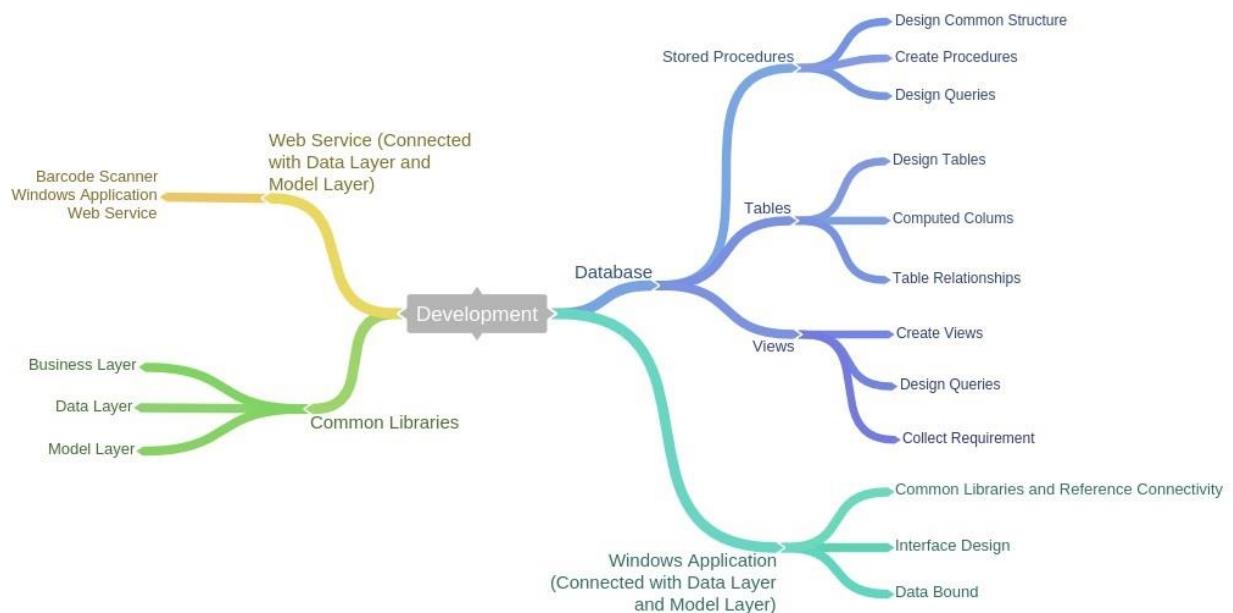


Figure 6.1.1: Components of Software Design

Source: Author

6.2 Common Layers Libraries Development

After finishing the database development, next step was making of the data and modeler layers to the application, by the section, all data transferring processors are handled via the Class liveries. From the section, mainly, the Data Layer and Modeler layers are developed. Those layers are used with the proposed Web Service and Windows Application to data transportation in between Application and Database.

By using the separately created layers, the re usability is achieved. And tasks are divided in to the separate responsible classes.

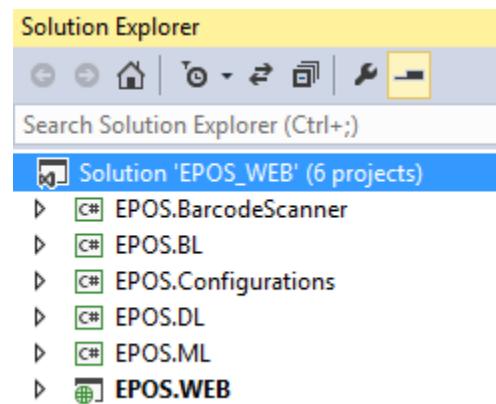


Figure 6.2.1: Layered Application Architecture

Source: Author

6.3 Layered Application Architecture

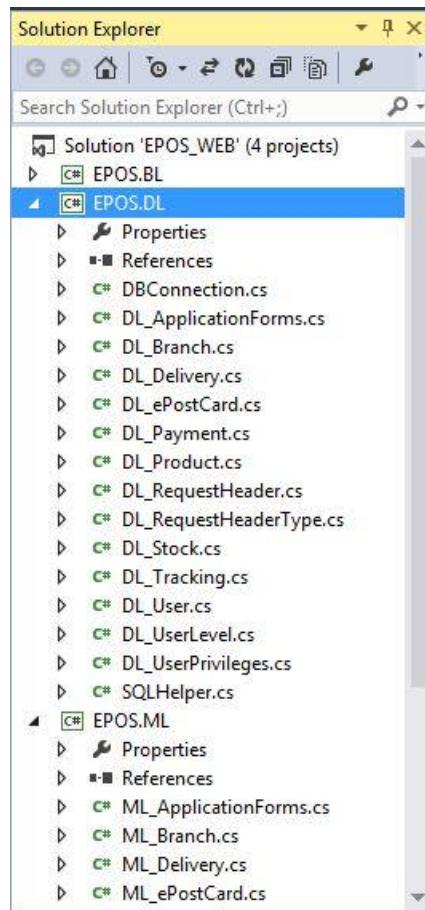


Figure 6.3.1: Layered Application Architecture

Source: Author

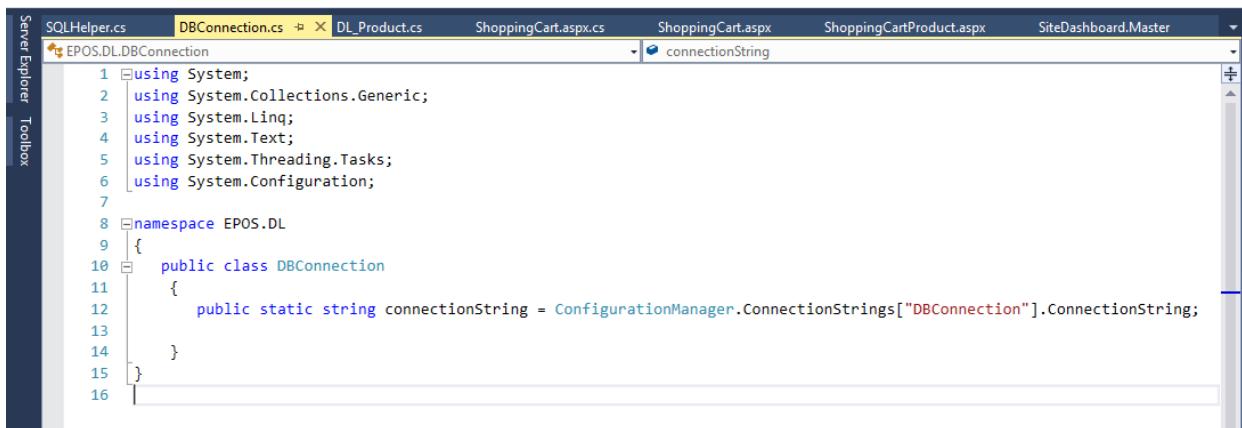
This application has been developed by using Layered architecture. In the Application as the Figure 6.3.1 the application has been divided in to separate tasks by allocating specific module to one library.

The main layer is in this application is Data Layer. All Data transaction and all methods that responsible to the Database has been developed in this layer. The all classed extended by the DBConnection.cs class that correlated to database connection.

6.3.1 Development Technologies in Data Layer

- **Database Connection**

The class is the responsible class for the Database connection.



A screenshot of the Microsoft Visual Studio IDE. The title bar shows multiple open files: SQLHelper.cs, DBConnection.cs (which is the active file), DL_Product.cs, ShoppingCart.aspx.cs, ShoppingCart.aspx, ShoppingCartProduct.aspx, and SiteDashboard.Master. The left sidebar includes the Server Explorer and Toolbox. The main area displays the C# code for the DBConnection class:

```
1  using System;
2  using System.Collections.Generic;
3  using System.Linq;
4  using System.Text;
5  using System.Threading.Tasks;
6  using System.Configuration;
7
8  namespace EPOS.DL
9  {
10    public class DBConnection
11    {
12      public static string connectionString = ConfigurationManager.ConnectionStrings["DBConnection"].ConnectionString;
13    }
14  }
```

Figure 6.3.1.1: DBConnection.cs Class

Source: Author

The Database connection is using the web.config configuration file to read the Database Connection, and the Database connection string has been created in the web.config file.

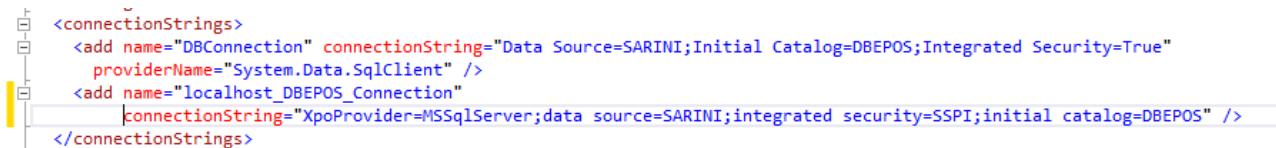


Figure 6.3.1.2: Create DBConnection In web.config

Source: Author

- **SQLHelper Class**

SQL helper class helps to run up data access with a single dll and single line of functions. Such as, fetch data with single line of functions, fetch data with custom column's name, fetch data with sorting, fetch data with different type of joins, and fetch data with paging and SQL error handling.

```
using System;
using System.Collections;
using System.Collections.Generic;
using System.Data;
using System.Data.SqlClient;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Xml;

namespace EPOS.DL
{
    [System.Diagnostics.DebuggerStepThroughAttribute()]
    public static class SqlHelper
    {
        #region private utility methods & constructors

        // Since this class provides only static methods, make the default constructor private to prevent ...
        /// <summary> ...
        private static void AttachParameters(SqlCommand command, SqlParameter[] commandParameters)
        {
            if (command == null) throw new ArgumentNullException("command");
            if (commandParameters != null)
            {
                foreach (SqlParameter p in commandParameters)
                {
                    if (p != null)
                    {
                        // Check for derived output value with no value assigned
                        if ((p.Direction == ParameterDirection.InputOutput || p.Direction == ParameterDirection.Input) && (p.Value == null))
                            p.Value = DBNull.Value;
                    }
                }
            }
        }
    }
}
```

Figure 6. 3.1.3: SQLHelper.cs Class

Source: Author

Data Layer Sample Tasks

In the system development Insert and Update task has been assign to one method in a specific class to increase the re-usability and minimize the code usability. Delete and select tasks also handled by this layer and these methods has been changed according to the requirement. All the database transaction are handled by the Stored Procedures.

```

namespace EPOS.DL
{
    public class DL_Branch
    {
        public bool BranchSave(ML_Branch br)
        {
            SqlParameter[] BranchSpara = {
                new SqlParameter("@Action", 1),
                new SqlParameter("@BranchID", br.BranchID),
                new SqlParameter("@BranchName", br.BranchName),
                new SqlParameter("@Longitudes", br.Longitudes),
                new SqlParameter("@Latitudes", br.Latitudes),
                new SqlParameter("@Email", br.Email)
            };

            SqlHelper.ExecuteNonQuery(DBConnection.connectionString, CommandType.StoredProcedure, "SP_Branch_CRUD", BranchSpara);
            return true;
        }

        public bool BranchDelete(ML_Branch br)
        {
            SqlParameter[] BranchDpara = { new SqlParameter("@Action", 3), new SqlParameter("@BranchID", br.BranchID) };
            SqlHelper.ExecuteNonQuery(DBConnection.connectionString, CommandType.StoredProcedure, "SP_Branch_CRUD", BranchDpara);
            return true;
        }

        public DataTable BranchSelect(ML_Branch br)
        {
            SqlParameter[] SelectByIDpara = { new SqlParameter("@Action", 2), new SqlParameter("@BranchID", br.BranchID) };
            return SqlHelper.ExecuteDataTable(DBConnection.connectionString, CommandType.StoredProcedure, "SP_Branch_CRUD", SelectByIDpara);
        }
    }
}

```

Figure 6.4.1.1: Insert, Update, Delete and Select Methods

Source: Author

6.3.2 Modeler Layer

Modeler Layer is another most important layer in this web application. Modeler layer also consist with several classes as Data Layer. All modeler Layers classes are responsible to passed and get the data from data layer and business layer.

```

using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace EPOS.ML
{
    public class ML_User
    {
        public int UserID { get; set; }
        public int UserLevelID { get; set; }
        public string Fname { get; set; }
        public string Lname { get; set; }
        public string Phone { get; set; }
        public string AddressNo { get; set; }
        public string AddressStreet_1 { get; set; }
        public string AddressStreet_2 { get; set; }
        public string AddressStreet_3 { get; set; }
        public string AddressCity { get; set; }
        public string PostalCode { get; set; }
        public string BranchID { get; set; }
        public string Username { get; set; }
        public string Password { get; set; }
        public DateTime Bday { get; set; }
        public char Gender { get; set; }
        public string Email { get; set; }
    }
}

```

Figure 6.3.2.1: Sample Class of Modeler Layer

Source: Author

6.4 Stored Procedures

In the enterprise database development, the Stored Procedures are used to execute many statements as a single execution statement. The Stored Procedures is group of transact SQL statement that complied with a single execution to take the return data as Output Parameter, Return Codes, Result Set that retrieving from Select statement or Cursors.

Using the Stored Procedures,

- Application can increase the data transaction performance
- Stored Procedures are more productive and easy to use
- Enterprise level concept
- More scalable
- Fast and easy maintainability
- Interoperability
- Security
- Reliability

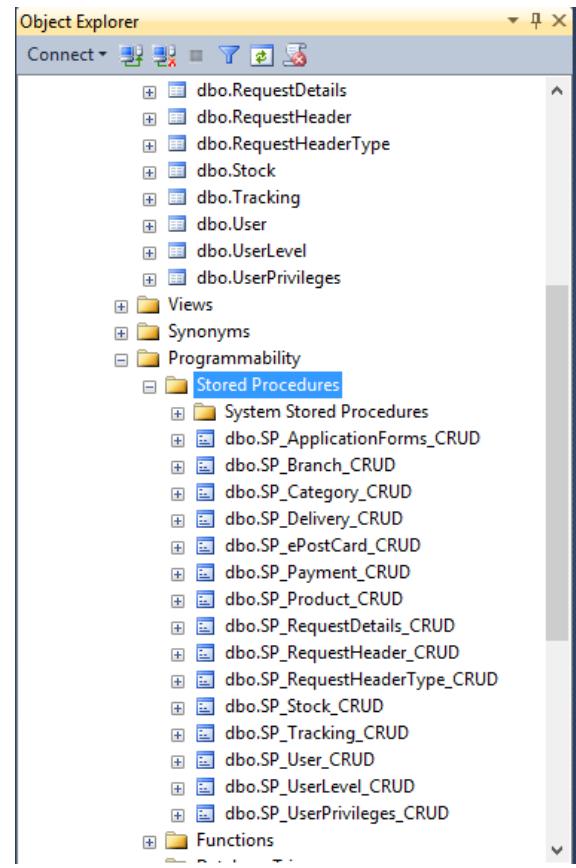


Figure 6.4.1: Stored Procedures

Source: Author

As the reasons of above, the stored procedures are chosen as the database construction and database transaction method.

In the application all the database transactions has been handled with the Stored Procedures the data layer of the application is connected to the stored procedures.

The stored procedures are specified for **insert, update, select and delete** tasks. These tasks are given to one specific Stored Procedure in the database.

As the Naming of the stored procedures of the application, the specific prefix has been used to identify the stored procedure's task.

