Online Service Management System for NWSDB

A dissertation submitted for the Degree of Master of Information Technology

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2017

Declaration

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.
To the best of my knowledge it does not contain any material published or written by another person, except as acknowledged in the text.

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Signature: Date: 017/06/2017

This is to certify that this thesis is based on the work of
Mr. W.D.N. Weerasinghe, under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

Certified by:
Supervisor Name: Dr. K.L.Jayarathne

_____

Signature: Date:

Abstract

This study is aimed to provide online services for billing, payment and other services provides by National Water supply and Drainage Board(NWSDB) in Sri Lanka, which controls all major functions of supplying of purified drinking water and sanitary service in Sri Lanka. Currently the NWSDB serves approximately two million Consumers Island wide. NWSDB has 40 regional offices and 325Water supply schemes manually provide customer services.

The problem identified that current process of customer service is the inefficient, time wasting and use more cost. Procedures and mechanisms used to handle customer services are different from location to location. There is no exact method to use all customer service providing offices of NWSDB. Hence NWSDB needs to develop and maintain a better system to provide high quality services for customers.

To overcome the above issues and to increase the productivity of providing customer services detailed study of the manual service process was performed and a system to automated and on lined. Proposed system will integrate with billing and payment services and other water connection services.

In this dissertation, we describe online service management system to address the above problems. The system facilitates the customer to make an online service request for billing and payments services and water connection maintenance services. i.e. All services provide by NWSDB is bring to customer fingertips saving their valuable time and money. All Customer submission of request system generates SMS/email notification massages. Customer those who are out of country can get benefits of innovative technology based on eGovernment concepts to achieve their requirements from home, avoiding the need for unnecessary visits of busy offices.

This online system was done adhering to the Rapid Application Development approach which was well suited for this project. The online system was developed using .NET frame work 4 environment using C #, MS SQL, IIS web server and HTML 5, JQuery and JavaScript. Object oriented concepts have been used to build the system throughout the entire development process.

Finally, the system performance was tested and evaluated by obtaining feedback from sector experts whom were comprised with domain experts and software development experts. A specific questionnaire was developed for this purpose to identify the feedback in a likert scale, under 05 main parameters comprised with 15 variable parameters. The feedback was quantified by using a measurement scale introducing a weightage to each identified parameter Evaluation and testing of the software was done to validate and verify the system both from engineering and user points of view. The user feedbacks were positive. The system was found to be easy to use and extremely helpful and saving consumer’s valuable time and money over the previously used manual systems.

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List of Abbreviations

NWSDB	National Water Supply and Drainage Board
CRO	Customer Relation Officer
OSMS	Online Service Management System
SO	System Operator
SMS	Short Message Service
MIS	Management Information System
IDE	Integrate Development Environment
GB	Gigabyte
GHz	Gigahertz
RAM	Random Access Memory
RAD	Rapid Application Development
UML	Unified Modeling Language
WCF	Windows Communication Foundation

Chapter 1: Introduction

This report is an outcome of the thesis study of the Master of Information Technology program being held by University of Colombo School of Computing. Writer is attached to National Water Supply and Drainage Board (NWSDB) and by identifying a current requirement at the workplace, in connection to the academic knowledge gained during the said Master's Degree program; this "Online Service Management System" was formulated.

1.1 About NWSDB

The National Water Supply and Drainage Board (NWSDB) has been serving for the island nation supplying of purified drinking water, maintain hygiene for the past four decades having established in 1975 as a prestigious statutory body in the discipline of sanitation engineering. NWSDB is a statutory board, which presently functions under the Ministry of Water Supply and Drainage. It is the principal authority providing safe drinking water facilitating the provision of sanitation in Sri Lanka. Currently the NWSDB serves approximately two million consumers envisioning to expand its` horizon to build a healthy nation.

The NWSDB is presently operating 325 Water Supply Schemes, out of which 40 schemes operate as Regional Manager Offices.
Currently, new water connection requests are being handled by all manager offices located island-wide. Operation and maintenance are being done by an area engineer. The commercial department is responsible for implementing standard mechanism for new water connection process and maintains water meter and water billing and bill payment processes. Customer billing and payment system manage by Customer Relation Officer (CRO) and System Operator (SO). The NWSDB has a customer base of more than 2 million in all categories, i.e. domestic, commercial, school, hospital, religious etc.

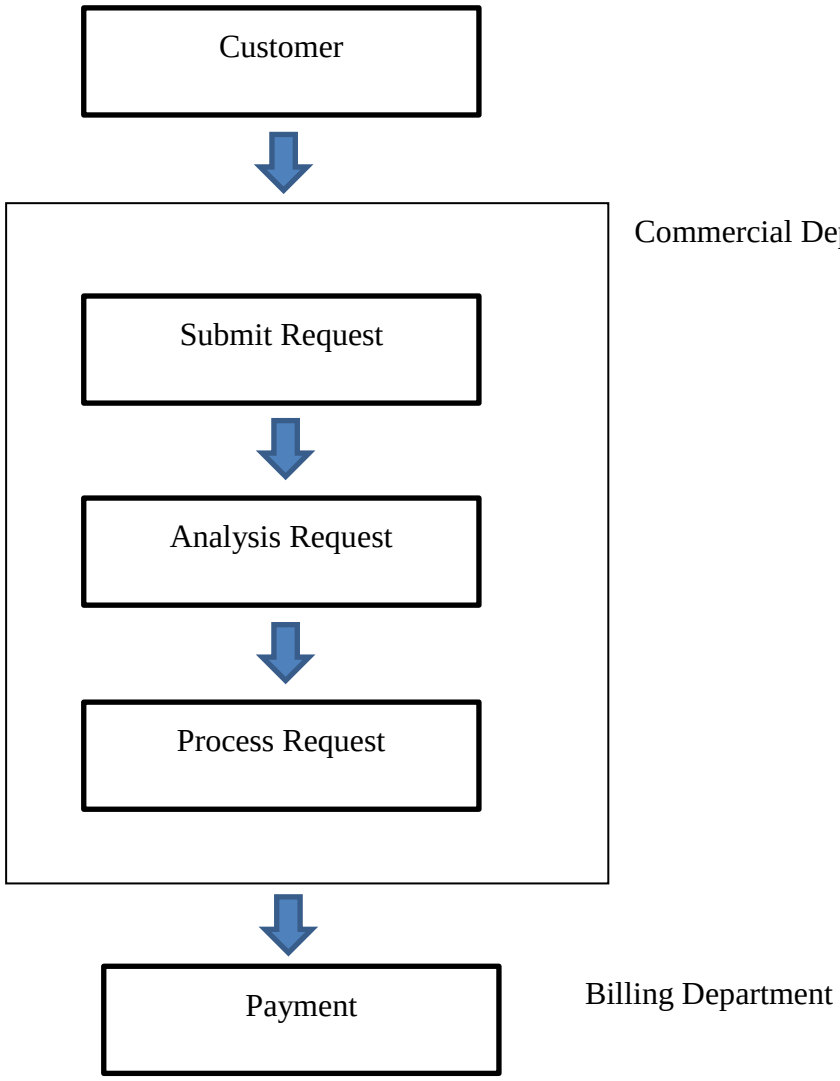
1.2 Background of Existing System

Currently, Water Board has manual system for provide customer services. It is wasting customer's valuable time and money. And customers faced difficulties unnecessary visits to busy offices.

The current process of Billing, Payment and Other Service, has found that following issues in manual process.

- Have to visit CRO in nearest manager office
- Filling the application form and select the service type and submit it to CRO
- Meet CRO again once or more times and to get feedback.
- Have to wait for next water bill to view requested updates.

The workflow of the existing system



The figure 1.1 Workflow of the existing system

According to the above workflow diagram, the current system can be described sub processes. These include,

- Submit Request
  - Any type of request comes from customer to nearest water board region office. The customer relation officer (CRO) will issue application to customer to fill necessary information. Customer filled the application and handed over to CRO.

- Analysis Request
    - CRO check the application and categorized the request type and identify the regional office which should service provide, according to customer address. Forward to application to relevant regional water board office.

- Process Request
    - The CRO in regional office register the applications in relevant log book. Check the customer validity and payment history manually.
    - Service provides only for valid customer and forward completed job to relevant billing department of regional office. Also send acknowledgement (post letter) to customer. Some services free of charge and others have to pay scheduled fees. Customer has to visit the office for payment to get the chargeable services.

1.3 Difficulties of Current System

The following are the shortcomings in the existing system:

- Since customer data is stored in manual files there is a probability of data loss.
- Information retrieving is not quick for inquires because of manual file usage.
- To store manual files record room space is required and service of a record keeper is required.
- Lots of paper work is done during this process.
- Customers have to visit the nearest water board office and have to fill the form to submit their request
- Several times have to visit the office for some tasks.
- Customer has to wait for next water bill to view the result of their requisitions.
- Customer those who are in overseas have faced inconveniences to get the services.
- Having decentralized database for bill calculation process cause to incorrect MIS report generation and time wasting.

1.4 Proposed System

To overcome the above short listed issues and to increase the productivity of providing customer services detailed study of the manual service process was performed and a system to automated and on lined.
Proposed system will integrate with billing and payment services and other water connection services.
Therefore new system brings you our services to your fingertips saving your valuable time and money. Enjoy the benefits of innovative technology based on e-Government concepts to achieve your requirements from home avoiding the need for unnecessary visits to our busy offices.

1.5 Objectives of Proposed System

Following are the objectives of the proposed system:

- Integrating all services which are operated in island-wide and implement a standardized procedure to perform all services.
- Online service provides for customer to reduce their valuable time and cost and limited visiting busy office.
- All customers requested services have provided feedback through email and SMS notifications.
- Centralized database provide accurate and fast information to the management.
- Implement systematic workflow for new connection process.
- New system is an enterprise-wide, web based online application software system there will not be any special client software requirement to access the system. i.e., user agents like Internet Explorer, Mozilla, or any other web browser is enough. Administration and maintenance is easy because application is hosted in central server.

Chapter 2: Background

2.1 Requirements Analysis

When online service management system is developed, systems analysis would represent the following steps:

- Conducting fact-gathering, designed to find out the requirements of the system's end-users.
- The development of a feasibility study, involving determining whether a project is economically, socially, technologically and organizationally feasible.
- Determining how the end-users would operate the system and what the system would be used to full fill current requesting services.

2.1.1 Fact Gathering Techniques

At present all services coordinate by Customer Relation Officer of all regional offices in island-wide. I have selected Dehiwala regional manager office to gather information for the proposed system.