- **C**- Representing the Stored procedure belongs to Create or Insert statements
- **R** - Representing the Stored procedure belongs to Read statements
- **U** – Representing the Stored procedure belongs to Update statements
- **D** - Representing the Stored procedure belongs to Delete statements

```

ALTER PROCEDURE [dbo].[SP_Branch_CRUD]
    @Action      INT,
    @BranchID   INT          = NULL,
    @BranchName NVARCHAR(250) = NULL,
    @Longitudes NVARCHAR(MAX) = NULL,
    @Latitudes  NVARCHAR(MAX) = NULL,
    @Email       NVARCHAR(250) = NULL
AS
BEGIN
    --Insert & Update
    IF @Action = 1
        BEGIN[...]
    --Select
    IF @Action = 2
        BEGIN[...]
    --Delete
    IF @Action = 3
        BEGIN[...]
END

```

Figure 6.4.2: Architecture of Stored Procedure

Source: Author

As Figure: 6.6.2 shown the procedure main task handler is the @Action parameter. When developer need to achieve specific task from the stored procedure, he has to provide the parameter with the expectation of stored procedure with the used code.

```

ALTER PROCEDURE [dbo].[SP_Stock_CRUD]
    @Action INT,
    @StockID int = NULL,
    @StockQty int = NULL,
    @ProductID int = NULL

AS
BEGIN
    IF @Action = 1
    BEGIN
        IF EXISTS (SELECT
                    1
                    FROM [Stock] s
                    WHERE s.StockID = @StockID)
        BEGIN
            UPDATE [dbo].[Stock]
            SET StockQty = COALESCE(@StockQty, StockQty),
                ProductID = COALESCE(@ProductID, ProductID)

            WHERE StockID = @StockID
        END
        ELSE
        BEGIN
            INSERT INTO [dbo].[Stock]
            ([StockQty]
            , [ProductID])
            VALUES (@StockQty, @ProductID)
        END
    END
    IF @Action = 2
    BEGIN
        SELECT
            [StockID],
            [ProductID],
            [StockQty]
        FROM [dbo].[Stock]
    END
END

```

Figure 6.4.3: Sample Store Procedure

Source: Author

6.5 Data Handling Forms

In this system development the general form structure all the controls are created. The main purpose of creating common structured data handling web forms is fast data transferring with edit update delete and add new records in to window getting fast and easy. And also to maintain easy access to user and user friendly.

Administrator's main grid views are holding data and he can click each record and take the all sub information to the textboxes and can force to edit or delete. And also he was able to do data Insert and Update with using one button.

To manage the special features on the grid view the Devexpress Grid views has been used and customized as the current requirement.

6.6 Customizable Data viewers or Grid views

In the application the grid views are created to make users work fast and make work easy.

Special features of the Data viewers/Grid view

- Data sorting
- Group
- Categorize
- Multi Categorize
- Filtering
- Custom filtering
- Search

All the functions are included in every module that required the Data viewers/Grid view, and the main purpose of having those function is Real-time Data Analyzing.

6.7 Customizable Reports

DevExpress Report Services are used in this application to create customizable reports. This feature may help to users to generate many reports at once, and can generate multiple outputs using one table.

Users can customize the report as their requirement and take outputs as reports. To customize the report users can drag and drop the column to the application.

6.8 Summary

This chapter mainly discussed more details about the system development techniques such as Common layers libraries architecture, development technologies of data layer and modeler layer, stored procedures and etc.

Chapter 07

System Testing

7.1 Introduction

This chapter mainly concern about how the system is going to be tested. In here, the importance of selecting the right testing methodologies and their objectives which is used with the development will be discussed in detail.

7.2 Importance of Testing

Testing is the most significant phase of the system. Testing should search and locate the all the weak points and fault that can occur within some conditions. Because it confirms the test results with the expected user requirements objectives. To develop a most reliable system the developer and the system users should be involved with the testing phase. It is necessary to agree that all modules of the system are developed and integrated as a whole system according to the arrangement.

When developing the system should be consider about the development time of the system. It can be more effective if the developers select a proper language and quality technologies. Thus this proposed system should be developed mainly focus with monitoring the network. With considering the networking, it is more effective if it use supportiveness tools and technologies. When using technologies should be consider about the following qualities.

- Efficiency and Performance
- Object oriented development support
- Re-usability and flexibility

Top- down development strategy has been selected to develop the system because of the complexity and the system development time. The main reason for the development order are developing interfaces at the beginning which will be used to make prototype of the system. And also they are more delicate with the database parts.

7.3 System Testing Objectives

As described above the software system is a collection of integrated components. These components or the modules can be tested individually or in group or as the whole software system. Moreover, system testing helps to ensure that the specifications and business functions are already met with the components. Some of system objective functions of the system described below.

- Gaining confidence in and providing information about the level of quality.
- To prevent defects.
- To make sure that the end result meets the business and user requirements.
- To ensure that it satisfies the Business Requirement Specification and System Requirement Specifications.
- To gain the confidence of the customers by providing them a quality product.

Therefore, software testing makes sure that the testing is being done properly and the system is ready for use. It also determines that the application can be deployed easily to the machine and without any resistance. Hence the application is easy to install, learn and use.

7.4 Testing Strategies

Testing strategy is designed to ensure that all the tests which are to be applied have to be identified and the test will cover each and every part of the system before it is put in to use. Testing strategy will implemented with the project state as well as the strategy use for system development. These are the tests which ensure to deliver of high quality product. Some of main test cases are provided in Appendix B.

7.4.1 Unit Testing

Unit testing will only tests the components of the system. But this does not help to identify every error in the system such as performance problems, integration errors and other issues with relevant to the system. Therefore unit testing will be highly effective only when it used in union with other testing techniques.

The unit testing planned to ensure that a module of the system generally matching to a single function which developed according to the specifications.

7.4.2 Integration Testing

Through integration testing, identify the errors that were not and could not identify in the unit testing. Therefore this testing ensures that the functional and performance requirements distinct on project design specifications. Integration testing will take the modules of the system which

are tested under unit testing. Then they will apply to test in test plan to delivers the output as integrated system which is ready for the system testing.

7.4.3 System Testing

System testing will not get many errors, because it uses inputs which are tested under unit testing and integration testing. In system testing the behavior of whole system is tested as defined by the scope of the development project. It may include tests based on requirement specifications, business process, use cases and system resources etc.

System testing is most often the final test to verify that the system to be delivered meets the specification and its purpose. It should look into both functional and non-functional requirements of the testing.

7.4.4 Acceptance Testing

After the unit testing, integration testing and system testing acceptance testing will be performed to ensure that all the changes made to the system during the design and development process are meet with original system specifications and user requirements. Most of the time for acceptance testing stakeholders may be involved as well.

7.5 Test Plan

Test plan mainly focus on the testing strategies of the proposed EPOS for Sri Lanka postal HQ. Test plan can be divided in to two classifications. They are unit testing and system testing. Under unit testing, system testing and integration testing components are included. Under system testing, system testing and acceptance testing are included. When designing the test plan following criteria are considered.

- Have to identify the components and the features which are tested and not tested.
- Ensure the all required and necessary elements are in ready to testing.
- Which authorities are conducted the testing part for particular component or feature.
- Identify the issues and problems which arise from the testing and plan to correct them.

7.5.1 Test Plan – Unit Testing

Unit testing conduct to validate the individual modules or units of source code are working properly. Each basic component of the software is tested to verify that the detailed design for the unit has been correctly. Unit testing is performed before the implementation and integration of EPOS modules to ensure the functionality. Main modules of the system will be tested during the unit testing.

Table 7.5.1.1: Unit Testing Test Plan (Author)

| Component | Description |
|--|--|
| Login Module | This module mainly focuses to register the users for the system, such as customer, delivery person, operator etc. Therefore in testing part check whether the activities such as the entering details of the stakeholders, add and update new members are working properly and the authorized access levels can involve with the system successfully. |
| Domestic Parcels and Mails Tracking Module | This module focuses to ensure that customers can request a deliver domestic parcel or mails by submitting the completed deliver domestic parcel or mails form, tracking them and also the testing should be checked whether the user requests are stored properly in the database. Moreover, testing conduct for entering delivery details to the system by delivery person and view delivery details for admin. |
| Shopping Cart Module | This module focuses to ensure that customers can online order products by submitting the completed order details form and also the testing should be checked whether the user requests are stored properly in the database. Moreover, testing conduct for entering product details to the system by admin and view order details for admin. |
| E-Post Card Module | This module test whether the customers can online order E-post card or upload their own image as post card image. And also the unit testing should conducts for checked whether the user requests are stored properly in the database. Moreover, testing also conduct for entering post card details to the system by admin and view orders of post cards details for admin. |

7.5.2 Test Plan – System Testing

The system testing will mainly focus to three functionalities namely user login activities which are used to do with inserting, deleting and updating. Test plan for the monitoring system testing can be shown as follows.

Table 7.5.2.1: Monitoring system Testing – Login (Author)

| Test Scenario | Description |
|-----------------------|---|
| User Login | The user Login consists with user name and password. The users who registered with this system can only access to the system. |
| Admin Login | The administrator of the system can access with the system when he entered the valid user name and the password. All the valid username and password should store in the database. |
| Delivery Person Login | The delivery person also can access the system when he enters the valid username and password. |
| Incorrect Login | When there is an invalid username and password an error message will be displayed on the screen. |
| Change Password | To ensure the confidentiality and the security purpose of the user's information the users allow changing their password. |
| User Functionality | When login in to the system as an administrator, delivery person or customer, they can perform their tasks with all the modules as per their user level access. In here ensure that they can perform their tasks very well. |

The second system test is used to manage the administrator's activities. It contains main three functionalities of user allocation, user enable or disable such as delivery person, Add or Edit user details, product details and post card details.

Table 7.5.2.2: Monitoring system testing – administrator (Author)

| Test Scenario | Description |
|-----------------------------|---|
| User Enable or Disable | Any user can see the content of the website. But the payments are allowed to only registered users. |
| Add or Edit User Details | The user's such as delivery person's information can be edit update and delete by the administrator of the system. After doing changes he can save them to the system database. |
| Add or Edit Product Details | Shopping cart product information can be edit update and delete by the administrator of the system. After doing changes he can save them to the system database. |

| | |
|-------------------------------|--|
| Add or Edit Post Card Details | Post Cards information also can be edit update and delete by the administrator of the system. He also allowed to save new details of the post cards. |
|-------------------------------|--|

The final system test is user category. It contains add and view information of the system.

Table 7.5.2.3: Monitoring system testing – User (Author)

| Test Scenario | Description |
|-----------------------|--|
| Add, view information | All the users of the system are able to view shopping cart items, E- post cards and other details. Customers who are register with the system are able to add details such as personal details, add shopping cart order details, add tracking details, add delivery details, add post card details and add payment details for online payments. And also they are able to view these details also. |

7.5.3 Test Plan - Integration Test

In this session represent the testing of group of sections such as reports available in the system and etc. Through the integration testing can identify the errors that couldn't find from the unit testing.

Table 7.5.3.1: Test Plan – Integration Testing (Author)

| Test Scenario | Description |
|-------------------------------|--|
| Personal Information Report | In here test all the modules of the PIM and test whether the report including the personal details, contact details. The authorities can view the reports of all the Customers and Employees details mentioned above. |
| Shopping Cart Products Report | In this session test the products of the shopping cart. This report includes the details of products. Also product orders, payment details reports also can be generated. All the reports can be viewed by the authority people. |
| E – Post Card Report | In this session test the e – post card module reports. This report includes the details of e – post card, orders and payment details reports also can be generated. |

| | |
|-----------------------------------|--|
| Domestic Parcel and Mail Tracking | In here test all the modules of domestic parcel and mail tracking and test whether the reports are able to generate with tracking details, customer details etc. The authorities can view the reports. |
|-----------------------------------|--|

7.5.4 Test Deliverables

After testing the results will be offered to the SAR office and other authorities by means of reports, charts and other documents on a regular basis during system development and testing.

7.5.5 Errors and Bugs uncovered

Following are the most important errors which occurred with the testing part of the system because often the different kind of the data inputs and with large volume of data.

- **Run-time errors**

The run time errors were occurred in various situations. Most of them are arise from the calculations of the averages and the percentages. Those errors are maintained by fixed the invalid algorithms. And also can manage details with fixing the system memory space.

- **Store data with null values**

With storing the data in database the problems can be occurred when entering the validation for the input data. But the problems will be arising when retrieving data from the database. These errors were fixed using validation techniques.

Server Error in '/' Application.

Failed to enable constraints. One or more rows contain values violating non-null, unique, or foreign-key constraints.

Description: An unhandled exception occurred during the execution of the current web request. Please review the stack trace for more information about the error and where it originated in the code.

Exception Details: System.Data.ConstraintException: Failed to enable constraints. One or more rows contain values violating non-null, unique, or foreign-key constraints.

Source Error:

```
Line 20360: }
Line 20361:     SDMDAL.SDM_Tran_GenerateInvoiceDataTable dataTable = new SDMDAL.SDM_Tran_GenerateInvoiceDataTable();
Line 20362:     this.Adapter.Fill(dataTable);
Line 20363:     return dataTable;
Line 20364: }
```

Source File: c:\Windows\Microsoft.NET\Framework\v4.0.30319\Temporary ASP.NET Files\vsled5b6348f3240ffe\App_Code.eleey6q-14.cs **Line:** 20362

Stack Trace:

```
[ConstraintException: Failed to enable constraints. One or more rows contain values violating non-null, unique, or foreign-key constraints.]  
System.Data.DataTable.EnableConstraints() +2001567  
System.Data.DataTable.set_EnforceConstraints(Boolean value) +39  
System.Data.DataTable.EndLoadData() +234  
System.Data.Common.DataAdapter.FillFromReader(DataSet dataset, DataTable datatable, String srcTable, DataReaderContainer dataReader, Int32 startRecord, Int32 maxRecords) +349  
System.Data.Common.DataAdapter.Fill(DataTable[] dataTables, IDataReader dataReader, Int32 startRecord, Int32 maxRecords) +349  
System.Data.Common.DbDataAdapter.FillInternal(DataSet dataset, DataTable[] dataTables, Int32 startRecord, Int32 maxRecords, String srcTable, IDbCommand command, CommandBehavior behavior) +160  
System.Data.Common.DbDataAdapter.Fill(DataTable[] dataTables, Int32 startRecord, Int32 maxRecords, IDbCommand command, CommandBehavior behavior) +160  
System.Data.Common.DbDataAdapter.Fill(DataTable dataTable) +198  
SDMDALTableAdapters.SDM_Tran_GenerateInvoiceTableAdapter.GetInvoiceBillingBySPID(String SPID) in c:\Windows\Microsoft.NET\Framework\v4.0.30319\Temporary ASP.NET
```

Figure 7.5.5.1: Storing the Data with Null Values

Source: Author

- **Error on connection to SQL server**

This error can be found when running the database. The error can be fixed by create the database connection in a proper manner. And also should be fixed the invalid names which are given to the server name.

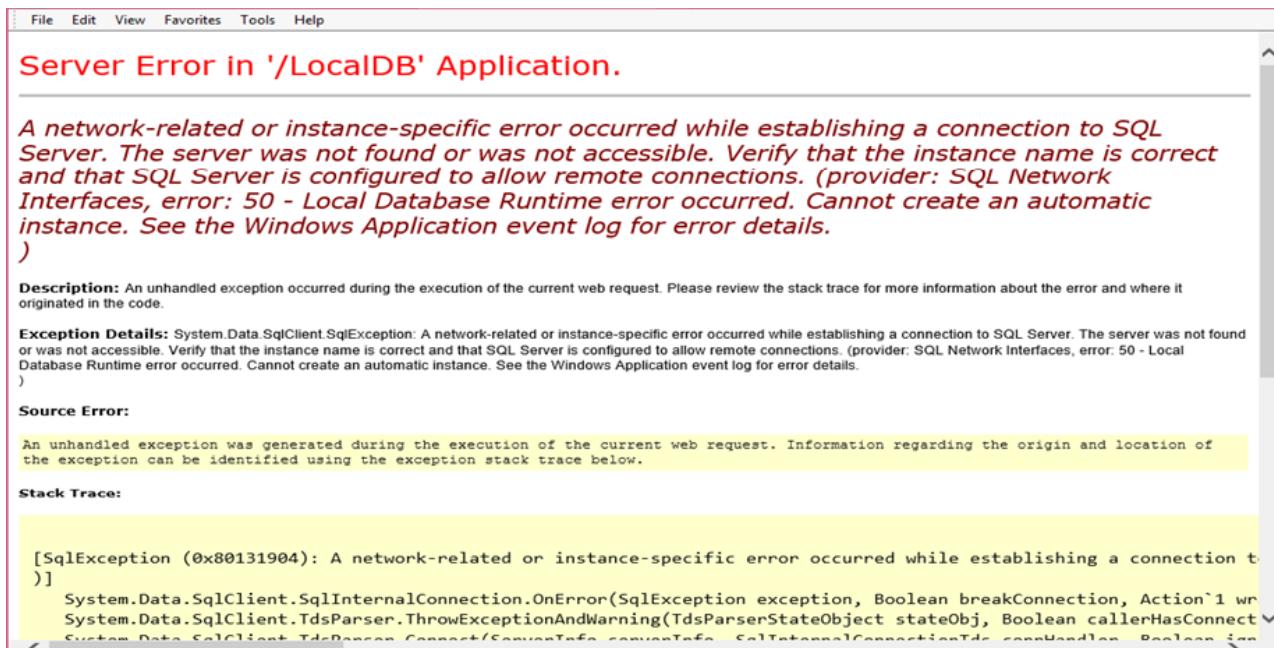


Figure 7.5.5.2: Error on connection to SQL server

Source: Author

- **Query problems**

When connecting queries with tables it can be more errors.

Server Error in '/' Application.

Internal error. The string routine in file e:\sql10_main_t\sql\ntdbms\storeng\dmu\dbcc\source\dumplog.cpp, line 5084 failed with HRESULT 0x8007007a.

Internal Query Processor Error: The query processor encountered an unexpected error during execution.

Description: An unhandled exception occurred during the execution of the current web request. Please review the stack trace for more information about the error and where it originated in the code.

Exception Details: System.Data.SqlClient.SqlException: Internal error. The string routine in file e:\sql10_main_t\sql\ntdbms\storeng\dmu\dbcc\source\dumplog.cpp, line 5084 failed with HRESULT 0x8007007a.
Internal Query Processor Error: The query processor encountered an unexpected error during execution.

Source Error:

An unhandled exception was generated during the execution of the current web request. Information regarding the origin and location of the exception can be identified using the exception stack trace below.

Stack Trace:

```
[SqlException (0x80131904): Internal error. The string routine in file e:\sql10_main_t\sql\ntdbms\storeng\dmu\dbcc\source\dumplog.cpp, line 5084 failed with HRESULT 0x8007007a.
Internal Query Processor Error: The query processor encountered an unexpected error during execution.]
   Nolics.ORMapper.DataProviders.SQLBuilder.EndStatement(SqlCommandEventArgs args, DataRow row) +503
   Nolics.ORMapper.DataProviders.SQLBlockBuilder.ExecCommandProcedure(StmContext context, DataRow data) +712
   Nolics.ORMapper.DataProviders.SQLBlockBuilder.ExecuteCommand(StmContext context, DataRow data) +76
   Nolics.ORMapper.DataProviders.SQLDataProvider.Update(DataSet updateData) +1711
   Nolics.ORMapper.Base.Transaction.Commit(Boolean fCleanIfSuccess) +909
   Nolics.ORMapper.Base.Transaction.Commit() +10
   Telerik.Cms.Data.StagedPage.Publish() +773
   Telerik.Cms.Data.StagedPage.CheckIn() +365
   Telerik.Cms.Web.UI.ToolBar.Button_Command(Object sender, CommandEventArgs e) +123
   System.Web.UI.WebControls.LinkButton.OnCommand(CommandEventArgs e) +108
   System.Web.UI.WebControls.LinkButton.RaisePostBackEvent(String eventArgument) +135
   System.Web.UI.WebControls.LinkButton.System.Web.UI.IPostBackEventHandler.RaisePostBackEvent(String eventArgument) +10
   System.Web.UI.Page.RaisePostBackEvent(IPostBackEventHandler sourceControl, String eventArgument) +13
   System.Web.UI.Page.RaisePostBackEvent(NameValueCollection postData) +175
   System.Web.UI.Page.ProcessRequestMain(Boolean includeStagesBeforeAsyncPoint, Boolean includeStagesAfterAsyncPoint) +1565
```

Version Information: Microsoft .NET Framework Version:2.0.50727.3623; ASP.NET Version:2.0.50727.3618

Figure 7.5.5.3: Query Problems

Source: Author

7.6 Summary

The chapter discussed about the system testing of the proposed system of EPOS. Software testing can commence at any time in the software development process. The system testing process is used to verify the development against the requirements, to check the system for errors and the system work flow. The errors discovered in testing the system are being discussed in a more detail approach in this chapter. When considering this chapter the main purpose is to show how the systems deliver a high quality product with minimum errors.

Chapter 08

Implementation

8.1 Introduction

This chapter describe about how the system is going to develop physically. Testing the system ensures that the implemented system will run with minimum errors and bugs. And also this report will provide information about the implementation facts, which is needed to run the system in the real environment. The implementation facts conveys about the system implementation procedures in depth in order to provide comprehensive knowledge to the reader regarding data runs, installation methods and system handover procedures.

And also concern about the data conversion and user training and factors which needed to be when work in real environment.

8.2 System Overview

Functionalities of the proposed EPOS are an automated sub component of the existing manual application processing at Sri Lanka postal service. There are three main users identified in the system as customer, delivery person and admin. Customer main functionalities are buy post shop products online, tracking their domestic parcels and mails and send their own post cards online. Administrator responsible with manage all the web pages and delivery person responsible with enter each and every domestic parcels and mails delivery details.

8.3 Installation

When the system is developed and tested, system will be implemented for the real world environment. Implementation of the system accompanied by the Sri Lanka Postal service HQ and it helped to reduce the risks of errors. The EPOS is an internet based product which developed with the client software components. The application and the database will install in the Postal service HQ main server and the clients can access from the browser.

8.4 System Changeover

This changeover method will be used for existing functions such shopping cart as parallel with the proposed EPOS because current system uses to manage and maintain all the operations of the postal services. Thus current EPOS will be replaced by the new system instantly. Hence all

together old and new systems will be run some period of time and all details will be loaded in to new system.

Parallel changeover helps to can minimize the errors and it helps to reduce the risk which is occurred from the system. Considering the parallel systems of new and old systems, it will be given some kind of training for the system users which are helps to understand the system clearly.

8.5 Data Conversion

Data conversion will be started after the implementation of the system. Current data will be retrieved from the current database and copied them to the new system's database. Data conversion for the monitoring system will be conducted as a manual process such as product details, employee details and post card details should be entered manually and will take some time.

8.6 User Training

With involve with the automated processes of the system, it is not necessary to require more user training except the entering data. In this phase the user should inform the flexibility to use this system. Thus the project team can identify the difficulties of the system. Because of the rules and regulations the system should be run in a proper way. The users will have some period of time to get some knowledge about the system and in that time duration they have the instruction to use it.

8.7 Summary

This chapter provides the detail of testing and implementation process of the EPOS. The implementation phase depicts how the system is being developed and implemented. This phase also concentrates on detailed description about how the system is developed with appropriate selection of languages, tools and how the system is going to implement and whether the system needs user training or not.

Chapter 09

Evaluation

0.1 Introduction

This chapter will offer the complete evaluation on the project of EPOS and how the project behaves from its original conditions and the issues during the project and the decisions that are made to overcome for those problems are discussed. And also this session is discussed about the knowledge that could be acquired during the project. As product evaluation it will further discuss about how far it met the functional requirements during the initial stages of the project.

9.2 Evaluation of Project Practice

In this section represent the evaluation of the project plan and variations which are occurred during the project phases. Moreover these sections discuss about the success of the process and the difficulties and recovery solutions which arise within the project. The main phases of the evaluation are analysis, design and implementation.

9.2.1 Analysis Phase

This is the most important stage of the development because it helps to identify the possible requirements for the developing system. For this development used interviews as a fact finding technique. In this stage, mainly identify the issues and limitations of the current system, model the current system, identify the functional and non-functional requirements and model the proposed system.

The interviewing process also faced some difficulties because of the busy working schedule of the stakeholders. But the requirement collection plan was successfully guided the requirements collection processes effectively.

Within this analysis phase from the guidance of the staff members and the operators a lot of knowledge could be gained. And also learnt to look at the problems in different scenarios and observe some weak points. The requirements are gathered from different views of staff members. Therefore most of the requirements are really different from one another. But it helped to prioritize the requirements among large number of requirements.

9.2.2 Design phase

In design phase included design the overall architecture and identify the main components of the proposed system. And also the databases interfaces of the system will be represented during this

phase. Mainly focus to design the system according to the software and module architecture, design the database, design the interfaces and integrate the modules of the system.

With the proper understanding of the user requirements gave back up to continue the design process without much difficulty. The overall system architecture helped to identify major tasks and components of the proposed system. The Software architecture represents a clear idea about the components of the system and communication between components. But in implementation process was changed due to the system characteristics. Interfaces designs were helped to develop the prototype of the system.

Design phase allows acquiring experience on which are collected from the analysis phase. And also identified how far design theories are come in to practice on real environment. For an example when design the databases using normalization techniques and theories, helped to identify the attributes, primary keys and foreign keys of the database.

9.2.3 Implementation phase

This phase will represent the responsibility on establish the system according to the specifications which are identified. All the construction, testing and implementation of the system will be represented during this phase. The main key process of this phase are identifying testing strategies, design the test plan, identifying major tasks on implementation and planning implementation.

System will be settled as separated components and integrated in to the development of overall development. To ensure the development of error free software complete tests should be implemented during this phase. The major task of implementation was making a proper implementation plan. Because any failure occurred during this phase it will affect to the day today process. Therefore, proper changing methods should be applied for the process to minimize the risks and the implementation time. Best testing strategies and proper implementation methods were helps to conduct the implementation in an effective way.

9.3 Evaluation of Product

In this phase mainly focus whether the final product of the project is achieved the functional requirements which are set by the users. To gather the results of evaluation process it is necessary to practice methods such as interviews and observations. Following described some techniques which are used to gather the results of evaluation.

- **Interviews**

Especially interviews focus on operator level people. Operators of the system have been interviewed after the system implementation and user training. The feedbacks of the interviewers are very important when considering about the further modifications of the system.

- **Observations**

Observations are carried out the new functions of the system and identify the problems which are occurred with the new system. This helped to identify the user training problems and whether the system is functioning and implementation process was successful.

9.3.1 Evaluation Criteria

By considering about the problems and limitations which are mentioned in the requirement gathering process was compared with the functions of the new system. System is assessed considering with these aspects such as User friendliness, Accuracy, Compatibility, Features of the system, Time effectiveness and Functionality of the system.

9.3.2 Evaluators and the Problems of the Current System

In this scenario describe the evaluators who access with the system usually. Because they are the people who interact with the system and can identify the issues regard to the system. A brief description can be shown as follows.

Table 9.3.2.1: Evaluators and the problems of the current system (Author)

| Evaluators | Problems of the current system |
|-------------------|--|
| Admin | <p>Difficult to insert, update and search information.</p> <p>Data records are stored in separate files in manual system because of that accessibility to the records is in low level and it allows to accessing only one person at a time.</p> <p>Since all the information is stored as a paper document it required more storing space.</p> <p>It requires a separate person to manage each function separately. Therefore there is waste of man power and time.</p> <p>There is a risk of losing files due to any misplacement of document or disaster like fire</p> |
| Customer | <p>It is difficult to buy postal product such as envelops, stamps in emergency situations.</p> <p>Customers cannot send their own postcards to friends</p> |

| | |
|--|--|
| | There is no way to viewing information to find details about domestic parcels and mail tracking details. |
|--|--|

9.3.3 Solutions for the problems

User involvement helps to deliver the new system as the user required. In this stage the problems of the current system are compared with the new system. The satisfactory level of the users can be shown as follows.

Table 9.3.3.1: Solutions for the problems (Author)

| Problems Addressed | Solutions Provided | User Comment |
|--|--|--------------|
| Difficult to insert, update and search information of each post shops products and post cards details. | Primary key of the recorded data in the Database. Therefore it is easy to Insert, update and search information about the post shop products and post card details through the system. | Satisfied |
| Difficult to analyze data and generate reports through the current system | Through the new system higher authorities are able to analyze data and generate reports easily. | Satisfied |
| Difficult to check whether customers domestic parcels and mails delivery process. | Through the new system customers are able to track their mails or parcels delivery process easily. | Satisfied |
| Security issues | There are some access levels for particular parties such as administrator, authorities and delivery person and customers. | Satisfied |
| Low accessibility of records | Multiple users can access with the system because all the data are stored in a central database. | Satisfied |
| Required more physical storing space | All the data are stored in separate tables in central database; therefore required space for new system is extremely less than the current system. | Satisfied |
| Wasting man power and time | All the functions of the system are automated, hence it helps to save man power and time | Satisfied |

| | | |
|--|--|-----------|
| There is a risk of losing files due to any misplacement of document or disaster like fire. | Backups are available for all the details of the system. | Satisfied |
|--|--|-----------|

9.3.4 Evaluating Functional Requirements

Purposes of evaluating the functional requirements are to identify whether the system's components meets the requirements specified.

Table 9.3.4.1: Evaluating Functional Requirement (Author)

| Functional Requirement | Component Developed |
|--|---|
| ▪ Be able to order products online | Shopping Cart Module |
| ▪ Be able to handle the customer credit card details | |
| ▪ Be able to track domestic parcel and letter delivery details | Domestic Parcels and Mail Tracking Module |
| ▪ Be able to maintain details of delivery items continuously | |
| ▪ Be able to select standard post cards or upload own post card online | E – Post Card Module |
| ▪ Be able to provide user accounts for each user of the system. | User Account Module |

9.4 Other Project Achievements

Other than the above mentioned project achievements following are the achievements acquired during the project time period. Learning experiences gained throughout the project are much important to face the future challenges in system development. Some of achievement received and lessons learnt during this lessoned learned are,

- Improve the project management skills learnt
- Have knowledge about many programming languages during the language selection process
- Improve the knowledge and find additional features of Asp.net
- Learning of effective time management
- Improve writing skills by preparing a comprehensive project report

9.5 Summary

This chapter provided a detailed evaluation on the project and the system developed. Phases of the project life cycle were evaluated under project evaluation. And the implemented system is evaluated by discussing the problems of the current system and functional requirements of the new system.

Chapter 10

Conclusion and Recommendations

10.1 Introduction

Research works had been carried out throughout the prototype application development process. EPOS is now developed based on all the stakeholders' requirements and opinions gathered via the interviews and documentation reviews. The purpose of this chapter is to conclude the research about the development of EPOS for Sri Lanka Postal service.

This chapter describes the outcome of the problem. Therefore this chapter focuses to assess the outcomes and the findings of this research how to apply for the different situations. And also this chapter include with overview of the project results, project practices and lessons learned, project achievements, future enhancement and recommendations of the project.