2.1.1.1 Interviews

Interviews allow getting an instant feedback and allow clarifying any doubts immediately. Further, during an interview an indirect observation also can be done.
Prepared questionnaire, Please refer Appendix A and the time scheduled to interview customers those who came Dehiwala office to get services and also CROs.
This was caused to gather most important information, to identify their requirements, duties and responsibilities, to understand the work flow of the process and to know what they expected from the proposed system.

2.1.1.2 Observation

Observing the users in the working environment is another most resourceful way to gather system requirement. However, certain things were necessary to observe in addition to their explanation and complaints. At Interview session what they explained was not clear and correct. Observation cleared them.

Observations were done at Regional Manager Offices on how customer manually requesting their services, what information is taken from them, how they submit request form and do payments for some services and what are the issues.

2.1.1.3 Prototyping

In requirement gathering of proposed system, prototyping was used to clarify the unclear areas and making sure the requirements were correctly identified. I used paper prototype to clear the requirement. Using paper prototype explained the work flow of the new system. Having requirement review meeting, I confirmed the requirement analysis stage. Finally, I could categorize requirements needed to be met in the new system design as follows.

2.1.2 Functional Requirements

Following are the list of functional requirements which have identified during the requirement analysis:

- Facility for customer to make online calculate and check current water bill.
- View billing information online,
- Facility to view and get duplicate print out of current month Water bill.
- Connect to system online and view payment history.
- Online facility to view Account Summery.
- Facility to view existing Water connection details
- Connect to other site for online payment gateways using Credit cards
- Facility for customer to make an online request for a new water connection.
- Facility to online customer name change request.
- Online request for water category change.
- Online Meter Shifting Request submission
- Online Meter Change Request submission.
- Facility to online connection change request.
- Facility to online meter disconnection request submission.
- System generates SMS and Emails feedback massages for submitted request.
- Customer's online registration and user profile detail updating.
- Unauthorized user access maintenance and data validation.

2.1.3 Non-Functional Requirements

Following are the non-functional requirements in the system:

Performance - System should respond quickly for the requests made by the user. The data will be readily available as soon as the request is made and the information requests from the system will be readily accessible at a single click. Screens should load quickly.

Reliability Online management system will be completely tested at the time of delivery. No computational error should occur. The proposed system will be written in a client server environment and used web methods to implement all services then it make easy to modifications when required.

Availability - The system will be available to the user on the internet for 24 hours a day, 7 days a week. If there is a down time and if pre-planned then that need to be informed early, so data lost and inconveniences will be minimized

Security - Consumer should register the online management system first. Then the system asks username and password to login and use the available service of the system. User can change password and user profile as required. Also can recover password if it was forgotten. All information notified to user by SMS and emailed. Data validation of all screen prevent unauthorized access to the customer's personal details and system login The database will be protected and encrypted by standard practice as well as measures. Periodic backups of system will be scheduled.

Maintainability - System will be maintained by the IT division. And also system and software documentation will be provided and that will give instruction about use and maintenance of the system.

2.1.4 Software Requirements

- Development - Microsoft Windows 10 ,Dot Net frame work 4 environment, Visual Studio 10, IDE with C# programming language, IIS Web Server, MS SQL 2012 database , Ajax, jQuery, Java Script, Adobe Photo Shop.

- Client - Microsoft Windows 2000 and above, Internet Explorer 8.0 and above, Mozilla Firefox, Google Chrome.

2.1.5 Hardware Requirements

- Development – Core i5 4 GHz, 4 GB of RAM, 500 GB storage
- Client - P IV processor 2.0 GHz, 512MB of RAM, 40GB storage
- Server – Windows 2008 R2, processor 2.0 GHz, 8 GB RAM, 500GB storage

2.3 User Classes and Characteristics

Primary User - The primary user of the proposed system is the customer. Therefore the user needs basic knowledge of the basic English knowledge and computer literacy and working in internet environment. The user should know how to fill the request application form and submission it. Also need to know how to make credit card payment, etc.

Secondary User - Secondary users will be Water Board officers like Customer Relation Officer, Managers, System Operator and Database Administrator.

2.4 Technical Constraints – Design and Implementation

- The proposed system is developed using the Microsoft .Net Framework 4.6
- The database is Microsoft SQL server 2012. The relevant version of the MS SQL server must be installed.
- The online management system's user interfaces were developed using only English language.
- By considering uniformity all user inter faces used the same theme throughout the system.
- Security and safety of the system like database security, effects of power failure; database backup procedure etc. will be the IT Division's responsibility.

2.5 Assumptions and Dependencies

- Full working of the system is dependent on the availability of 24 hour Internet connection.
- The users should know the English language, as the user interface will be provided in English.
- The System Operator will maintain customer profiles, payment details as well as connection details.
- The Billing database will be accessible in real time through the online management system when transitioning.

2.6 Literature Review

With the world population reaching 6 billion and counting, the need for water is growing. Only 2.4% of all water on Earth is fresh water, and less than 1% of all freshwater is available for human use. There is no question that water is absolutely necessary for human survival. However, over one billion people on Earth already do not have access to a clean water supply [1].

With diminishing water supplies and rapid human population growth, communities and countries are being prompted to investigate alternative water resources. Water pipelines have been a proposed, but controversial option. These massive water supply schemes use pipe bone water from a large source and transfer it across a great distance to areas in where customer need. Pipelines can be installed underground or above ground.

In most of the countries all over the world there is an organization established to handle water supply connections in that country. The main responsibilities of these organizations include: laying pipelines, distributing good quality water to community, maintaining water reservoirs, billing and payment collection using standardized tariff setting, providing consumer services, giving new water connections to the requested consumers, etc.

In Sri Lanka, NWSDB which presently functions under the Ministry of Water Supply & Drainage is the principal authority providing safe drinking water to the nation.
The Vision is "To be the most prestigious utility organization in Sri Lanka through technological and service excellence" and Mission is "Serve the nation by providing sustainable water and sanitations ensuring total user satisfaction".

2.7 Similar Systems

Proposed system is an online web based Service Management System that will facilitate to customer to apply for new water connection online and get other services online, and also gets billing and payment service, make payment through credit card etc. without visiting to any regional office.

As per the result of my survey thought internet, I found some similar systems for the proposed system. They are,

A system has been developed for the Hyderabad Metropolitan Water Supply and Sewerage Board (HMWS&SB) [2]. That system is toying with the idea of accepting applications for water connections online to cut down delays and corruption. And that system covers functions such as, apply new connection online, online bill payments, register complaint, water quality report, complain status, tariff, etc.

A system has been developed for the Department of Delhi Jal Board [3]. Delhi Jal Board has been able to supply pure and wholesome filtered water to the capital city of India. That system provides facility for online bill payments, SMS complaints, drinking water quality, rain water harvesting, etc. And also provide ability to customers to see the Water Tariff and Policy of Water Tariff. It also provides online water connection system that gives facility to customers for apply new warer connection online .

A system has been developed for the Bangalore Water Supply and Sewerage Board (BWSSB) [4]. The BWSSB is committed to providing drinking water of unquestionable quality in sufficient quantity and to treat the sewage generated to the required standards. This system provides facility to submit new connection application by online for registered users. And also it gives some other facilities such as online bill payments, rain water harvesting, water testing, sewerage, etc.

Thames Water is another similar system which was found [5]. They are the United Kingdom's largest water and Sewerage Company, serving millions of customers across London and the Thames Valley, and is proud to be an Official Provider to London.. The main functions of that system include; apply for a new water connection, pay bills online, change account detail online, Request copy of water bill etc.

United Utilities website is another similar system which was found and that has been developed for water and waste water in the North West of England [6]. The main functions of that system includes; apply new water connection, pay bills online, submit a meter reading, report a leak, apply for a water meter, etc.

Chapter 3: System Design

A good design is prerequisite for a successful system implementation. This chapter documents the design considerations which attempt to link the findings of the analysis with the final system implementation.

3.1 Choice of Methodology

Methodology is generally a guideline system for solving a problem, with specific components such as phases, tasks, methods, techniques and tools. Every methodology consists of a process model and modeling language. The process model is a collection of stages, which may further have a set of activities. The Modeling Language consists of several modeling techniques, which are further supported by a set of diagrams.

3.1.1 Selection of an Appropriate Process Model

In selecting a suitable development approach some of the widely used development approaches were evaluated. The main software development process models can be listed out as follows:

- Waterfall Model
- Prototyping Model
- Rapid Application Development (RAD) Model

3.1.1.1 Waterfall Model

This is a linear sequential model often used in software development processes. This approach is useful if the objectives and requirements of the system are clearly defined and well known. Figure 3.1 shows the waterfall model.

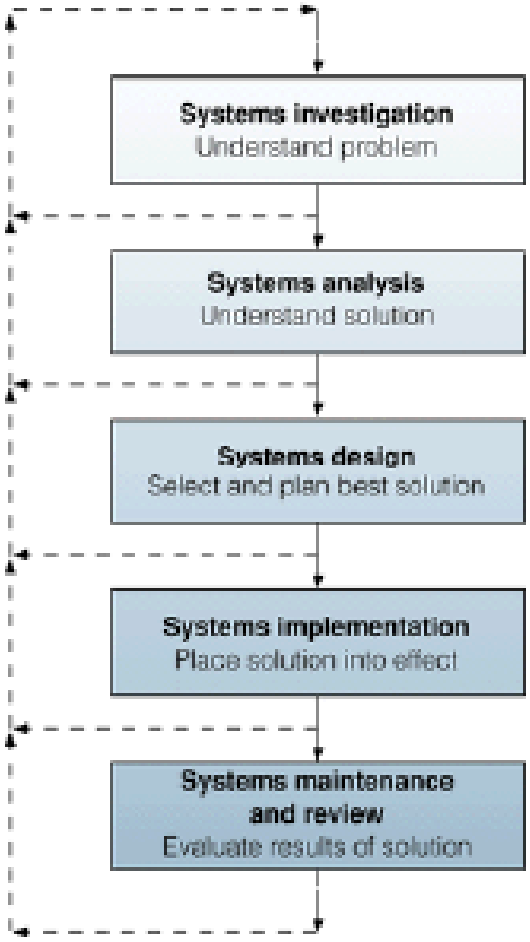


Figure 3.1 Waterfall Model

Drawbacks of the Waterfall Model

- Each stage of waterfall model is shut off before proceeding to the next stage. Therefore some problems are ignored or left for later consideration. This could result in delivering software that does not meet the customer's requirements.
- Some of the problems are solved by implementation tricks which result in badly structured systems.
- It is difficult to define all the requirements at the beginning of a project.
- A working version of the system is not seen until late in the project's life.