10.2 Project Results Overview

The main aim of this project is to offer an EPOS for Sri Lanka postal service to manage the all the details of Shopping cart, domestic parcels and mail tracking and E-post card. The proposed EPOS is feasible enough to provide all the details Shopping cart products and order details, domestic parcels and mail tracking details and E-post card order details and many more. Main beneficial people of this system are higher authorities of Sri Lanka postal Service, customers and operators of the system. This system not allows wasting expenditure, time and space. And also mainly concern about the user friendliness of the system.

Overall project results gathered using fact gathering techniques such as interviews and observations. These details help to analysis and identified analytical perspectives such as technical, economical, operational and social easily.

10.3 Overview of Practices and Lessons Learned

The important point of this research is providing the solution according to the problem domain. Therefore with the guidance of the literature review session can identify the problems which were occurred in such situations. With the understanding of the previous systems problems it was easy to consider about the proposed systems features.

For the purpose of the data gathering from users various techniques such as interviews, document review and observation methods were used. With the practical assistance of these methods can identify the system requirements. Considering about the quantitative and qualitative methodologies which were used in data gathering techniques they were really useful to analyze the data. When using the fact gathering techniques, such as interviews and should be

aware of the time plan of the project. Because these kinds of techniques are more time consuming. With considering these aspects the sessions were modified and continue the work.

10.4 Project Achievement

The proposed EPOS is enabling to align with the aim and objectives of the project. The EPOS fetches the accuracy and effectiveness throughout the system. As the solution for the problem domain of the current system, this well-functioning EPOS system was developed. As mentioned earlier the new system included modules such as Shopping cart, domestic parcels and mail tracking and E-post card. The EPOS deliver an enhanced service to the Sri Lanka postal service by deliver a computerized system. The entire customer, higher authorities were able to access with the system very effectively more than the current system.

An initial prototype of EPOS is developed with a flexible architecture that can be enhanced for future expansion. Testing was conducted on EPOS to test correctness and completion of the prototype application, this includes the testing on user friendliness, efficiency as well as the technical feasibility of this prototype application.

This system development provides consumers with a new look on doing online shopping, domestic parcels, mail tracking and online E-post card sending through Sri Lanka postal service, where customers can access information they want using the Internet, anytime. The features of EPOS are translated into functional and non-functional requirements which have been discussed in Chapter 4. Testing also carried out during the system development.

The system provides the functionalities such as insert, update, delete and search. And also new system can generate reports according to the authority's requests. The availability of the system is mainly responsible for the members who registered with the system. So the customers can insert, update, view details of their personal details, order and details of domestic parcels and mail tracking. The authorities can view the detail reports of all the functions which are carried out the system. And also the operator or admin were able to insert the details to the shopping cart module and E-post card module. The delivery person can enter details about domestic mails and parcels delivery details through this system.

The EPOS mainly concern to decrease the limitations of the current system and moderate the functionalities of the new system. Therefore it helps to avoid the representative issues from the manual systems such as data redundancy.

10.5 Future Enhancement

At this stage the initial development of EPOS with its basic functionalities and to whomever who is interested to improve or enhance this project work, this will serve as the foundation to continue to work on as the EPOS is still in its early stage of having the entire complete system that are fully functioning. The EPOS is developed with its flexibility in terms of system architecture

which is easily allowed for future expansion. When consider about this project development there are a couple of recommended areas for future enhancements:

- **Expanding Interactive Content and Rich User Experiences**

A more interactive and dynamic content will help to keep the system ahead of the competition and creating rich user experiences will be helps to increase the actual value of current EPOS.

- **SMS and MMS Feature**

Add on a function to send SMS and MMS automatically to notify the customers regarding promotional items of the day, improvement of sending domestic parcels or mails.

- **Using Data Mining Techniques**

Using variety of data mining techniques can be helps to identify and simplify customer perceptions and attitudes. Every day, every hour and every minute, tera-bytes of data can be utilize and this data can be used to generate certain knowledge that can help in modeling and predicting customer behavior and further in order to know their customers better.

- **Using Online Editor**

For E-Post Card Module using online image editor can be helps to increase customer satisfaction of this module.

- **Using more Encryption methods**

Hence EPOS is empowering with online payments it needs more encryption methods. This will provide more secure transactions with EPOS.

10.6 Recommendation

EPOS should provide accurate and effective service to the Sri Lanka postal service with the availability of high security. Therefore it is necessary to access with the system through a high secure network. The main access point of the EPOS is HQ of the Sri Lanka postal service. The people should have to access the system at any place at any time. Therefore the manual system move in to the computerized web based system. The user can login to the system using valid username and password.

The proposed computerized system is highly concern about the user-friendliness of the system and reduces the wasting of manpower and the valuable time.

Most of the client machines have the operating system such as Windows xp and Windows 7. Server computer should have operating system such as Windows xp, Windows 7.

10.7 Summary

This chapter described whether the problem domain is tally with the outcome of the system development and how the outcome of the system development is fulfilling the user requirements. Moreover, this chapter describes the overview of the project, practice and lessons learned during the process, project achievements and recommendations which can be gained from the project and also the overall background of the project environment, problem domain and the requirements gathering process are discussed.

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Appendix A

Interview Questionnaire

1. What are the current services which are provided by Sri Lanka Postal Service?
2. What are the current file base systems which are used by Sri Lanka Postal Service?
3. What are the limitations of the current system?
4. As you think what are the solutions we can reduce the current limitations of the system?
5. Do you think for postshops is it possible to have shopping cart for customers to order products online?
6. Do you have IT facilities in postShop and other normal Branches in Sri Lanka?
7. Do you Employees who are working with current file based system have any experience for system operation?
8. What are the things you sell in postshop branches?
9. Do you like to use online payment system for postshop products?
10. Would you like to have domestic tracking system for domestic Registered mails and parcels delivery?
11. Can you describe the current process of domestic parcels and mails delivery?
12. Would you like to have barcode reader process for track mails?
13. Can you explain about domestic parcels and mails chargers?
14. As new feature would you like to have online epost card sending?
15. How should epost card delivered to receiver, as an email or notification through the system?
16. Is it possible to print post card from branch post offices and delivered it to receiver?
17. What are the payment chargers if you print the epost card and send it to receiver?
18. Is it ok to have tracking number for epost card and orders for postshop products?
19. What are the reports you want to generate through the system?
20. Do you want any dashboard or summarize reports for tracking?
21. What are the user access levels you need for this system?

Appendix B

System Models

In this section, project team describes the process of the system using four kinds of UML diagrams.

Activity Diagrams

Here, project team try to describe overall process as a one process separately using several diagrams. Processes which have a common procedure are shown using an example.

Login

This process is common for every function. Before doing anything all users have to go through this process. After the login process, they can continue other processes. The selecting function in this diagram is describes more in following diagrams after this.

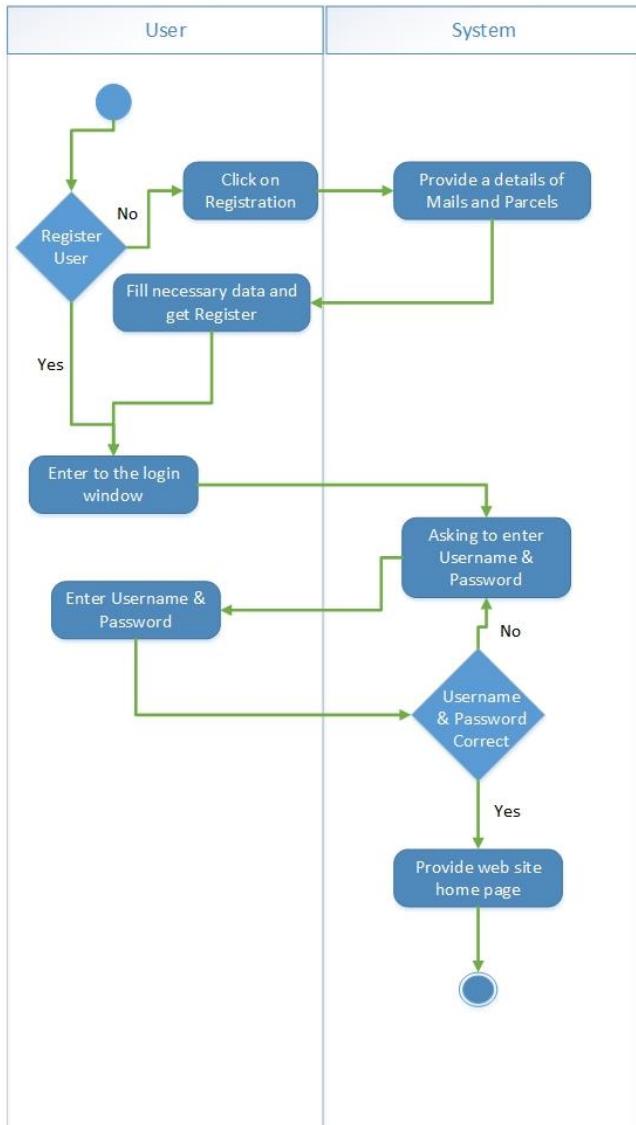


Figure: Activity Diagram for Login

Source: Author

Insert Details

This is the common process for entire system insert details to the system such as insert delivery details, insert post card details and insert employee details. As an example in here, this process is described using the process of add new employee to the system.

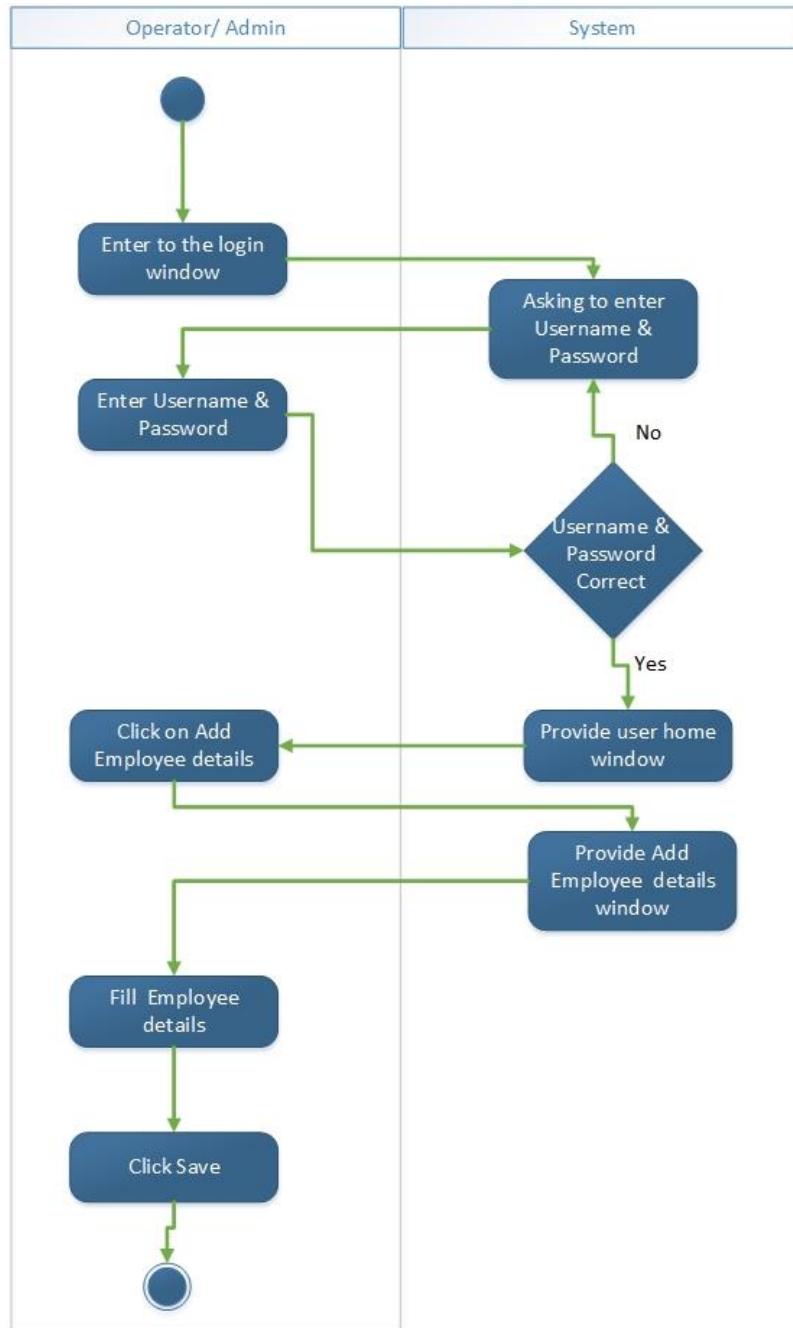


Figure: Activity Diagram for Insert Employee to the System

Source: Author

Update Details

This process also a common process for all data edit forms such as Update delivery details, update post card details and update employee details. This process explain with update current product process.

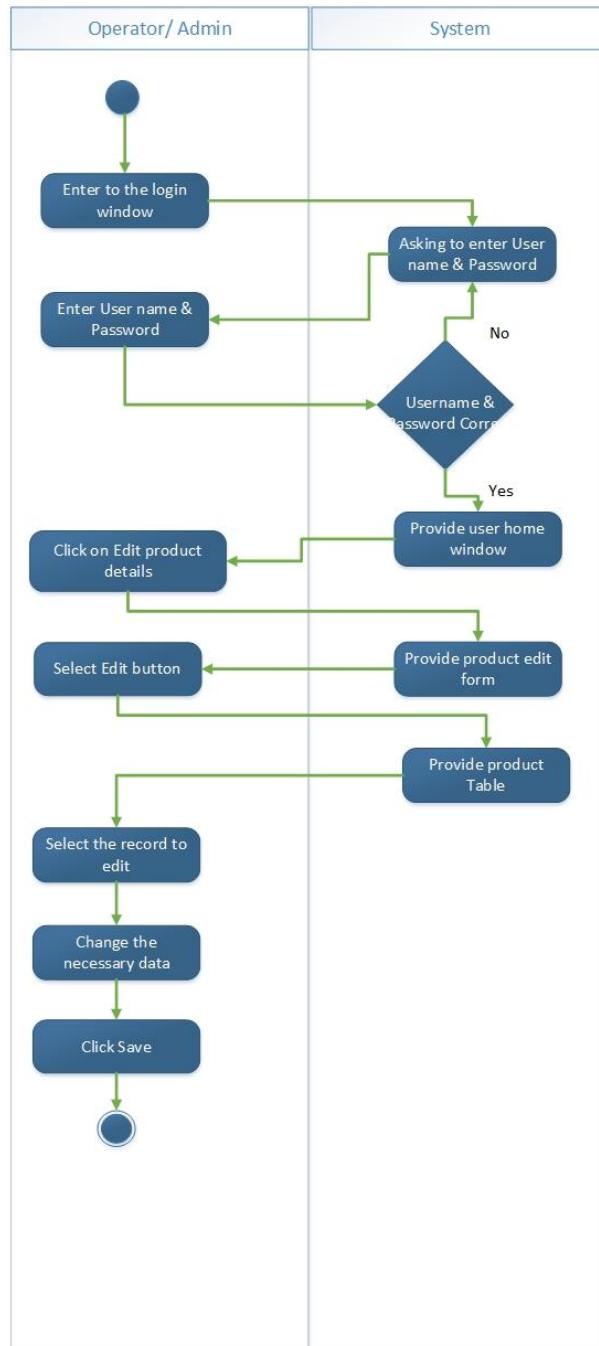


Figure: Activity Diagram for Update Product

Source: Author

View Domestic Mails and Parcels Tracking Details

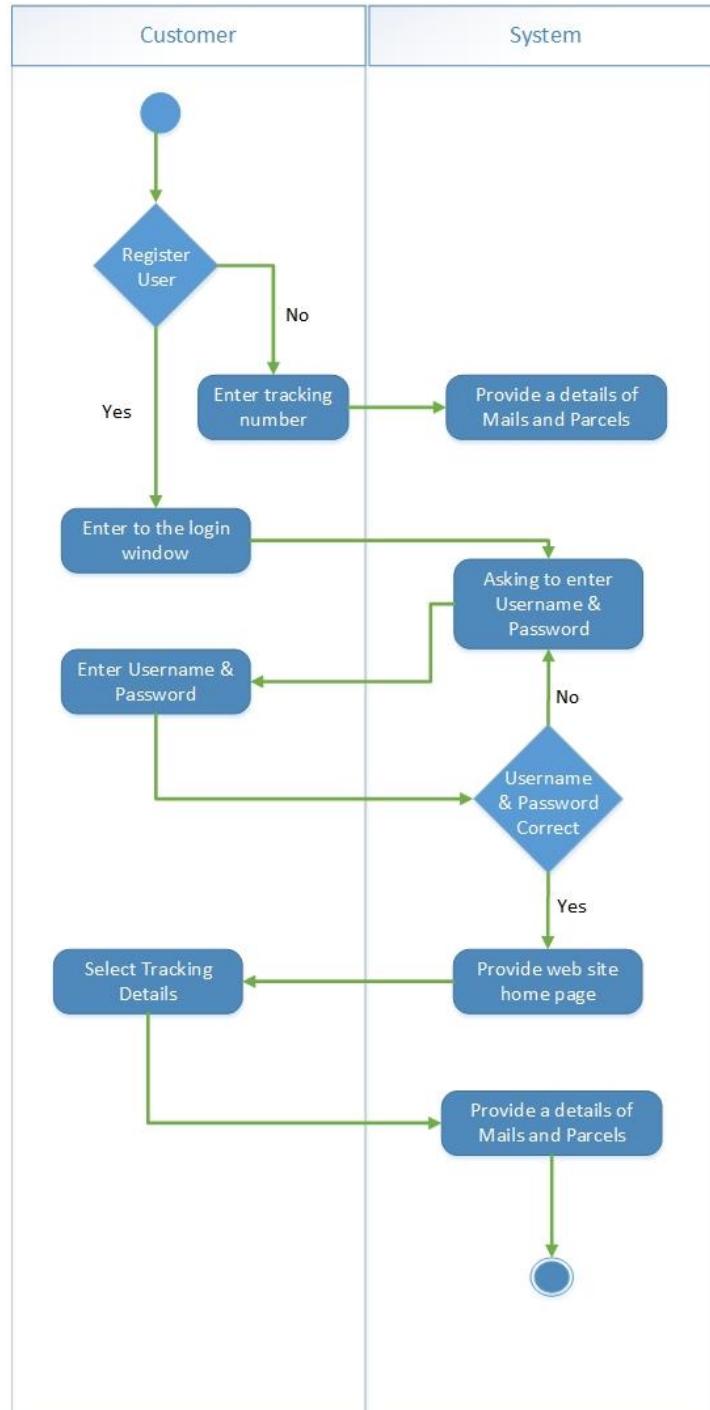


Figure: Activity Diagram for Update Product

Source: Author

View Reports

This is a common process for all the reporting modules.

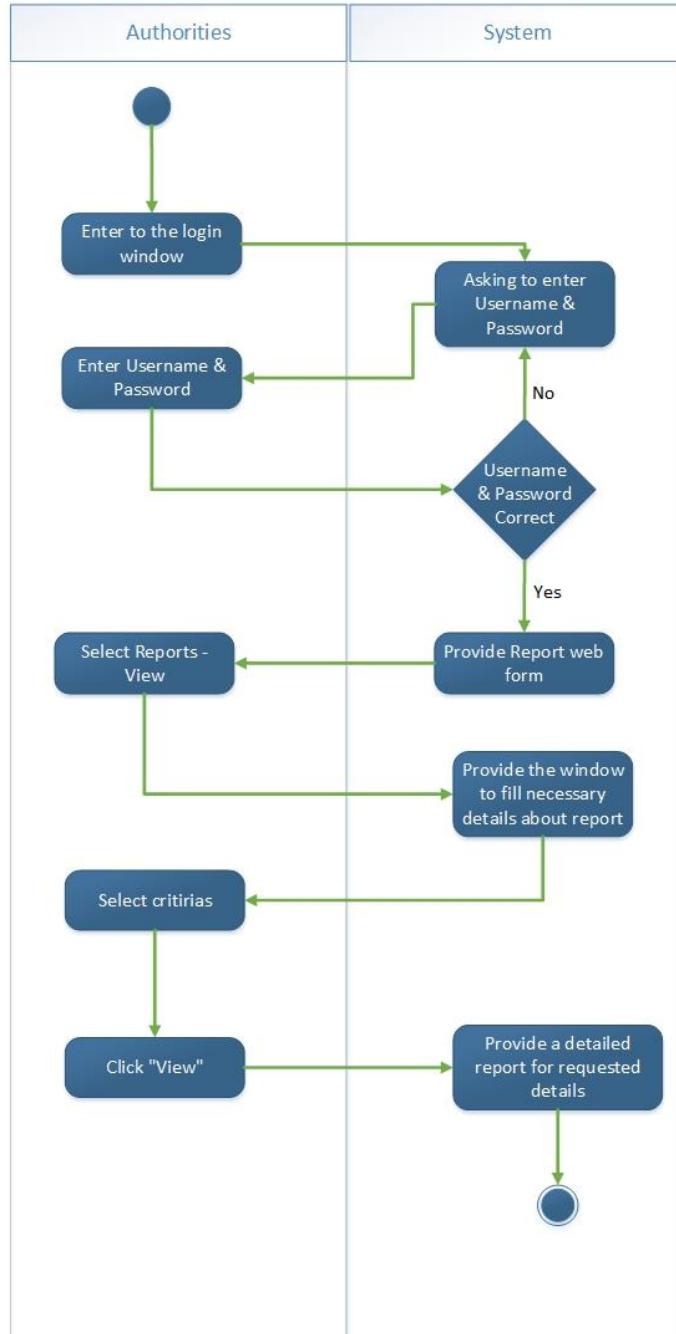


Figure: Activity Diagram for View Reports

Source: Author

Use Case Diagrams

Here, project team has described all the modules separately with related to the overall EPOS process.

Domestic Parcels and Mails Tracking Module

This diagram represent the Domestic Parcels and Mails Tracking module and user levels of access.

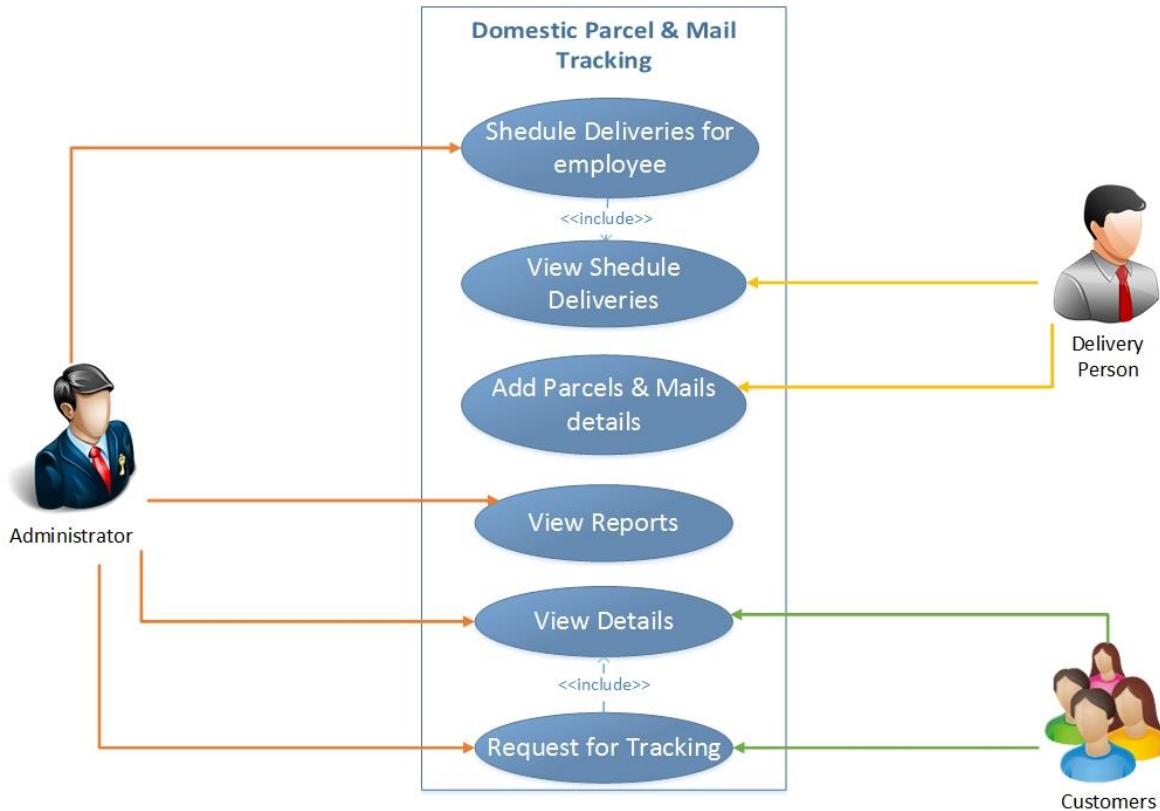


Figure: Use Case Diagram for Domestic Parcels and Mails Tracking Module

Source: Author

Shopping Cart Module

This diagram represent the Shopping cart module and user levels of access.

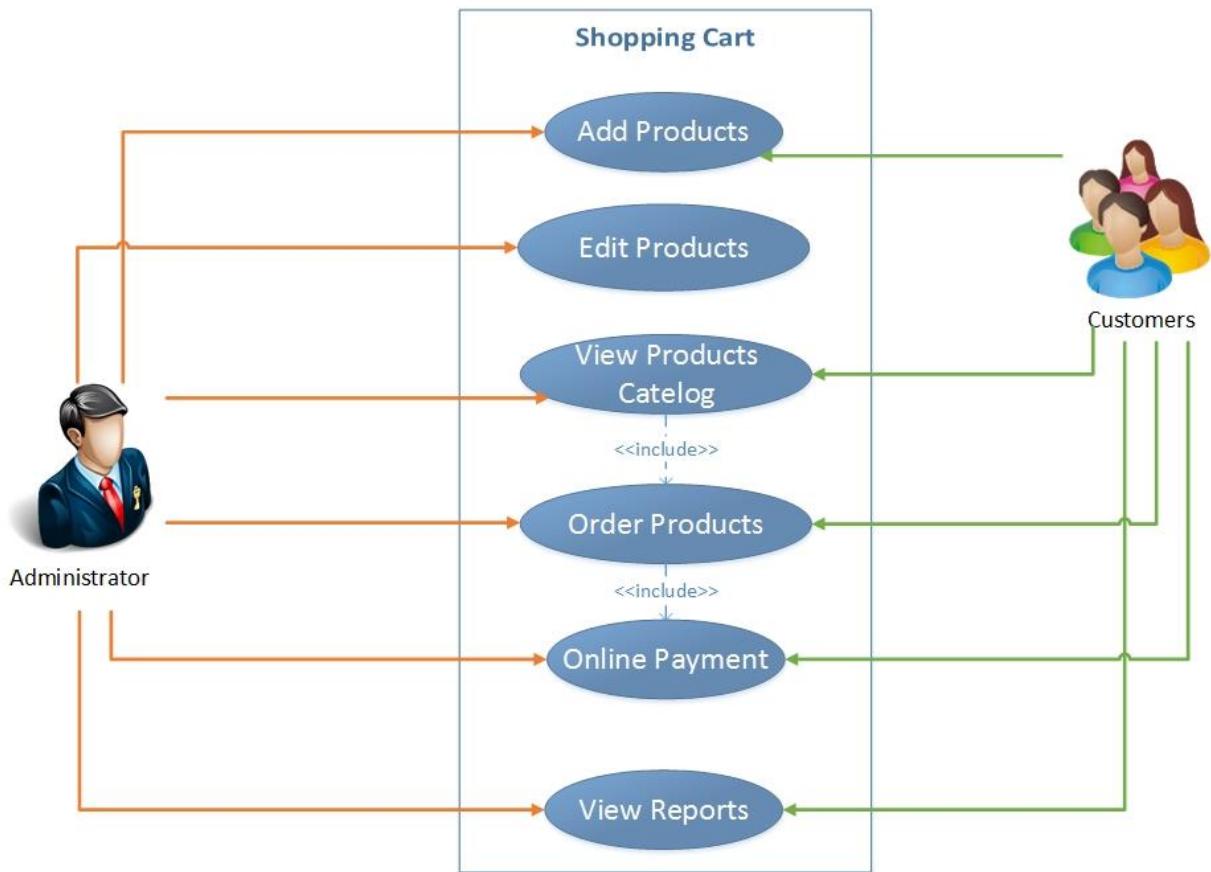


Figure: Use Case Diagram for Shopping Cart Module

Source: Author

E – Post Card Module

This diagram represent the Shopping cart module and user levels of access.