3.1.1.2 Prototyping Model

This model has evolved, especially to overcome the rigidity of the waterfall approach. A prototype model can be used to clear the vague requirements. The basic elements of the prototype approach are to design and code a key part of the desired system and to test this implemented part with the user participation.

Figure 3.2 illustrates the prototyping model.

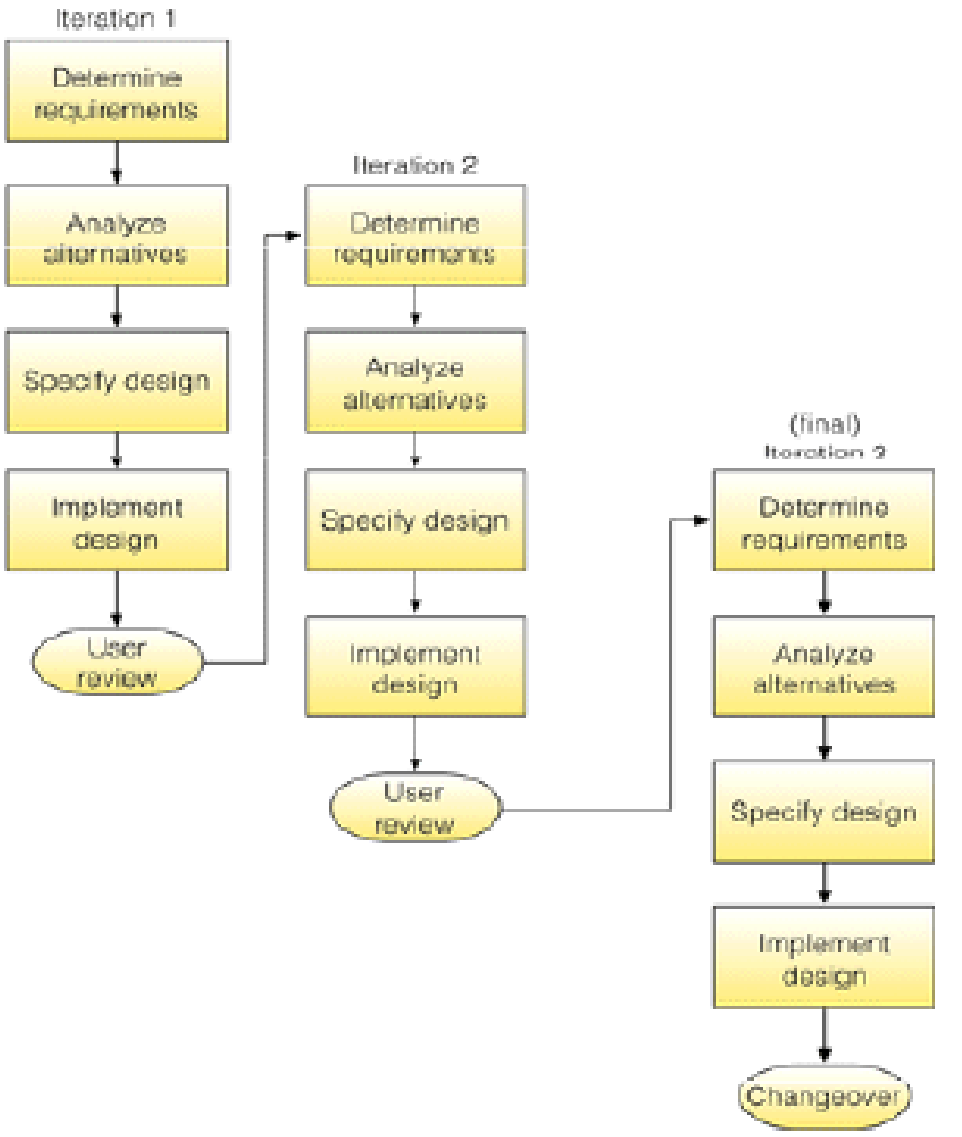


Figure 3.2 Prototyping Model

Drawbacks of the Prototyping Model

- Non-functional requirements such as those concerning reliability, robustness and safety cannot be adequately tested in a prototype implementation.
- Continual change tends to corrupt the structure of the prototype system. Maintenance is therefore likely to be difficult and costly.
- Formal end-of-phase reviews may not occur. Thus it is very difficult to contain the scope of the prototype and the project never seems to end.
- Each iteration builds on the previous one. The final solution may be only incrementally better than the initial solution.

3.1.1.3 Rapid Application Development (RAD) Model

Rapid application development (RAD) is a software development methodology that uses minimal planning in favor of rapid prototyping. A prototype is a working model that is functionally equivalent to a component of the product.

In RAD model the functional modules are developed in parallel as prototypes and are integrated to make the complete product for faster product delivery.

The most important aspect for this model to be successful is to make sure that the prototypes developed are reusable.

RAD Model is an incremental software development process model that emphasizes an extremely short development cycle. The RAD model is a "high-speed" adaptation of the linear sequential model in which rapid development is achieved by using component-based construction. If requirements are well understood and project scope is constrained, the RAD process enables to create a "fully functional system" within a very short period. (e.g., 60 to 90 days) The main objective of the RAD model is delivery of a system fit for the purpose. The RAD approach encompasses several phases as shown in figure 3.3.

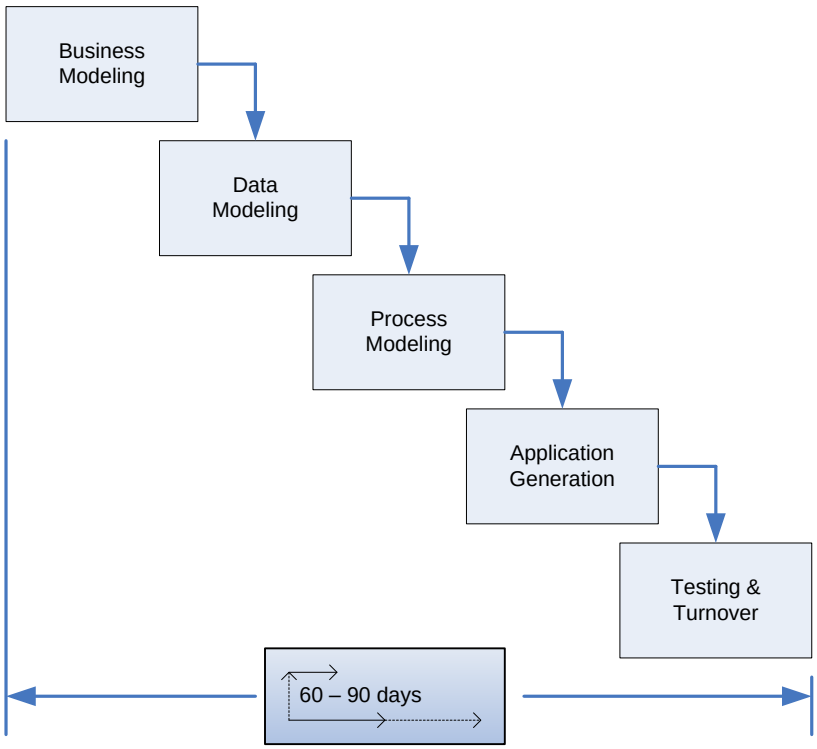


Figure 3.3 RAD Model

- **Business Modeling:** The business model for the product under development is designed in terms of flow of information and the distribution of information between various business channels. A complete business analysis is performed to find the vital information for business, how it can be obtained, how and when is the information processed and what are the factors driving successful flow of information.

- **Data Modeling:** The information gathered in the Business Modeling phase is reviewed and analyzed to form sets of data objects vital for the business. The attributes of all data sets is identified and defined. The relation between these data objects are established and defined in detail in relevance to the business model.

- **Process Modeling:** The data object sets defined in the Data Modeling phase are converted to establish the business information flow needed to achieve specific business objectives as per the business model. The process model for any changes or enhancements to the data object sets is defined in this phase. Process descriptions for adding , deleting, retrieving or modifying a data object are given.

- **Application Generation:** The actual system is built and coding is done by using automation tools to convert process and data models into actual prototypes.

- **Testing and Turnover:** The overall testing time is reduced in RAD model as the prototypes are independently tested during every iteration. However the data flow and the interfaces between all the components need to be thoroughly tested with complete test coverage. Since most of the programming components have already been tested, it reduces the risk of any major issues.

3.1.2 Selection of appropriate Process Model

For this project RAD model was chosen after considering all the above mentioned process models due to various reasons,

- RAD forces lots of interaction between users during the software development process.
- It is flexible and adaptable to changes.
- RAD realizes an overall reduction in project risk.
- It can handle large projects without a doubt.
- Generally RAD incorporates short development cycles.
- It develops high quality applications rapidly with the help of powerful application development tools.

3.1.3 Selection of appropriate Modeling Language

Unified Modeling Language (UML) was selected as modeling language for the design of the proposed solution. UML has an industry wide recognition as the best modeling language for software development.

The following reasons could be given for the selection of the UML:

- A comprehensive support is provided by UML for a use case approach and meets the requirements of incremental development, allowing visual modeling of software.
- The language focuses on visualizing the software that will help to manage complex system development efficiently.
- It supports to model just about any type of application, running on any type and combination of hardware, operating system, programming language, and network.
- It can specify systems in an implementation-independent manner.

- Even though there are many types of diagrams to represent various modeling view points, only three of them have been used for the design of this online service management system. They are,

- Use Case Diagram - represent the functions of a system from the users' point of view.
- Class Diagram - represent the static structure in terms of classes and relationships.
- Sequence Diagram - temporal representation of objects and their interactions.
- Activity Diagram - graphical representation of workflows of stepwise activities and actions

3.1.4 Use Case Diagram

Typically define interactions between an actor and a system, to achieve a goal. The actor can be a human or an external system. The figure 3.4 is the use case diagram that depicts different scenarios in which different actors interact and collaborate in the proposed system.