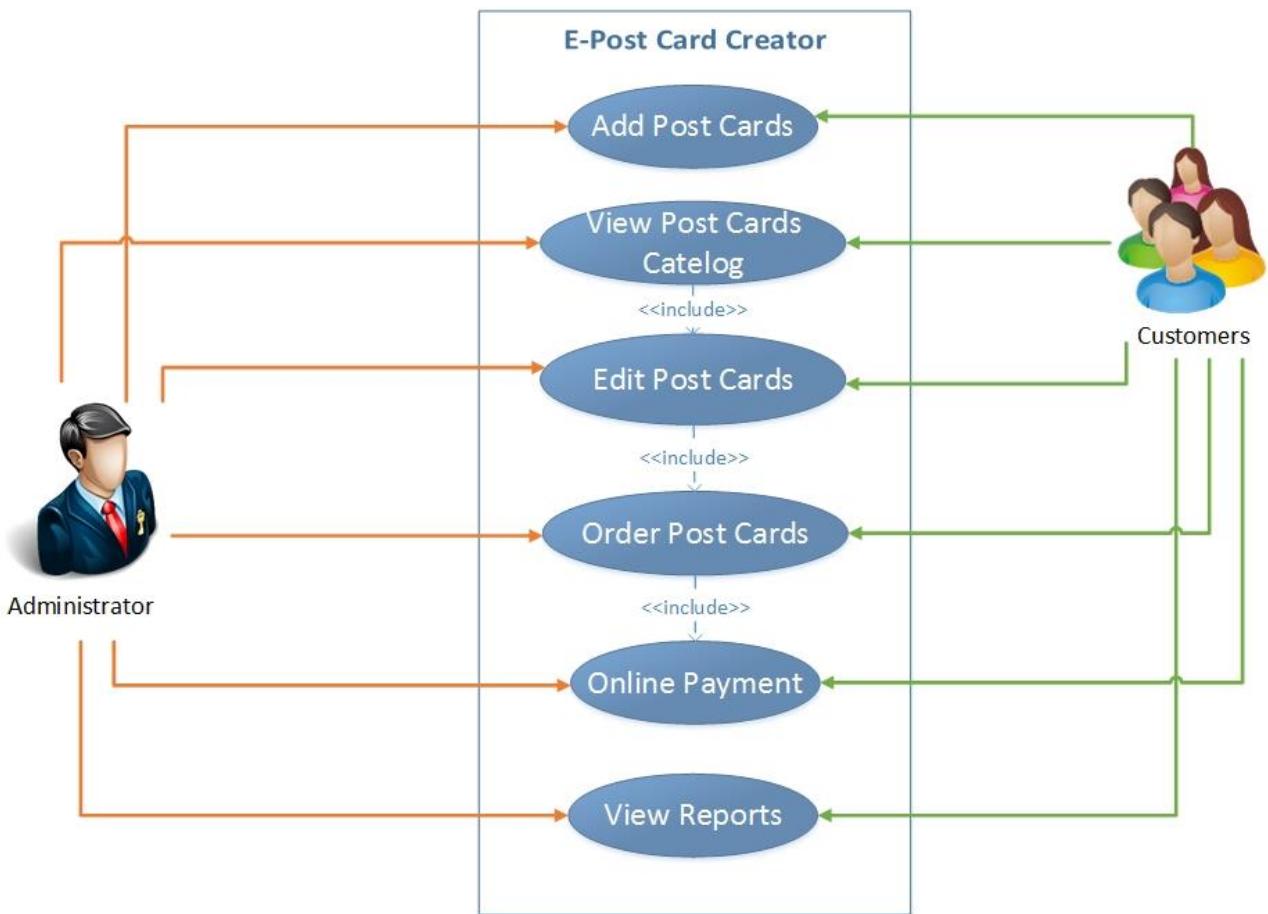


Figure: Use Case Diagram for E- Post Card Module

Source: Author

Sequence Diagrams

Project team has explained communication with users and interaction with the database in the processes. There are diagrams which have common processes in several modules and an example from one module is used to make that process understand clearly