The Use Case diagram for the proposed system is given in figure 3.4

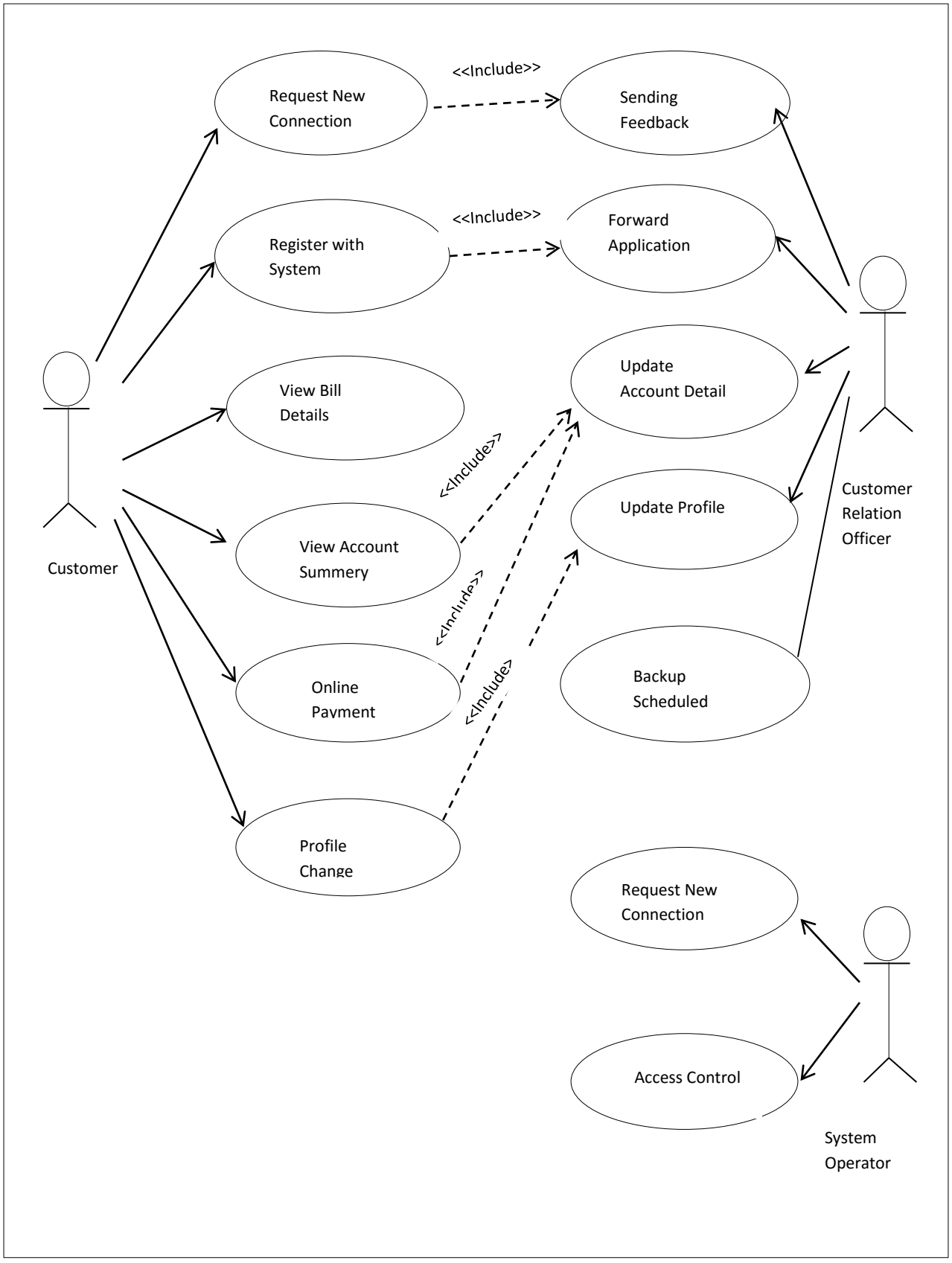


Figure 3.4 - Use Case Diagram

3.1.5 Class Diagram

The class diagram for the proposed system is given in figure 3.5.

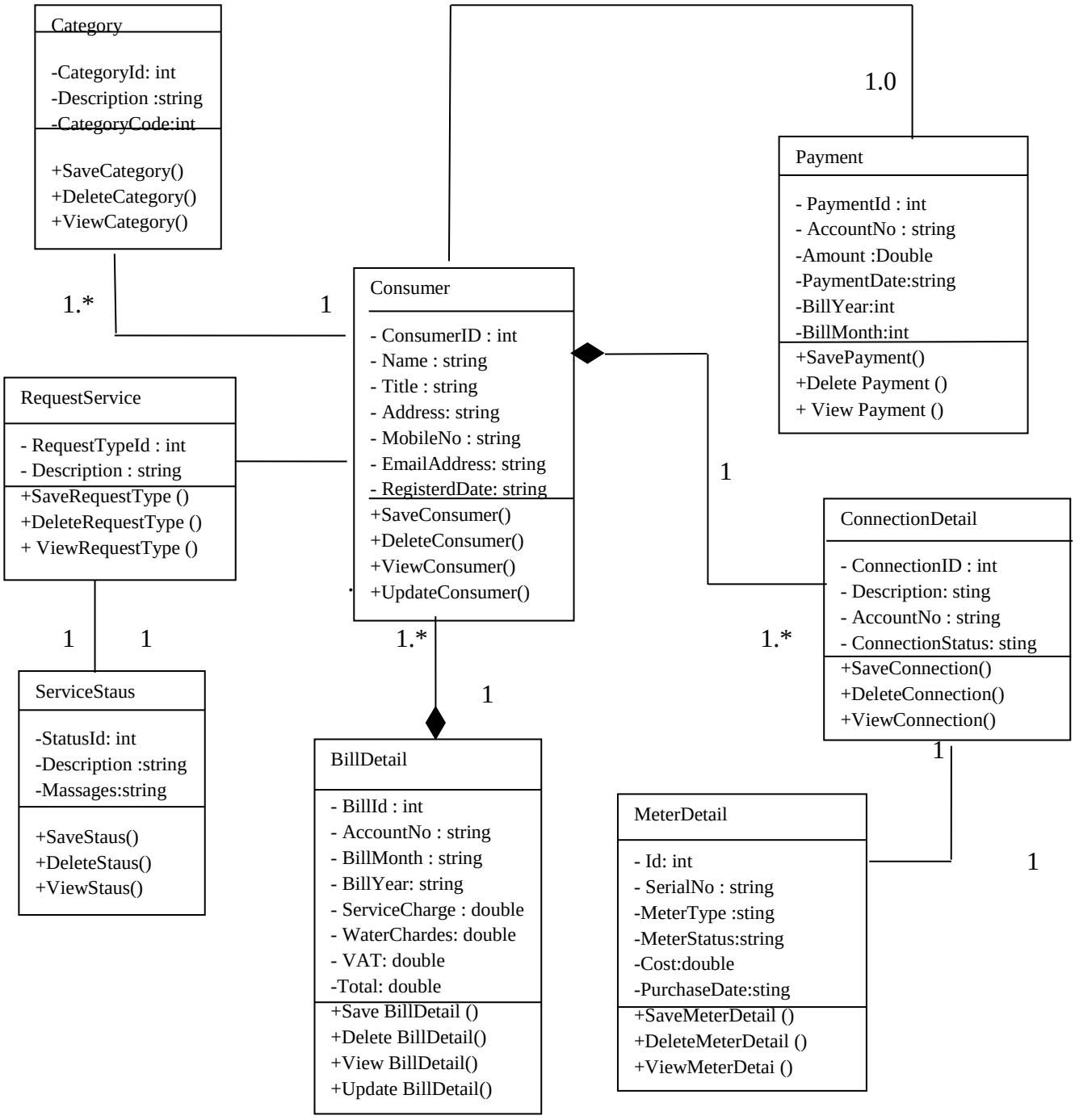


Figure 3.5 Class Diagram for Proposed System

3.2 Database Design

For this project relational database concepts were used to design the database and normalization was used to restructure the logical data model of a database to eliminate redundancy, organize data efficiently and to avoid data anomalies such as insert anomaly, update anomaly and delete anomaly.

An entity-relationship diagram (ER diagram) is used to diagram a data model and describe the relationships between different groups of data in the system. Figure 3.5 is the database diagram that depicts the entities and attributes of the proposed system and also relationships among entities.

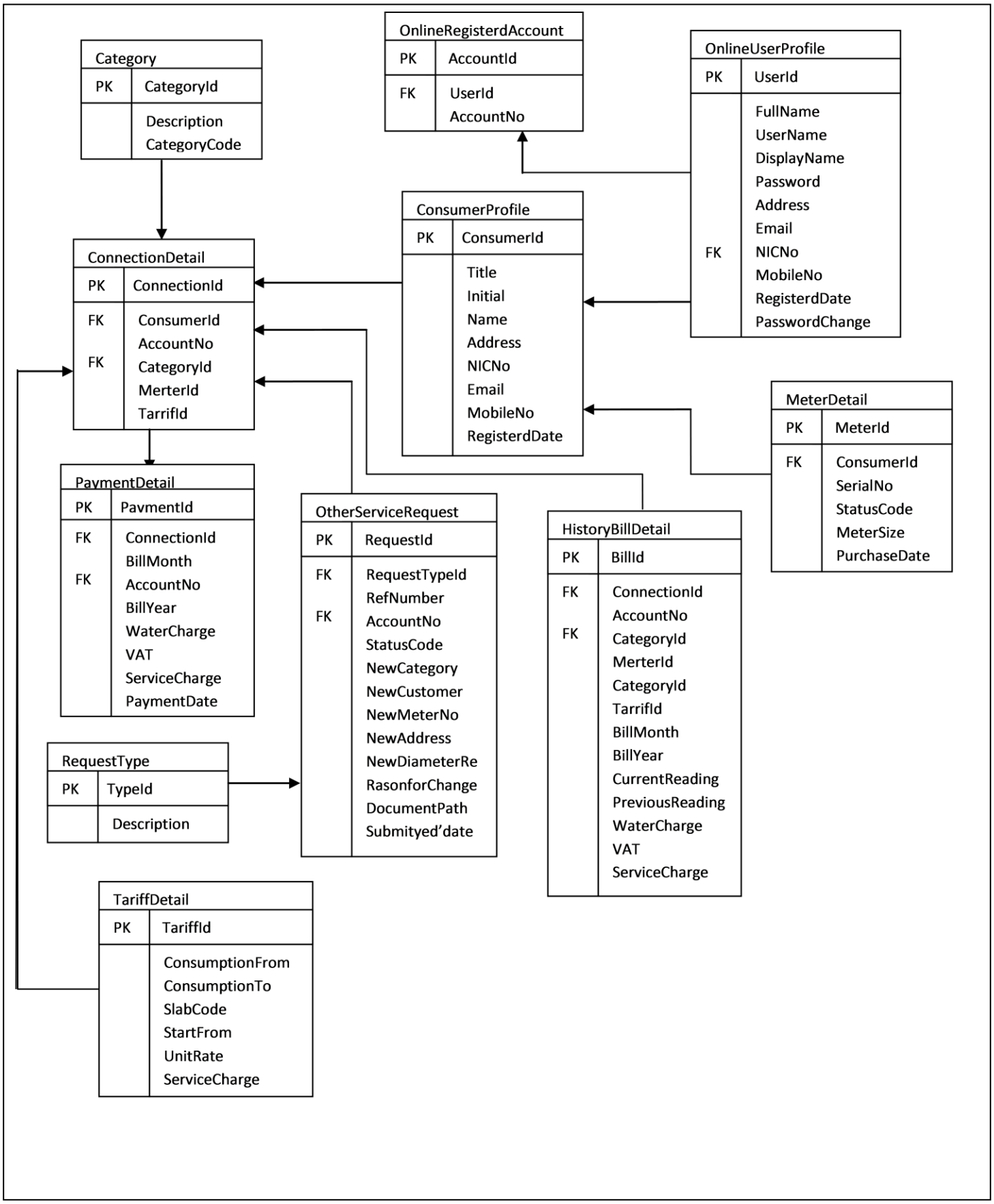


Figure 3.5 Database Diagram for Proposed System

3.3 Architecture Design

The Online Service Management System is web based and the centralized server will be located at the Head Office. Client computers located at all over the world and will be connected to the server though Internet. Customers will be accessed the application through Internet using web browser. Figure 3.6 is the architecture diagram for the proposed system.