Login

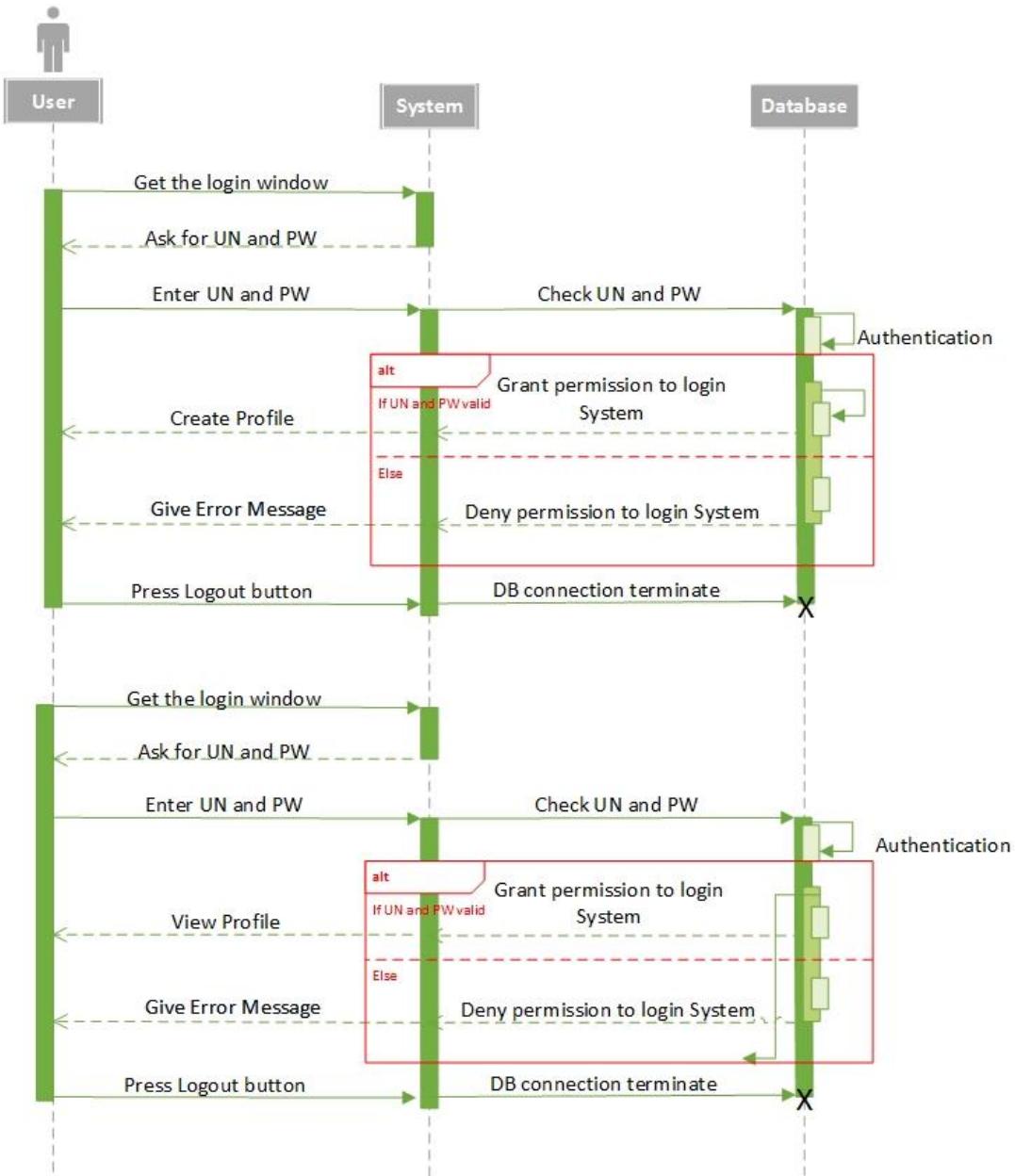


Figure: Sequence Diagram for User Login

Source: Author

Admin Insert, Update and Delete

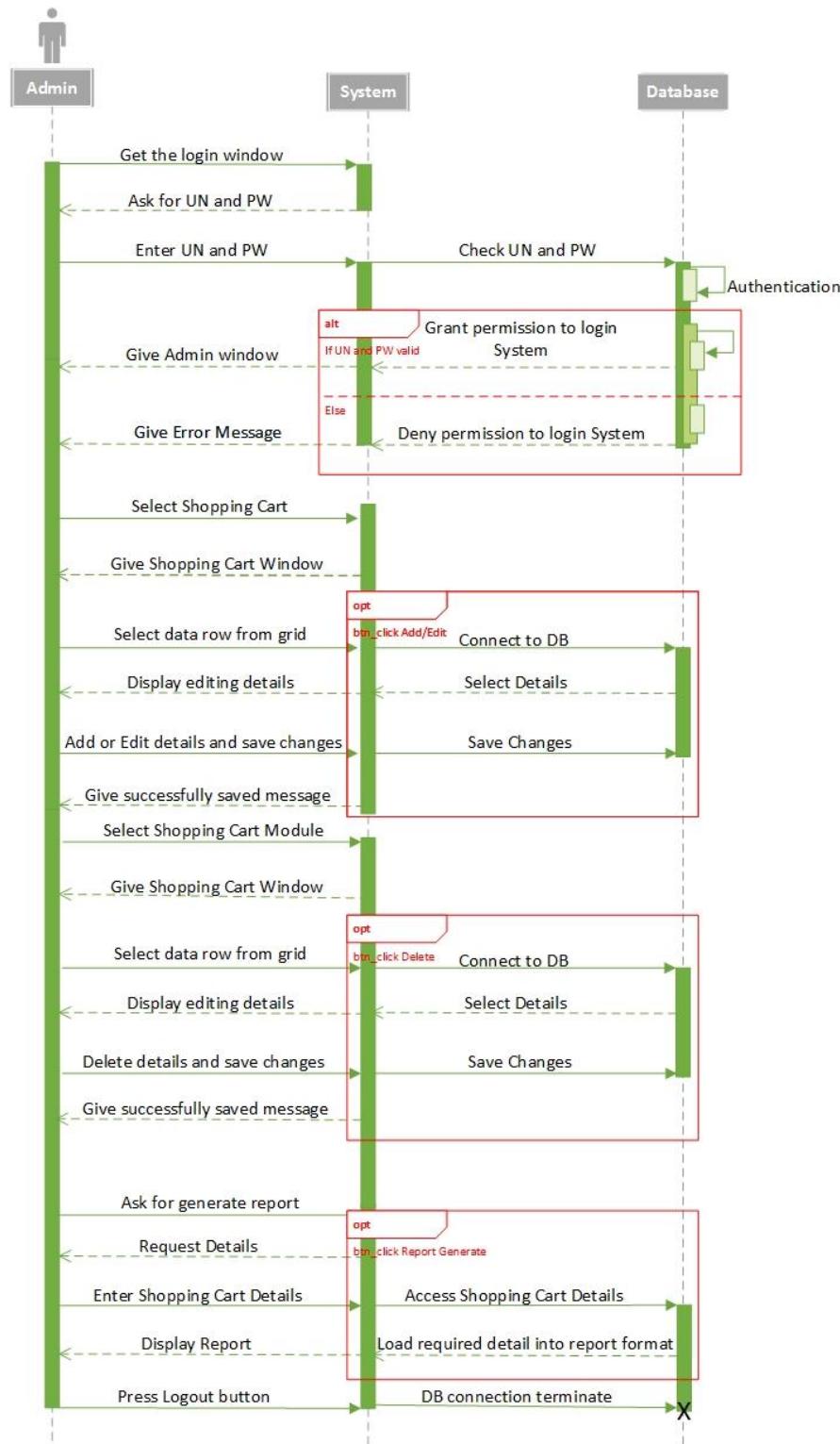


Figure: Sequence Diagram for Admin Insert, Update and delete Details

Source: Author

Buy Product Online

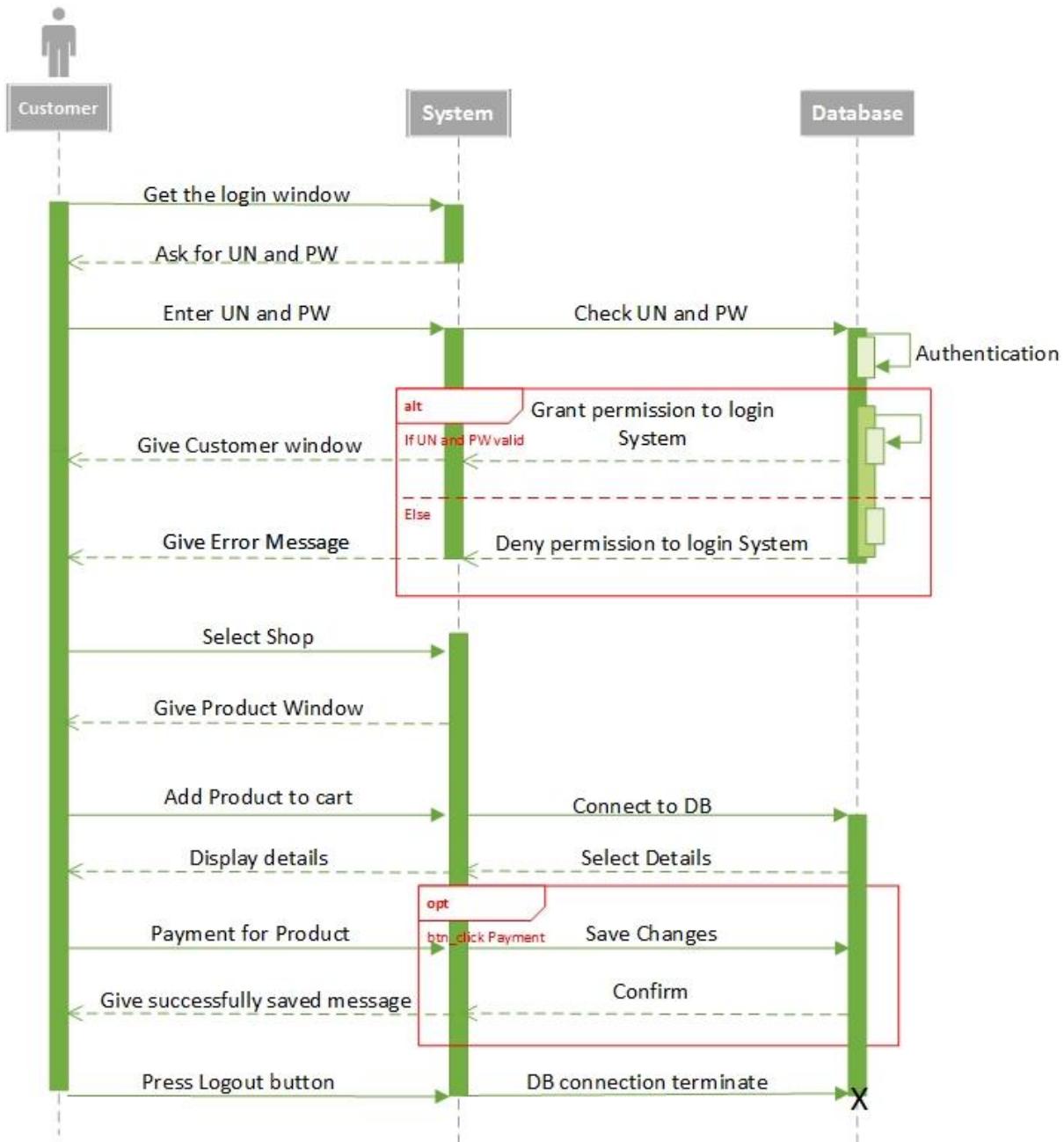


Figure: Sequence Diagram for purchasing online Products from Cart

Source: Author

E – Post Card Purchasing

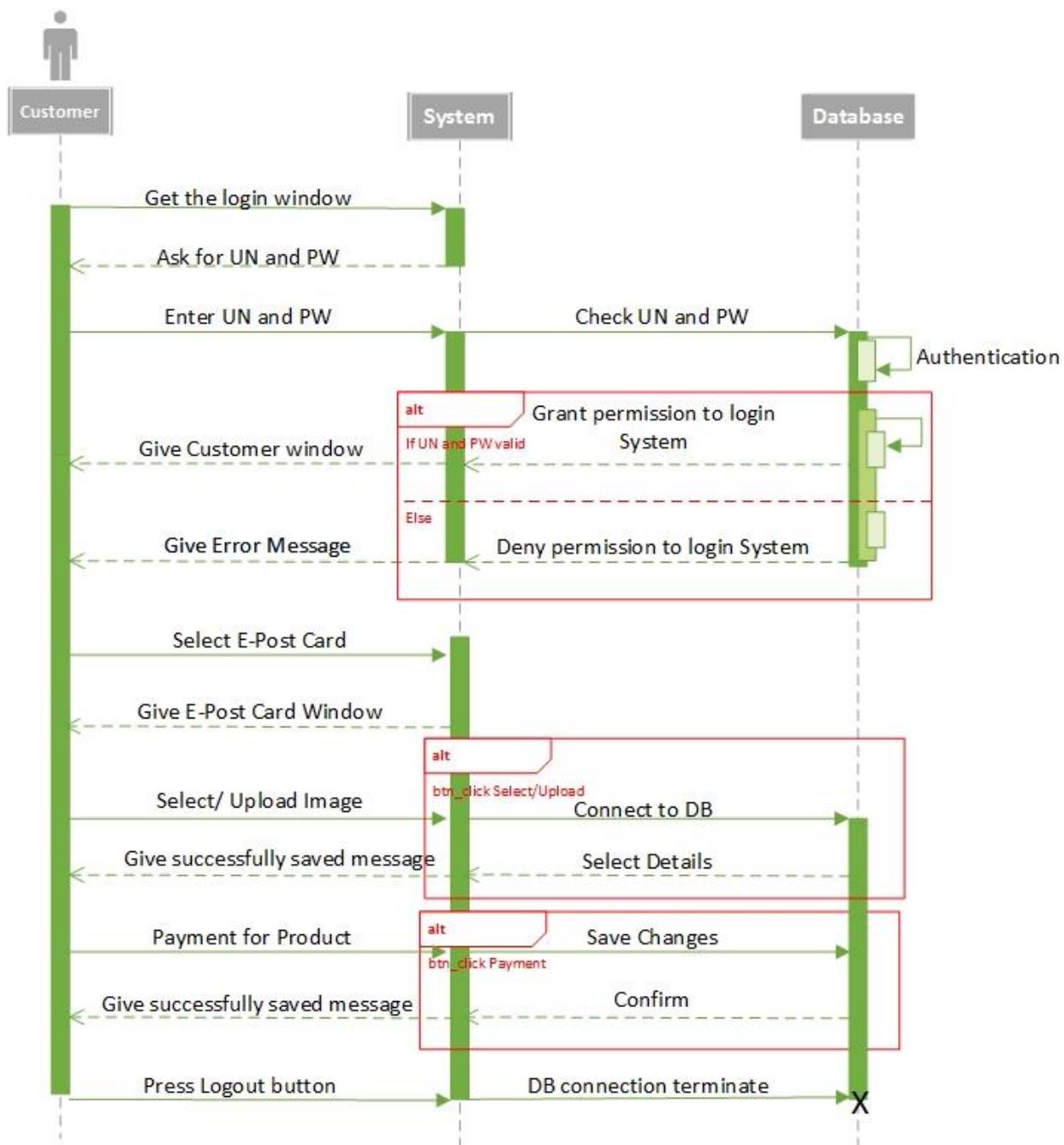


Figure: Sequence Diagram for purchasing E- Post Card

Source: Author

Customer Tracking Details View

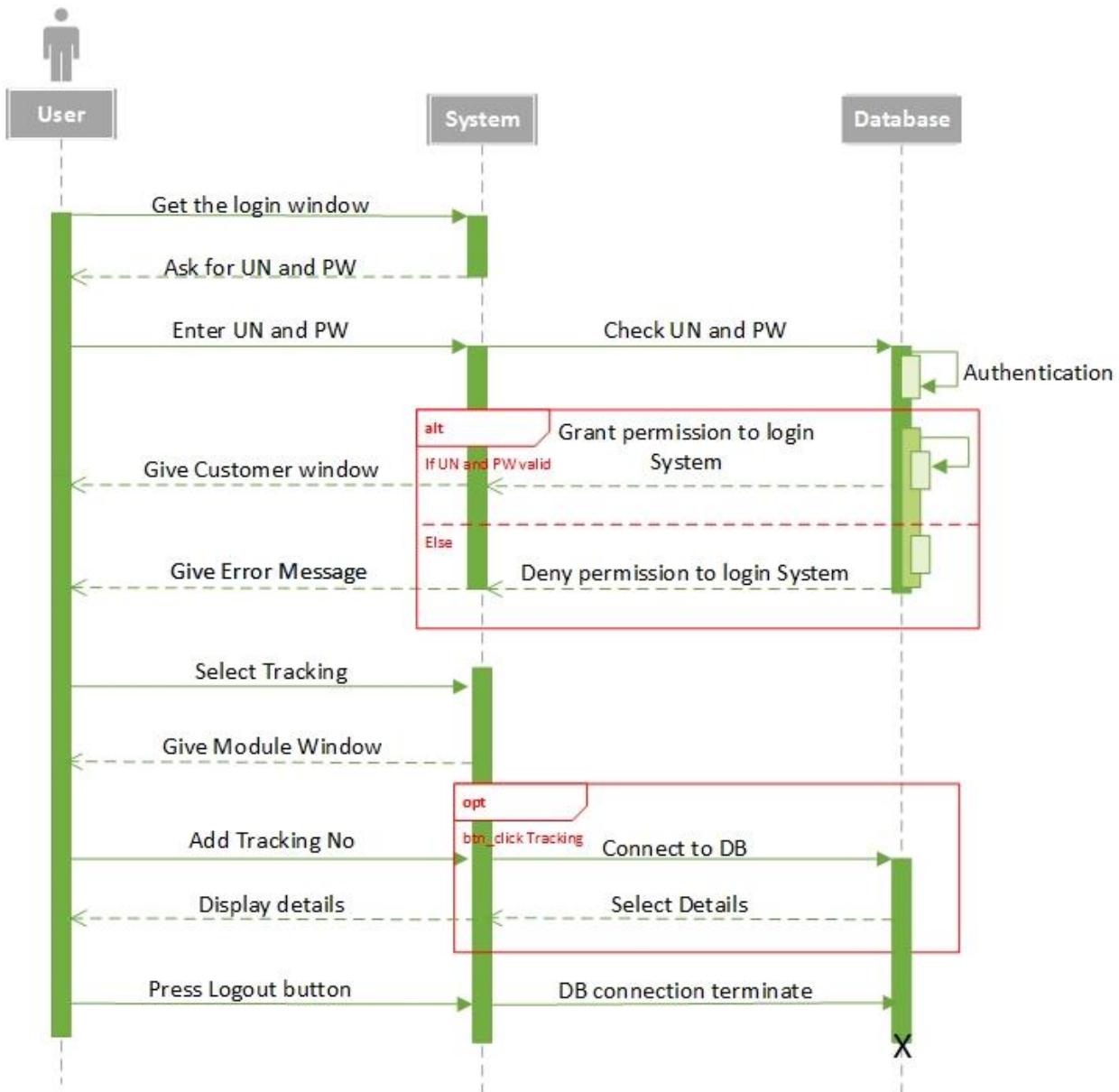


Figure: Sequence Diagram for User Tracking Details View

Source: Author

Delivery Person Insert and Update Tracking Details

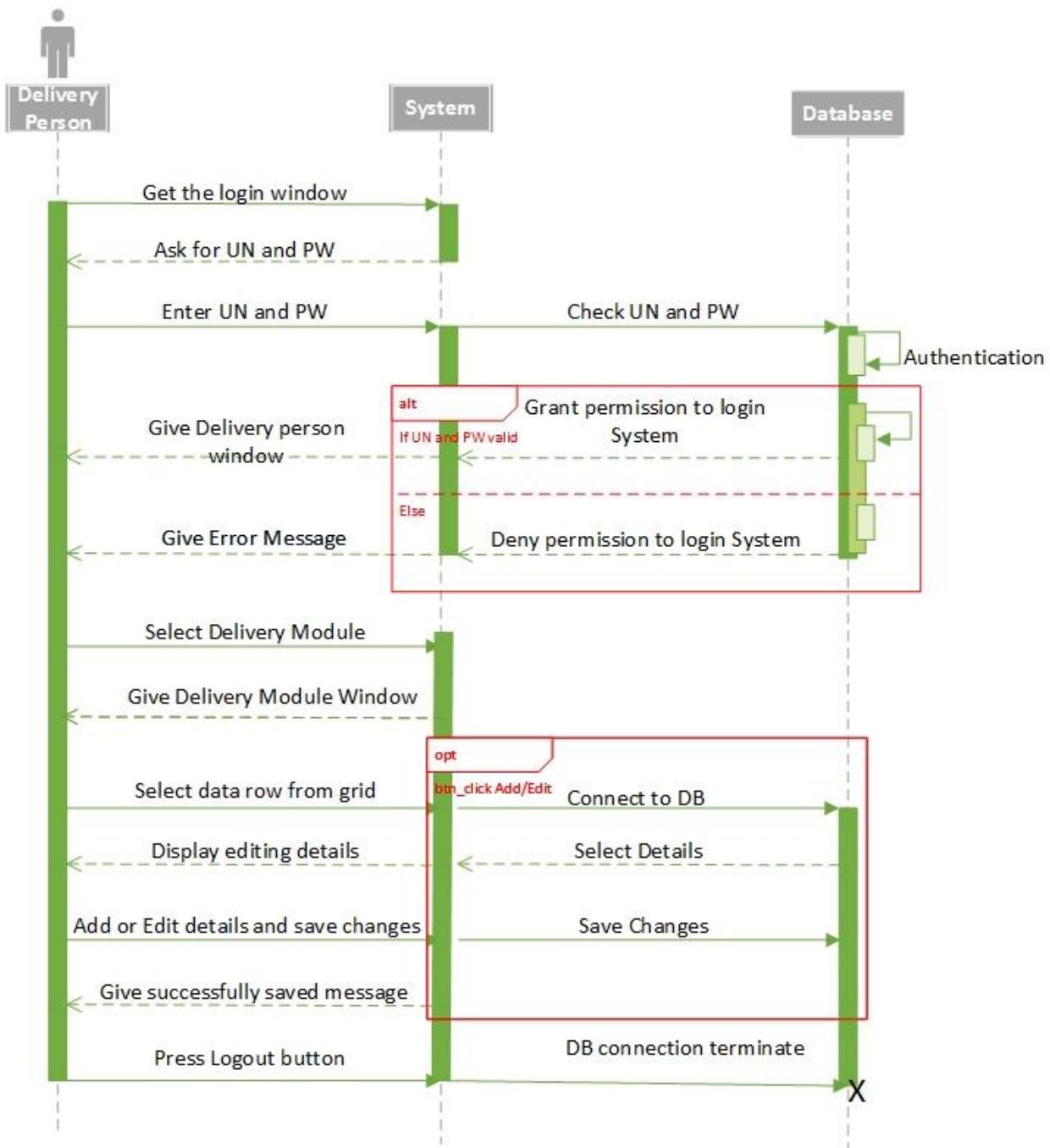


Figure: Sequence Diagram for Delivery Person Insert and Update Tracking Details

Source: Author

Appendix C

| Test Cases for Login | | | | | | |
|---|--|--|--|--|--|--|
| Pre-conditions: User has valid username and password | | | | | | |

| Step | Test Step | Test Data | Expected Result | Actual Result | Status | Notes |
|------|---|--|--|-------------------------|--------|-------|
| 1 | Navigate to login page | Click login button | Display login page | Same as expected result | Pass | |
| 2 | User able to login successfully | Correct Username And Password | User must successfully login to the web page | Same as expected result | Pass | |
| 3 | Unregistered users is not login to site | incorrect username, incorrect password | Proper error must be displayed and prompt to enter login again | Same as expected result | Pass | |
| 4 | Test with valid username and empty password such that login must get failed | valid username and empty password | Proper error must be displayed and prompt to enter login again | Same as expected result | Pass | |
| 5 | Test with empty username and valid password such that login must get failed | empty username and valid password | Proper error must be displayed and prompt to enter login again | Same as expected result | Pass | |
| 6 | Check if the login function handles case sensitivity | case changed username /password | Login must fail saying incorrect username/password | Same as expected result | Pass | |
| 7 | Verify the URL without logging into to the site | Registered username and password | the URL should not redirect to a logged in page but to a logged out page of the site | Same as expected result | Pass | |

| | | | | | | |
|---|---|-----------------------|---------------------------|-------------------------|------|--|
| 8 | Verify Register button click navigate to registration page | Click register button | Display registration form | Same as expected result | Pass | |
|---|---|-----------------------|---------------------------|-------------------------|------|--|

Test Cases for Registration Page

Pre-conditions: Enter to the system

| Step | Test Step | Test Data | Expected Result | Actual Result | Status | Notes |
|------|--|---|---|-------------------------|--------|-------|
| 1 | Navigate to Registration page | Click Register button | Display Registration page | Same as expected result | Pass | |
| 2 | Verify that all the specified fields are present on the registration page | First name, last name , address, phone number, and all other fields | All the specified fields are present on the registration page | Same as expected result | Pass | |
| 3 | Verify that the required/mandatory fields are marked | | All the required/mandatory fields are marked | Same as expected result | Pass | |
| 4 | Verify that not filling the mandatory fields and clicking submit button will lead to validation error | Keep First name, Last name, Address No. fields empty | Display error message as "Please try again" | Same as expected result | Pass | |
| 5 | Verify that not filling the optional fields and clicking submit button will still send data to server without any validation error | Address street 1 and Address street 2 fields keep empty | Display Registration is successful | Same as expected result | Pass | |
| 6 | Verify that clicking submit button after entering all | Fill registration form details and click register | Display Registration is successful data save into | Same as expected | Pass | |

| | | | | | | |
|----|---|---|--|-------------------------|------|--|
| | the required fields, submits the data to the server | button | database | result | | |
| 7 | Verify that clicking cancel button after entering all the required fields, cancels the submit request and resets all the fields | Fill registration form details and click cancel button | Resets all the fields | Same as expected result | Pass | |
| 8 | Enter empty value for First Name | Keep first name empty and click register button | Display error message "Name required" | Same as expected result | Pass | |
| 9 | Enter empty value for Password and Confirm Password | Keep username and passwords fields empty and click the button | Display error message "Password required." | Same as expected result | Pass | |
| 10 | Enter empty value for either Password or Confirm Password | Password: 123 And confirm password keep empty | Display error message "Password does not match." | Same as expected result | Pass | |
| 11 | Enter empty value for Contact Number | Keep username and passwords fields empty and click the button | Display error message | Same as expected result | Pass | |
| 12 | Enter non-numeric value in Contact Number field | aaaaaaaaaa | Display error message | Same as expected result | Pass | |
| 13 | Enter empty value for Address no | Keep address No empty and click the button | Display error message "Address No required" | Same as expected result | Pass | |
| 14 | Value entered in Password field must be visually encrypted | 123 | xxxxxxxx | Same as expected result | Pass | |

| | | | | | | |
|----|--|------------------------------|---|-------------------------|------|--|
| 15 | check for the error message for mobile no field by enter less than 10 characters | 01231556 | Display error message | Same as expected result | Pass | |
| 16 | Check Birthday for current date | Select birthday as 2015/10/1 | Display error message as "Invalid Birthday" | Same as expected result | Pass | |
| 17 | Check Birthday for future date | Select birthday as 2016/1/1 | Display error message as "Invalid Birthday" | Same as expected result | Pass | |

Test Cases for Online Purchasing

Pre-conditions: User has valid username and password

| Step | Test Step | Test Data | Expected Result | Actual Result | Status | Notes |
|------|--|---|--|-------------------------|--------|-------|
| 1 | Verify click the URL link for the online purchasing page | Click payment button | Display payment page | Same as expected result | Pass | |
| 2 | If customer is new user register for system | Login to the system as new user | Display login page | Same as expected result | Pass | |
| 3 | If already registered customer login to system | Please refer Login test cases | | | | |
| 4 | If customer is new user register to the system | Please refer Registration test cases | | | | |
| 2 | Verify that all the specified fields are present on the payment page | Card details, delivery address and etc. | All the specified fields are present on the payment page | Same as expected result | Pass | |

| | | | | | | |
|---|--|---|---|-------------------------|------|--|
| 3 | Verify that the required/mandatory fields are marked | | All the required/mandatory fields are marked | Same as expected result | Pass | |
| 4 | Verify that not filling the mandatory fields and clicking submit button will lead to validation error | Keep credit card number, credit card holder's Last name empty | Display error message as "Please try again" | Same as expected result | Pass | |
| 5 | Verify that not filling the optional fields and clicking continue button will still send data to server without any validation error | Address street 1 and Address street 2 | Display Payment is successful | Same as expected result | Pass | |
| 6 | Verify that clicking continue button after entering all the required fields, submits the data to the server | Fill payment form details and click continue button | Display payment is successful data save into database | Same as expected result | Pass | |
| 7 | Verify that clicking cancel button after entering all the required fields, cancels the submit request and resets all the fields | Fill payment form details and click cancel button | Resets all the fields | Same as expected result | Pass | |
| 8 | Verifying Payment Methods | | | | | |
| 9 | Verify with expired credit card | | | | | |