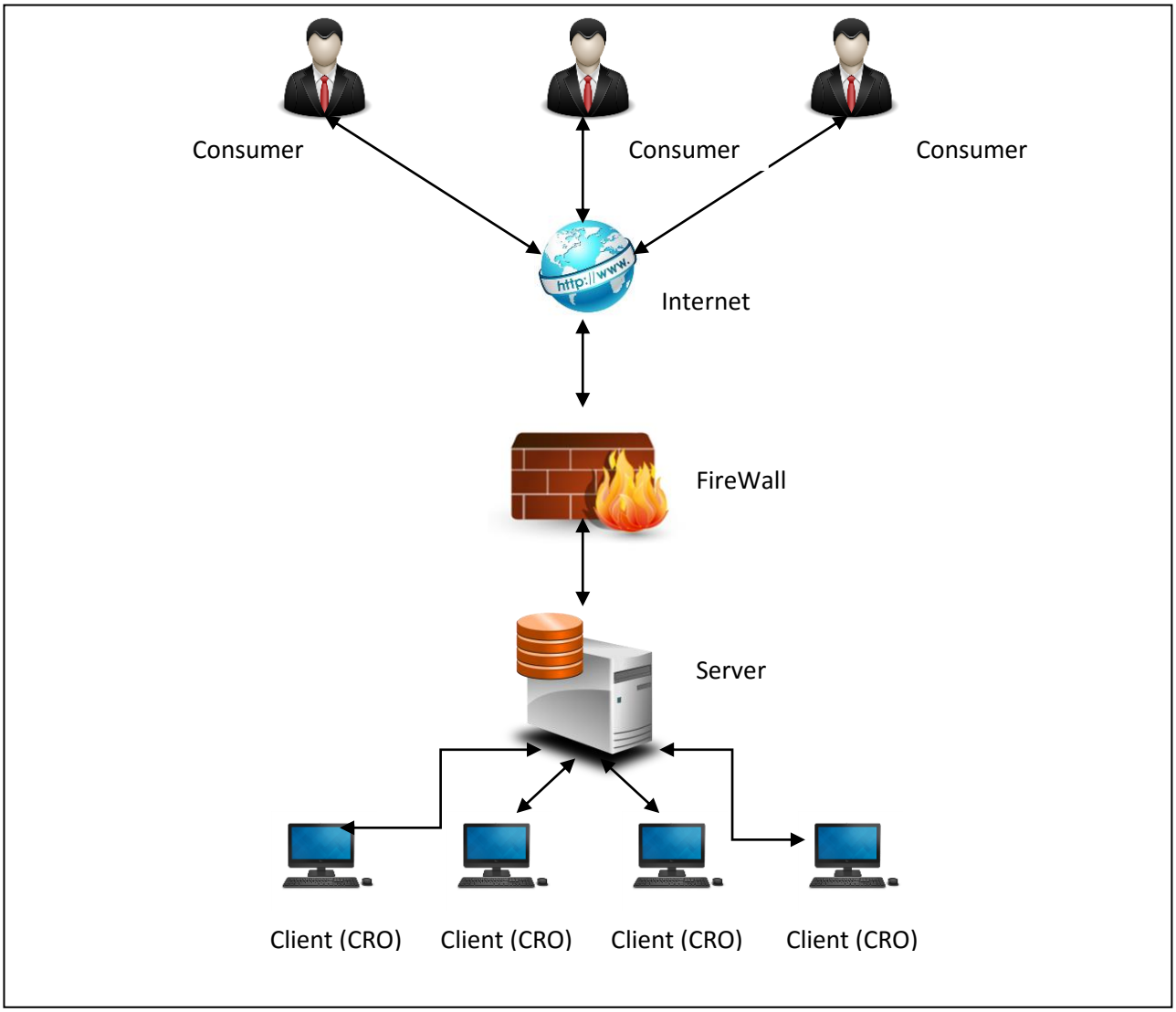


Figure 3.6 - Architecture Diagram

Chapter 4: Implementation

4.1 Implementation

This is the phase at which the actual software is being developed. It include all the tools and techniques that are used to implement the system like the programming languages, scripting languages, frameworks, designing tools and techniques, database management systems, etc. Implementation stage also consists of system installation, providing technical support, user training etc.

4.1.1 Tools used in Development

It is important that select software tools and technologies should be compatible with NWSDB current systems. Because this system is modules that will be integrate to the existing other system, therefor following software have been selected without any choice.

4.1.1.1 Dot NET Framework 4

The .NET Framework is a managed execution environment that provides a variety of services to its running applications. It consists of two major components: the common language runtime (CLR), which is the execution engine that handles running applications; and the .NET Framework Class Library, which provides a library of tested, reusable code that developers can call from their own applications [8]. The services that the .NET Framework provides to running applications include the following:

Memory management. In many programming languages, programmers are responsible for allocating and releasing memory and for handling object lifetimes. In .NET Framework applications, the CLR provides these services on behalf of the application.

A common type system. In traditional programming languages, basic types are defined by the compiler, which complicates cross-language interoperability. In the .NET Framework, basic types are defined by the .NET Framework type system and are common to all languages that target the .NET Framework.

An extensive class library. Instead of having to write vast amounts of code to handle common low-level programming operations, programmers can use a readily accessible library of types and their members from the .NET Framework Class Library.

Development frameworks and technologies. The .NET Framework includes libraries for specific areas of application development, such as ASP.NET for web applications, ADO.NET for data access, and Windows Communication Foundation for service-oriented applications.

Language interoperability. Language compilers that target the .NET Framework emit an intermediate code named Common Intermediate Language (CIL), which, in turn, is compiled at run time by the common language runtime. With this feature, routines written in one language are accessible to other languages, and programmers can focus on creating applications in their preferred language or languages.

Version compatibility. With rare exceptions, applications that are developed by using a particular version of the .NET Framework can run without modification on a later version.

Side-by-side execution. The .NET Framework helps resolve version conflicts by allowing multiple versions of the common language runtime to exist on the same computer. This means that multiple versions of applications can also coexist, and that an application can run on the version of the .NET Framework with which it was built.

Multitargeting. By targeting the .NET Framework Portable Class Library, developers can create assemblies that work on multiple .NET Framework platforms, such as Windows 7, Windows 8, Windows 8.1, Windows 10, Windows Phone.

4.1.1.2 C#

C# is an elegant and type-safe object-oriented language that enables developers to build a variety of secure and robust applications that run on the .NET Framework. C# can use to create Windows client applications, Web services, distributed components, client server applications, database applications. C# provides an advanced code editor, convenient user interface designers, integrated debugger, and many other tools to make it easier to develop applications based on the C# language and the .NET Framework [9].

C# language has the following features:

- C# is pure object-oriented
- C# is more type safe
- The Assembly concept solves the versioning control problem well.
- Ease-to-development, The rich class library makes many functions easy to be implemented.
- Cross-platform. application will run well only if the machine installed the .NET framework.
- Good support for distributed system.

4.1.1.3 MS SQL

Microsoft SQL Server 2012 is a full-featured relational database management system (RDBMS) that offers a variety of administrative tools to ease the burdens of database development, maintenance and administration. In this article, we'll cover some of the more frequently used tools: SQL Server Management Studio, SQL Profiler, SQL Server Agent, SQL Server Configuration Manager, SQL Server Integration Services.[10]

4.1.1.4 jQuery

jQuery is a fast, small, and feature-rich JavaScript library. It makes things like HTML document traversal and manipulation, event handling, animation, and Ajax much simpler with an easy-to-use API that works across a multitude of browsers. jQuery is a lightweight, "write less, do more", JavaScript library.The purpose of jQuery is to make it much easier to use JavaScript on your website. jQuery takes a lot of common tasks that require many lines of

JavaScript code to accomplish, and wraps them into methods that you can call with a single line of code. [11]

jQuery also simplifies a lot of the complicated things from JavaScript, like AJAX calls and DOM manipulation. The jQuery library contains the following features:

- HTML/DOM manipulation
- CSS manipulation
- HTML event methods
- Effects and animations
- AJAX
- Utilities

4.1.1.5 HTML 5

HTML5 is the latest version of Hypertext Markup Language, the code that describes web pages. It's actually three kinds of code: HTML, which provides the structure; Cascading Style Sheets (CSS), which take care of presentation; and JavaScript, which makes things happen. HTML5 advantages: The following are the advantages of HTML5 [12].

- Cleaner markup/ Improved code
- Elegant forms
- Consistency
- Supports rich media
- Offline Application Cache

4.1.1.6 Visual Studio 2012

Microsoft **Visual Studio** is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs for Microsoft Windows, as well as web sites, web applications and web services.

4.1.2 Methods used to enhance Coding Quality

In this system following methods are used to increase the quality and human computer interaction to performance of system coding.

- **Classes objects** - When developing a system there can be lots of same coding which can be applied in several forms. If we have such coding or same variables which need to be re-use in several forms we can put them into common classes based on namespaces.

- **Data validation and Error Handling Techniques**
    - Each and every method, function, event, etc have been covered with the error handling functionality and if an error occurs, system will automatically call the Error Handling object and provide a meaningful error message to the user and also it will log the error details into a separate error handling log file for further reference.

- **Naming Conventions** - When declaring necessary variables, meaningful names have been used for them to aid the readability of coding. Meaningful names help others to understand what has been done in coding.

- **Use Comments** - Comments increase the readability of coding as they describe what has done in coding. This feature is very useful for future purposes also. Because when authorized person (except the system developed programmer) needs to handle system errors or do more modifications to the system, he has to know the existing coding. Even the programmer may forget coding which he has done after certain time period. Comments are essential in coding and very helpful for code maintenance.

  Some important code segments are provided in appendix C.

4.1.4 Installation Procedure

4.1.4.1 Server Installation

This system was developed using .NET Frame Work 4.6 using C# object Oriented Programming , and back end developed MS SQL Server 2012 and jQuey, Java Scripts. The systems was designed and implemented by considering the portability as well. Hence the installation is straight forward in any compatible environment. This system runs on both Windows and Linux environments and uses Apache IIS web server.

Since the client had his own hosting server with the operating system and other applications, only the application software installation was needed.

4.1.4.2 Client Installation

For the end users Internet Explorer is usually available in windows operating system. Mozilla Firefox browser can be freely downloaded from
http://www.mozilla.org/en-US/products/download.html.Google Chrome is available in
https://www.google.com/intl/en/chrome/browser.

Chapter 5: Testing and Evaluation

Software testing is a process used to identify the correctness, completeness and quality of developed computer software. It includes a set of activities conducted with the intent of finding errors in software. So that it could be corrected before the product is released to the end users. In simple words, software testing is an activity to check whether the actual results match the expected results and to ensure that the software system is defect free.

Software testing, depending on the testing method employed, can be implemented at any time in the development process. However, most of the test effort occurs after the requirements have been defined and the coding process has been completed but in the RAD approaches most of the test effort is on-going.

The purpose of project evaluation is to assess the software development methodology that was used throughout the development of the framework, assess the usefulness of the technologies and tools, the accuracy of the estimations and the usefulness of the reviews. The solution will be reviewed and evaluated to decide whether it accomplishes the ideas presented in the initial overview and for the quality of the product.

Since the software engineering model used in this project was as incremental model, the evaluation for each delivery was obtained by the client at the time the components were delivered. They were mainly review meetings and the feedback obtained was used in corrective maintenance and/or change management.

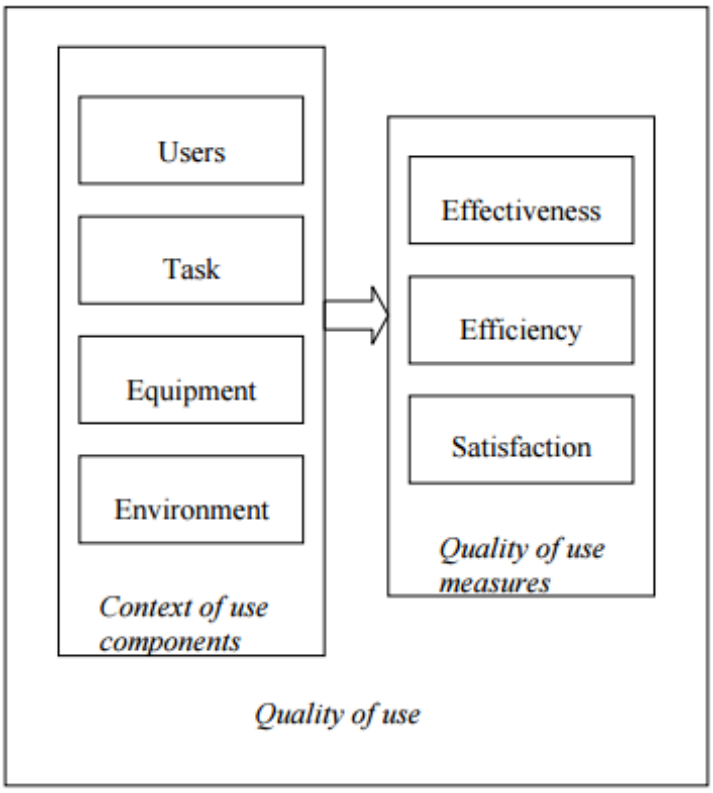


Figure 5.1 : Software Evaluation

Based on a prepared list of criteria along with some practical experimentation, a software evaluation makes it possible to check whether the project objectives were satisfied. Table 5.1 was designed to collect feedback from the end users of the system. This was distributed among the users to get their feedback anonymously. The evaluator assessed the returned forms in order to obtain the actual feedback of the users and to assess that the project objectives have been met.

The evaluation of OSMS in terms of their ability to inform users, including the following aspects:

Measures for the effectiveness of the system

Technological measures for evaluating the system

User-oriented measures

Feedback

5.1 Testing

There are many approaches to software testing:

Static testing includes reviews, walkthroughs, or inspections and this can be omitted, and unfortunately in practice often is.

Dynamic testing includes actually executing programmed code with a given set of test cases. It takes place when the program itself is used. Dynamic testing may begin before the program is 100% complete in order to test particular sections of code and are applied to discrete functions or modules.

5.1.1 Testing Levels

Testing can also be grouped by where they are added in the software development process, or by the level of specificity of the test. The main levels of testing during the development process can be mainly identified as unit testing, integration testing, system testing and acceptance testing.
Figure 5.2 shows the testing levels in the project life cycle.

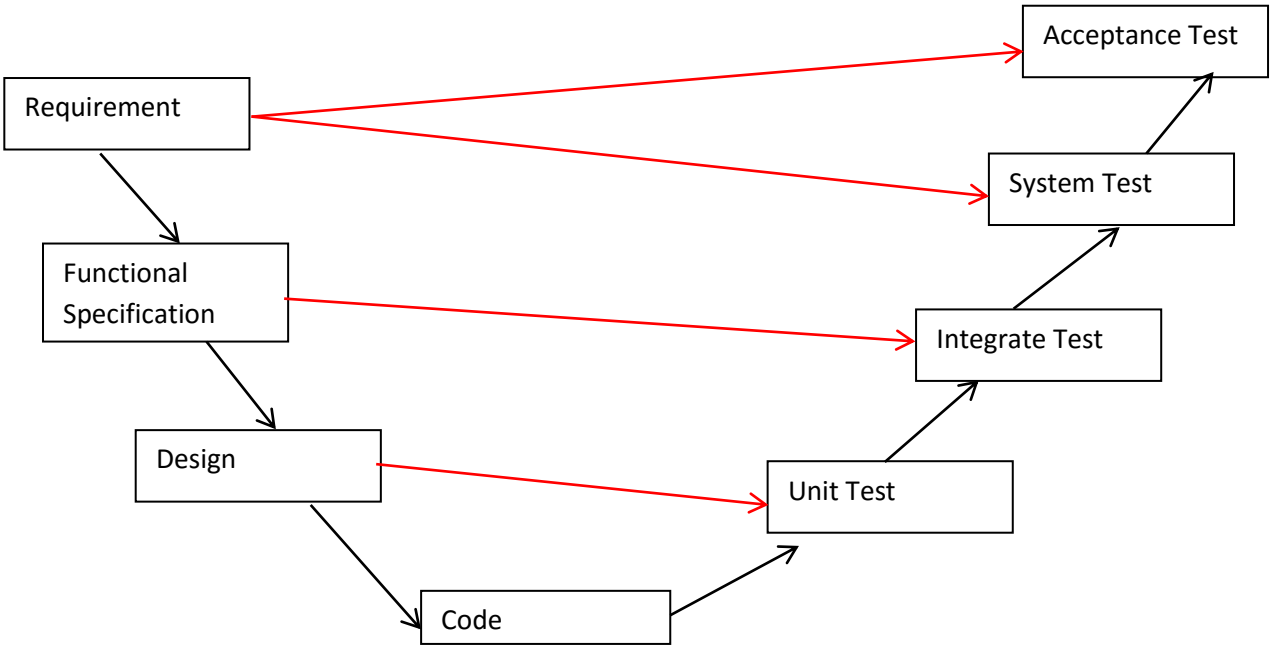


Figure 5.2 Testing Levels in Project Life Cycle

5.1.1.1 Unit Testing

Unit testing is carried out as a part of the coding task. This phase is based on the design of the software for a piece of code. Unit testing should prove robustness, functionally correctness and correct interface of the code.

5.1.1.2 Integration Testing

Integration testing is carried out after the separate software modules have been unit tested. Integration testing is based on the functional specification of the software and it should prove integration and functionally correctness of the software. There are several types of integration testing: incremental integration testing, top-down integration testing and bottom-up integration testing.

5.1.1.3 System Testing

System testing is carried out at the completion of the integration testing. The purpose of system testing is to prove that the software meets the agreed user requirements and works in the target environment. System testing covers both functional and non-functional requirements. This will also include recovery, security, stress and performance tests.

5.1.1.4 Acceptance Testing

Acceptance testing is carried out at the customer's site with the customer in attendance. The purpose of the acceptance test is to show to the customer that the software does indeed work. These tests are usually a sub set of the system test.

5.1.2 Used Software Testing Techniques

Testing techniques were used to effectively design efficient test cases. These techniques can be grouped into white-box testing and black-box testing.

5.1.2.1 White box Testing

White box testing tests internal structures of a program, as opposed to the functionality exposed to the end-user. The tester chooses inputs to exercise paths through the code and determine the appropriate outputs.
White box testing was done for this project that based on knowledge of the internal logic of an application's code. Tests are based on coverage of code statements, branches, paths, conditions. Using this method, test cases were derived according to the program structure.

5.1.2.2 Black box Testing

Black-box testing treats the software as a "black box", examining functionality without any knowledge of internal implementation. The tester is only aware of what the software is supposed to do, not how it does it.
In this project, Black box testing done for all functionalities and requirement of online services. Using this method, test cases were derived based on the system specification.

5.1.3 Used Testing Strategies

Following were adopted for better practice of testing process of this system.

- Creating a Test Plan
- Prioritizing Tests
- Test Cases and Design
- Test Reporting

5.1.3.1 Creating a Test Plan

For this system, a test plan was created explaining the outline and defined approaches taken to perform testing of the project. Test plan was developed to fulfill the following objectives:

- To establish a comprehensive test plan that identifies the nature and extent of tests deemed necessary to achieve the testing objectives for the project, including software and hardware requirements.
- To coordinate an orderly schedule of events, identify equipment and organizational requirements, describe test methodologies and strategies to be used and identify items to be delivered.

5.1.3.2 Prioritizing Tests

Before testing was started we had to prioritize according to the importance of tests, because of the limited time. When prioritizing tests we concentrated on the following ranking criteria:

- Test where a failure would be most severe
- Test where failures are most likely
- Ask the user to prioritize the requirements
- What is most critical to the user's business

An advantage we got by prioritizing is when we stopped testing; we have done the best testing in the time available.