Test Cases for Shopping Cart

Pre-conditions: User has valid username and password

| Step | Test Step | Test Data | Expected Result | Actual Result | Status | Notes |
|------|--|---|--|-------------------------|--------|-------|
| 1 | Click the URL link for the shopping cart | Click Shopping cart button | Display shopping cart home page | Same as expected result | Pass | |
| 2 | Verify products show stock availability | Click on product | Display stock is available or not | Same as expected result | Pass | |
| 3 | Provide clear editing for update quantity and remove | Add 2 quantity for a product | Update quantity | Same as expected result | Pass | |
| 4 | Move to wish list | Click Add to cart button | Display wish list | Same as expected result | Pass | |
| 5 | Adding Item in shopping cart | Add few products to shopping cart | Display add products with correct quantity | Same as expected result | Pass | |
| 6 | Deleting item from wish list cart | Delete one product from wish list | Display other products with quantity | Same as expected result | Pass | |
| 7 | Verifying Item count after adding and deleting | Add 5 product and delete 2 items from wish list | Display remaining products with correct quantity | Same as expected result | Pass | |
| 8 | Verifying Sales price of product | Add product to wish list | Display product price on wish list | Same as expected result | Pass | |
| 9 | Verify that not filling product quantity field and clicking add to cart button will lead to validation error | Keep product quantity empty and click add to cart | Display error message for add quantity | Same as expected result | Pass | |

| | | | | | | |
|----|---|---|----------------------|-------------------------|------|--|
| 10 | Verify that clicking continue button after entering all the required fields, submits the data to the server | Add products and click Payment button and check whether data is saved on database | Display payment page | Same as expected result | Pass | |
| 11 | Verify display payment option | Add products details and click continue | Display payment page | Same as expected result | Pass | |

Test Cases for E – Post Card

Pre-conditions: User has valid username and password

| Step | Test Step | Test Data | Expected Result | Actual Result | Status | Notes |
|------|--|--------------------------------------|---------------------------------------|-------------------------|--------|-------|
| 1 | Click the URL link for the E – Post card page | Click E – Post card button | Display E – Post card page | Same as expected result | Pass | |
| 2 | Verifying purchasing of any item when it is not in stock | Click on product | Display stock is available or not | Same as expected result | Pass | |
| 3 | Verifying Sales price of product | Select post card | Display post card price on the screen | Same as expected result | Pass | |
| 4 | Verify uploaded images | Please Refer Image Upload Test Cases | | | | |
| 5 | Click the URL link for the Select post cards | Click Select post cards | Display Select post cards page | Same as expected result | Pass | |
| 6 | Verify Select post cards show stock availability | Click on Select post cards | Display stock is available or not | Same as expected result | Pass | |
| 7 | Adding Select post cards | Add post card | Display add Select post | Same as expected | Pass | |

| | | | card | result | | |
|----|--|--|---|-------------------------|------|--|
| 8 | Deleting item | Click cancel button to remove post card | Remove post card | Same as expected result | Pass | |
| 9 | Verifying Sales price of product | Add product to wish list | Display product price on wish list | Same as expected result | Pass | |
| 10 | Verify that all the specified fields are present on the page | Post card receiver's address and message | Display all the required fields on the screen | Same as expected result | Pass | |
| 11 | Verify that the required/mandatory fields are marked | Post card receiver's address no, street and city | Marked all the mandatory fields | Same as expected result | Pass | |
| 12 | Verify that not filling the mandatory fields and clicking submit button will lead to validation error | Keep post card receiver address no and city empty | Display an error message | Same as expected result | Pass | |
| 7 | Verify that not filling the optional fields and clicking continue button will still send data to server without any validation error | Address street 2 and Address street 3 | Confirm sending with message | Same as expected result | Pass | |
| 8 | Verify that clicking continue button after entering all the required fields, submits the data to the server | Fill post card receiver's form details and click continue button | Confirm sending with message | Same as expected result | Pass | |
| 9 | Verify that clicking cancel button after entering all the required fields, cancels | Fill post card receiver's form details and click cancel button | Resets all the fields | Same as expected result | Pass | |

| | | | | | | |
|----|--|---|----------------------|-------------------------|------|--|
| | the submit request and resets all the fields | | | | | |
| 10 | Verify display payment option | Fill post card receiver's form details and click continue | Display payment page | Same as expected result | Pass | |

Test Cases for Image Upload

Pre-conditions: User has valid username and password

| Step | Test Step | Test Data | Expected Result | Actual Result | Status | Notes |
|------|--|--|--|-------------------------|--------|-------|
| 1 | Verify for uploaded image path | Upload an image | Take image path for system | Same as expected result | Pass | |
| 2 | Verify image upload functionality with image files of different extensions | Use images with JPEG, PNG extension | Upload image successfully | Same as expected result | Pass | |
| 3 | Verify image upload with image size greater than the max allowed size | Upload image greater than the max allowed size | Proper error message should be displayed | Same as expected result | Pass | |
| 4 | Check image upload functionality with file types other than images | Use files with txt, doc, pdf, exe extension | Proper error message should be displayed | Same as expected result | Pass | |
| 5 | Verify Image upload progress bar appear | Upload an image | Image upload progress bar should appear | Same as expected result | Pass | |
| 6 | Verify if cancel button | Upload an image and click | Cancel image | Same as expected | Pass | |

| | | | | | | |
|---|--|---|--|-------------------------|------|--|
| | functionality is working in between upload process | cancel button | | result | | |
| 7 | Check if user is able to view the uploaded images | Upload an image | View uploaded image | Same as expected result | Pass | |
| 8 | Verify image quality after upload. | Upload an image and check for image quality | Image quality should not be changed after upload | Same as expected result | Pass | |

Test Cases for Employee Insert, Update and Delete

Pre-conditions: User has valid username and password

| Step | Test Step | Test Data | Expected Result | Actual Result | Status | Notes |
|------|---|---|---|-------------------------|--------|-------|
| 1 | Navigate to Employee Insert, update and delete page | Click Employee menu button | Display Employee Insert, update and delete page | Same as expected result | Pass | |
| 2 | Verify that all the specified fields are present on the registration page | First name, last name , address, phone number, and all other fields | All the specified fields are present on the registration page | Same as expected result | Pass | |
| 3 | Verify that the required/mandatory fields are marked | | All the required/mandatory fields are marked | Same as expected result | Pass | |
| 4 | Verify that not filling the mandatory fields and clicking submit button will lead to validation error | Keep First name, Last name, Address No. fields empty | Display error message as "Please try again" | Same as expected result | Pass | |

| | | | | | | |
|----|--|---|--|-------------------------|------|--|
| | | | | | | |
| 5 | Verify that not filling the optional fields and clicking submit button will still send data to server without any validation error | Address street 1 and Address street 2 fields keep empty | Display Registration is successful | Same as expected result | Pass | |
| 6 | Verify that clicking submit button after entering all the required fields, submits the data to the server | Fill registration form details and click register button | Display Registration is successful data save into database | Same as expected result | Pass | |
| 7 | Verify that clicking cancel button after entering all the required fields, cancels the submit request and resets all the fields | Fill registration form details and click cancel button | Resets all the fields | Same as expected result | Pass | |
| 8 | Enter empty value for First Name | Keep first name empty and click register button | Display error message "Name required" | Same as expected result | Pass | |
| 9 | Enter empty value for Password and Confirm Password | Keep username and passwords fields empty and click the button | Display error message "Password required." | Same as expected result | Pass | |
| 10 | Enter empty value for either Password or Confirm Password | Password: 123 And confirm password keep empty | Display error message "Password does not match." | Same as expected result | Pass | |
| 11 | Enter empty value for Contact Number | Keep username and passwords fields empty and click the button | Display error message | Same as expected result | Pass | |
| 12 | Enter non-numeric value in Contact Number field | aaaaaaaaaa | Display error message | Same as expected result | Pass | |

| | | | | | | |
|----|--|---|---|-------------------------|------|--|
| 13 | Enter empty value for Address no | Keep address No empty and click the button | Display error message "Address No required" | Same as expected result | Pass | |
| 14 | Value entered in Password field must be visually encrypted | 123 | xxxxxxxx | Same as expected result | Pass | |
| 15 | check for the error message for mobile no field by enter less than 10 characters | 01231556 | Display error message | Same as expected result | Pass | |
| 16 | Check Birthday for current date | Select birthday as 2015/10/1 | Display error message as "Invalid Birthday" | Same as expected result | Pass | |
| 17 | Check Birthday for future date | Select birthday as 2016/1/1 | Display error message as "Invalid Birthday" | Same as expected result | Pass | |
| 18 | Check employee details are select for correct fields | Select data record from grid | Select data into text box fields | Same as expected result | Pass | |
| 19 | Check employee details update correctly to the server | Edit text box data and click button to save data | Display success Message | Same as expected result | Pass | |
| 20 | Check employee details delete correctly from the server | Select data from the grid and click delete button | Display success Message | Same as expected result | Pass | |

Test Cases for Product Insert, Update and Delete

Pre-conditions: User has valid username and password

| Step | Test Step | Test Data | Expected Result | Actual Result | Status | Notes |
|------|--|--|---|-------------------------|--------|-------|
| 1 | Navigate to Shopping cart product Insert, update and delete page | Click Product button | Display Product insert, update, delete page | Same as expected result | Pass | |
| 2 | Verify that all the specified fields are present on the product insert, update, delete page | Product ID, Name, category, Unit Price, and all other fields | All the specified fields are present on the Product insert, update, delete page | Same as expected result | Pass | |
| 3 | Verify that the required/mandatory fields are marked | | All the required/mandatory fields are marked | Same as expected result | Pass | |
| 4 | Verify that not filling the mandatory fields and clicking submit button will lead to validation error | Keep Name, category, Unit Price fields empty | Display error message as "Please try again" | Same as expected result | Pass | |
| 5 | Verify that not filling the optional fields and clicking submit button will still send data to server without any validation error | Discount field keep empty | Display successful message | Same as expected result | Pass | |
| 6 | Verify that clicking submit button after entering all the required fields, submits the data to the server | Fill Product details and click save button | Display successful message for data save into database | Same as expected result | Pass | |

| | | | | | | |
|----|---|--|--|-------------------------|------|--|
| 7 | Verify that clicking cancel button after entering all the required fields, cancels the submit request and resets all the fields | Fill the form details and click cancel button | Resets all the fields | Same as expected result | Pass | |
| 8 | Enter empty value for Product Name | Keep Product name empty and click save button | Display error message "Product Name required" | Same as expected result | Pass | |
| 9 | Enter empty value for Product Category | Keep Product Category field empty and click the button | Display error message "Please select the product category" | Same as expected result | Pass | |
| 10 | Enter Characters for unit Price | aaaaaaaaaaa | Display error message "invalid Unit Price." | Same as expected result | Pass | |
| 11 | Enter empty value for unit Price | Keep unit Price field empty and click the button | Display error message | Same as expected result | Pass | |
| 12 | Check Product details are select for correct fields | Select data record from grid | Select data into text box fields | Same as expected result | Pass | |
| 13 | Check Product details update correctly to the server | Edit text box data and click button to save data | Display success Message | Same as expected result | Pass | |
| 14 | Check Product details delete correctly from the server | Select data from the grid and click delete button | Display success Message | Same as expected result | Pass | |

Test Cases for Post Card Insert, Update and Delete

Pre-conditions: User has valid username and password

| Step | Test Step | Test Data | Expected Result | Actual Result | Status | Notes |
|------|--|--|---|-------------------------|--------|-------|
| 1 | Navigate to E-Post card Insert, update and delete page | Click E-Post button | Display E-Post card insert, update, delete page | Same as expected result | Pass | |
| 2 | Verify that all the specified fields are present on the E-Post insert, update, delete page | Post card ID, Name, Unit Price, and all other fields | All the specified fields are present on the E-Post card insert, update, delete page | Same as expected result | Pass | |
| 3 | Verify that the required/mandatory fields are marked | | All the required/mandatory fields are marked | Same as expected result | Pass | |
| 4 | Verify that not filling the mandatory fields and clicking submit button will lead to validation error | Keep Name, Unit Price fields empty | Display error message as "Please try again" | Same as expected result | Pass | |
| 5 | Verify that not filling the optional fields and clicking submit button will still send data to server without any validation error | Discount field keep empty | Display successful message | Same as expected result | Pass | |
| 6 | Verify that clicking submit button after entering all the required fields, submits the data to the server | Fill Post card details and click save button | Display successful message for data save into database | Same as expected result | Pass | |

| | | | | | | |
|----|---|---|---|-------------------------|------|--|
| 7 | Verify that clicking cancel button after entering all the required fields, cancels the submit request and resets all the fields | Fill the form details and click cancel button | Resets all the fields | Same as expected result | Pass | |
| 8 | Enter empty value for Post card Name | Keep post card name empty and click save button | Display error message "Post card Name required" | Same as expected result | Pass | |
| 9 | Enter Characters for unit Price | aaaaaaaaaaaa | Display error message "invalid Unit Price." | Same as expected result | Pass | |
| 10 | Enter empty value for unit Price | Keep unit Price field empty and click the button | Display error message | Same as expected result | Pass | |
| 11 | Check Post card details are select for correct fields | Select data record from grid | Select data into text box fields | Same as expected result | Pass | |
| 12 | Check Post card t details update correctly to the server | Edit text box data and click button to save data | Display success Message | Same as expected result | Pass | |
| 13 | Check Post card details delete correctly from the server | Select data from the grid and click delete button | Display success Message | Same as expected result | Pass | |

Test Cases for Tracking Details Insert and Update

Pre-conditions: User has valid username and password

| Step | Test Step | Test Data | Expected Result | Actual Result | Status | Notes |
|------|---|---|--|-------------------------|--------|-------|
| 1 | Navigate to Tracking details Insert, update and page | Click Tracking button | Display Tracking insert, update page | Same as expected result | Pass | |
| 2 | Verify that all the specified fields are present on the Tracking insert and update, page | Date, Activity and location fields | All the specified fields are present on the tracking insert and update, page | Same as expected result | Pass | |
| 3 | Verify that the required/mandatory fields are marked | | All the required/mandatory fields are marked | Same as expected result | Pass | |
| 4 | Verify that not filling the mandatory fields and clicking submit button will lead to validation error | Keep Date, Activity and location fields empty | Display error message as "Please try again" | Same as expected result | Pass | |
| 5 | Verify that clicking submit button after entering all the required fields, submits the data to the server | Fill tracking details and click save button | Display successful message for data save into database | Same as expected result | Pass | |
| 6 | Verify that clicking cancel button after entering all the required fields, cancels the submit request and resets all the fields | Fill the form details and click cancel button | Resets all the fields | Same as expected result | Pass | |

| | | | | | | |
|----|---|--|---|-------------------------|------|--|
| 7 | Enter empty value for Location | Keep Location empty and click save button | Display error message "Location required" | Same as expected result | Pass | |
| 8 | Enter empty value for location | Keep location field empty and click the button | Display error message | Same as expected result | Pass | |
| 9 | Check tracking details are select for correct fields | Select data record from grid | Select data into text box fields | Same as expected result | Pass | |
| 10 | Check tracking details update correctly to the server | Edit text box data and click button to save data | Display success Message | Same as expected result | Pass | |