5.1.3.3 Test Cases

Test case is a set of actions with expected results based on requirements for the system. It contains of outputs and procedures, follows when doing the testing process. There are two types of test cases as positive test case and negative test case.

A test case includes these elements:

- The purpose of the test or description of what requirement is being tested.
- Test data - Test data is a specification of the data elements, values or set that define how to satisfy the test intent.
- The setup to test - Version of application, hardware, software, operating system, access level, logical or physical date and any other setup information being tested.
- Actions and expected results.

5.1.3.4 Test Reporting

Immediate Purpose:

Provide information to the users of the software system, so that they can determine whether the system is ready for production. It will help to show the progress of testing to clients when they have doubts.

Long Term Purpose:

- To trace problems in the event application of the main functions.
- To use the data to analyze rework process and to make changes to prevent defects occurring in the system.

Following are the sample test cases which were used to run unit and integration tests

Test case for the registration to the eService portal - Table 5.1

No	Test Case	Expected Result
3.1	Enter invalid email address or leave it blank and click Submit button	Pop up Error message of "Please enter valid email address."
3.2	Enter invalid mobile phone number or leave it blank And click Submit button	Error message of "Please enter valid phone number."
3.3	Enter invalid account number	Error message Pop up Invalid Account No!. Check Digit Not Valid!

Table 5.1 Test Cases for registration to the eService portal

Test case for login to the eService portal Table - 5.2

No	Test Case	Expected Result
3.4	Enter invalid username and/or password and clicks on Login button.	Pop up error massage "Login Fail!. You have entered Invalid User Name / Password Please try again!

Table 5.2 Test Cases for Login to the eService portal

Test case for enter "FromDate" and "ToDate" for checking billing and payment detail Table 5.3

No	Test Case	Expected Result
3.5	Enter "FromDate" which is greater than current date	Pop up massage "Invalid Date ! FromDate should less than current Date!"
3.6	Enter "FromDate" which is greater than "ToDate"	Error message of "Invalid Date ! ToDate should greter than FromDate."

Table 5.3 Test Cases for entering invalid date for date fields

5.2 Evaluation

The purpose of project evaluation is to assess the software development methodology that was used throughout the development of the framework, assess the usefulness of the technologies and tools, the accuracy of the estimations and the usefulness of the reviews. The solution will be reviewed and evaluated to decide whether it accomplishes the ideas presented in the initial overview and for the quality of the product.

Since the software engineering model used in this project was as RAD model, the evaluation for each delivery was obtained by the client at the time the components were delivered. They were mainly review meetings and the feedback obtained was used in corrective maintenance and/or change management.

Based on a prepared list of criteria along with some practical experimentation, a software evaluation makes it possible to check whether the project objectives were satisfied. Table 5.1 was designed to collect feedback from the end users of the system. This was distributed among the users to get their feedback anonymously. The evaluator assessed the returned forms in order to obtain the actual feedback of the users and to assess that the project objectives have been met. In analyzing, a measurement against likert scale was used to quantify the feedback and the values assigned parameters were as follows;

Likert Option	Value
Poor	1
Fair	2
Satisfactory	3
Good	4
Excellent	5

Table 5.4 Option and weights given to identified against likert scale

The marks assigned to relevant parameters (considering the weightage) are as follows;

Online Service Management System for NWSDB **Software Evaluation Form**		
	Parameter	**Rating**
Appearance		10
	User Interfaces are attractive	4
	Background colors and color combination matched	2
	Font face and size are compatible and readable	4

Usability		**25**
	Screen are easy to navigate	5
	Tab menus are easy to understand	5
	Data validation are satisfied	5
	The requested output results are successful	10
Functionality		**25**
	Accuracy of online bill calculation	10
	Displaying History bill detail	5
	Displaying payment detail	5
	Submission of online request applications	5
Performance		**20**
	Time taken to documents download/upload	10
	Response time for request's events	10
Security		**20**
	Document security	10
	User role base activities	10
Total		**100**

Table 5.5 Parameters and weights given to Evaluation

5.3 Evaluation Results

Evaluation Result for Appearance
According to the results of the feedback following graphs have been generated and analyzed. Special scenarios have been described below with the graphical results of the feedback.

Table 5.6 shows evaluation results for the criteria of Appearance related to User Interfaces are attractive of eService portal

Likert Option	Result	Percentage (%)
1 - Excellent	9	30
2 - Good	13	43
3 - Satisfactory	6	20
4 - Fair	2	7
5 - Poor	0	0

Table 5.6 Evaluation Results for Appearance

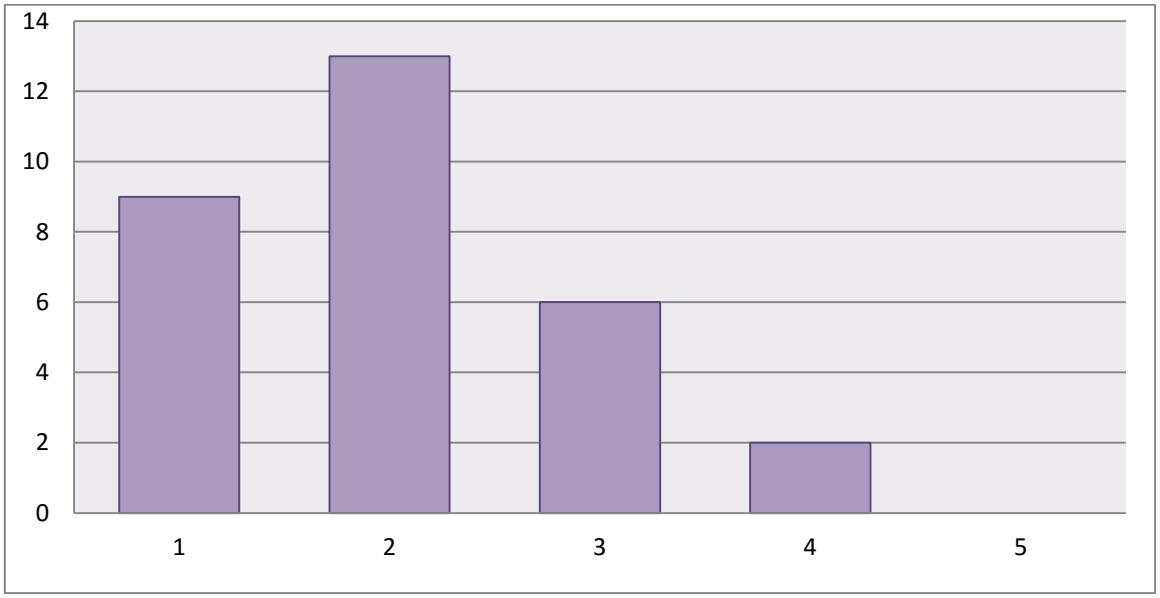


Figure 5.3 graphical representations of Evaluation Results for Appearance

According to the Graphical representation most of the users have agreed with the User Interfaces are attractive of the system. Overall Appearance of the web site is not excellent but it was not bad according to the results of the feedback. 43% of the results are "Good" while 30% results are "Excellent".

Evaluation Result for Usability

Following Table 5.7 shows evaluation results for the criteria of **Usability** related to "Data validation are satisfied" of the system.
The online system provide Data validation for every client's input data.

Likert Option	Result	Percentage (%)
1 - Excellent	8	27
2 - Good	12	40
3 - Satisfactory	5	17
4 - Fair	3	10
5 - Poor	1	3

Table 5.7 Evaluation Result for Usability

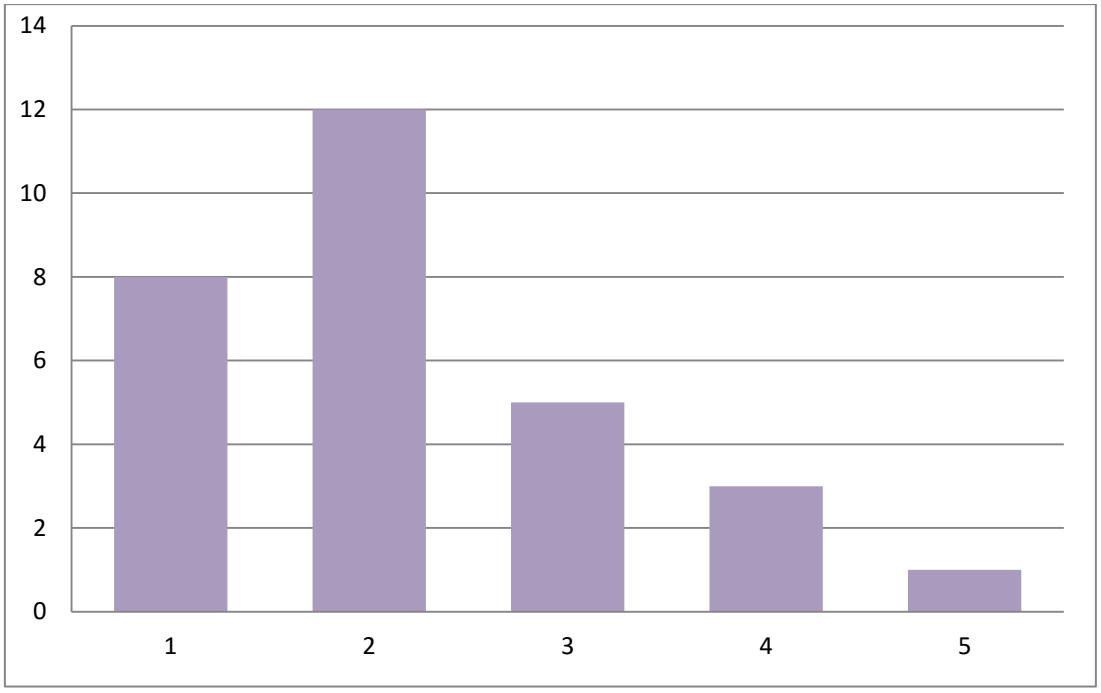


Figure 5.4 Graphical representation of Evaluation Results for Usability

Comparatively less result for the "Poor" option and the majority of 40% have voted for "Good" option. 27% of the users selected as "Excellent".

Evaluation Result for Functionality

Following Table 5.8 shows the evaluation results on Functionality of Accuracy of online bill calculation. User have done this with comparing manual bill calculations.

Likert Option	Result	Percentage (%)
1 - Excellent	7	23
2 - Good	12	40
3 - Satisfactory	5	17
4 - Fair	4	13
5 - Poor	2	7

Table 5.8 Evaluation Result for Functionality

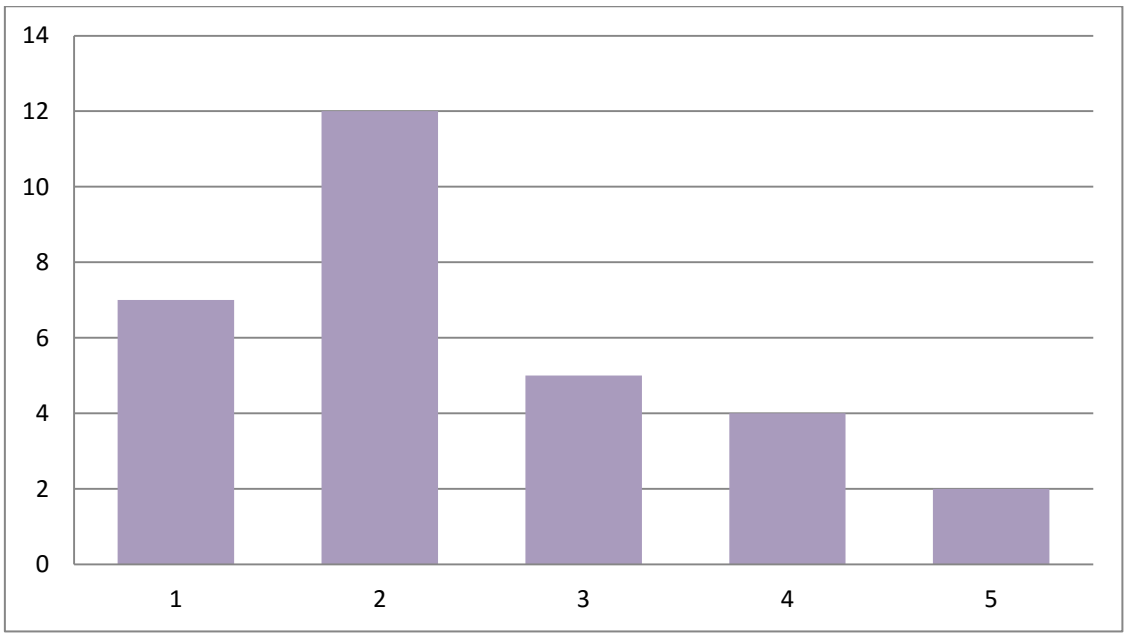


Figure 5.5 Graphical representation of Evaluation Results for Functionality

In generally most of the users are satisfied with the accuracy of online bill calculation function Overall results of the evaluation accuracy of bill calculation function 40% are "Good" while 23% results are "Excellent".

Evaluation Result for Performance

Table 5.9 shows evaluation results for the criteria of Performance related to Response time for request's events of the web pages. While developing the system response time of the activities were mainly considered, i. e, inserted few images for web sites because customers don't wait long time for web page load.

Likert Option	Result	Percentage (%)
1 - Excellent	8	27
2 - Good	10	33
3 - Satisfactory	6	20
4 - Fair	5	17
5 - Poor	1	3

Table 5.9 Evaluation Result for Performance

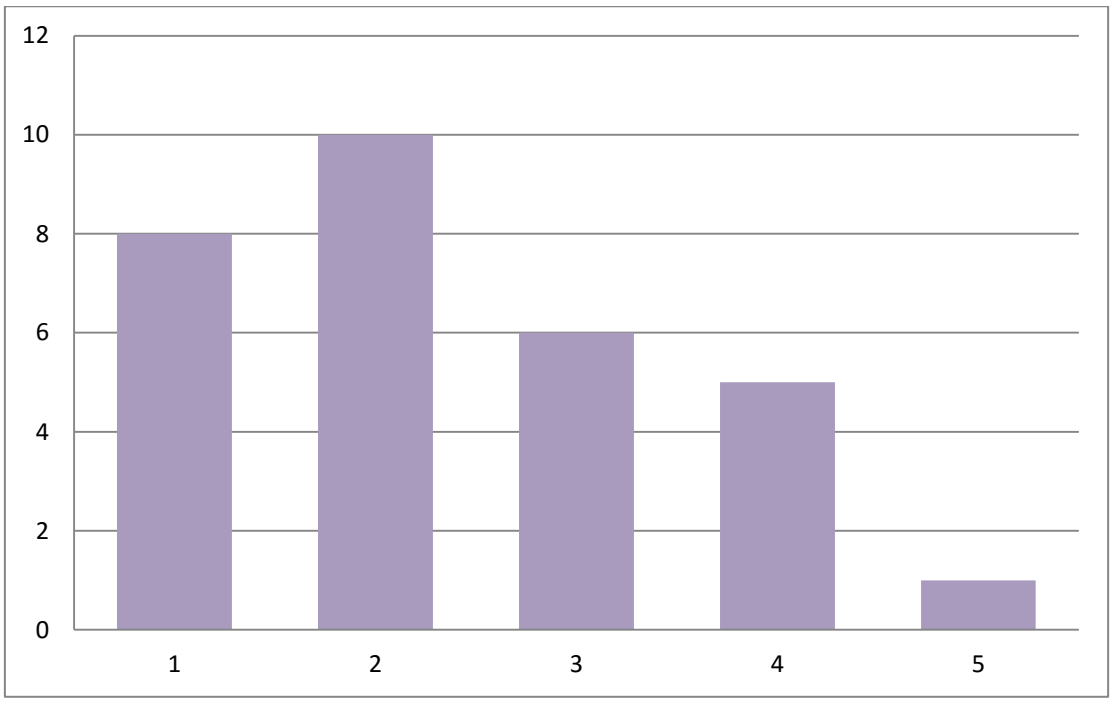


Figure 5.6 Graphical representations of Evaluation Results for Performance

Overall results of the evaluation for response time are excellent and more than 20% of users were satisfied with this criterion. 33% of the results are “Good” while 27% results are “Excellent”.

Chapter 6: Conclusion

Conclusion phase is the phase where project is officially concluded and the outcome of the whole project is reviewed. This chapter documents the work during this phase.

According to the evaluation identified following area should be improved. As per the feedback received from the evaluation of eService portal

- The "**Appearance**" has **overall 43% "good"** evaluation. Therefore User Interfaces are attractive.
- **Usability** has 40% "good" evaluation. Therefor "Data validation is satisfied" some extend but have to improve of the system.
- **Functionality** has 40% "good" evaluation. Therefor accuracy of online bill calculation should improve.
- The Performance has 33% "good" evaluation. Therefor Response time for request's events should be minimized.

The system evaluation was successfully completed with the end users rating the system as being satisfactory.

The web site has been developed as a public site and anyone could access it via web. Getting the look and feel according to satisfaction of all the customers was another challenge successfully faced during design of the layouts and themes of the web site.

6.1 Problems Encountered and Lesson learned

Every project encounters problems along the way of its execution.
The following problems were encountered during system implementation process

- There wasn't standard procedure for Billing and Payment services provide from manager offices and they use different application format and processes in island wide
- Most of customer refused to give their information during requirement gathering process.
- I have to study and get understand the manual bill process and water tariff table.
- Management doesn't allow to use customer billing information and history data
- I used WCF technology and web method of Dot Net frame work version 4. That was new section therefore, I have to learn and complete the project within given time frame
- I have to study to sending SMS and email massage to mobile phone and Internet from the system.

The following lessons were learnt during the projects work.

- Prepared standard procedure to Billing and Payment services with discussing process champions
- Through the interviewing process it was easy to get necessary details from consumers.

- I have used prototype to show the process flow to user, to obtain billing information and customer history bill detail.
- Fast learnt WFC technology, web method, sending SMS ,Email messages and related sample code using Google search.

The importance of planning and finishing work as early as possible was the most important lesson. Initially defined timeline for developing a software project is supposed to be a guideline, deviations from the guideline occur from time to time. It is important to make changes to the work and the guideline to stay on course for meeting the deadline set for the project. Reviewing project work often is necessary to ensure that effort is translated in to meaningful work.

6.2 Critical Evaluation of the System

OSMS is an online web based Service Management System that will facilitate to customer to apply for new water connection online and get other services online, and also gets billing and payment service, make payment through credit card etc. without visiting to any regional office.

During my survey though internet, found some similar systems for the OSMS .

In most of the countries all over the world publish online services for water management. The main responsibilities of these organizations include: laying pipelines, distributing good quality water to community, maintaining water reservoirs, billing and payment collection using standardized tariff setting, providing consumer services, giving new water connections to the requested consumers, etc.

Most of similar system provide integrated service and provide full customer requirement.

i.e they provide maintenance other service in same system as module basis and all services were integrated with store management, financial management and procumbent management.

When compare this OSMS and other similar sites, this OSMS is at very initial stage.

This wasn't integrating with other module.

Therefore it will develop other services as module and integrate in future work.

6.3 Future Enhancements

We use this Online Service Management System (OSMS) to bring services to customer fingertips saving their valuable time and money. Enjoy the benefits of innovative technology based on eGovernment concepts to achieve customers' requirements from home avoiding the need for unnecessary visits to NWSDB busy offices.

There for OSMS is need for NWSDB, it facilitates customer services, and also this system is future investment for Water Board that can increase the new water connection also provide quality and efficient service to the Sri Lankan.

Online Service Management System (OSMS) facilitate with Billing and Payment service (which are already developed) and Other Service.

Other Service include following online request submissions

- New Connection Request
- Name Change Request
- Category Change Request
- Meter Shifting Request
- Meter Change Request
- Connection Change Request
- Disconnection Request

For the time being I have developed above request submission process and customer gets acknowledgement through SMS and Email. Every requisition has business process to complete the services. In My future work I have to complete each process as modules. Finally customer can get result final output through online and they don't need to visit offices.

Also Online Service Management System (OSMS) can integrate with other operation done in Water Board i. e.

i. Water leak detection process.
ii. Pipe and other service break down and repairer process
iii. Water Quality detection and maintenance
iv. Ground water detection and deep well excavation process
v. Water purify and transportation
vi. Public grievances and complain system
vii. Legal Module

All above function operate in water board can integrate with online service management system as module wise.

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Appendix A: Interviewed Questions

Following are some interviewed questions which were used to interview the secondary users of the system to gather the requirements:

1. What is your job function with the customer request services?
2. How does customer collect service request application?
3. How many customers are coming onto your desk per day with filled application forms?
4. How do you give them feedback result
5. How many time need to visit you to full fill the requirement / feedback.
6. If there are any issues in the submitted application, how do you correct those issues?
7. How do you contact customer for get answer for the issues.
8. How do you calculate the bill and do you have the standard tariff table?
9. How about your computer literacy
10. Does your computer can access internet of the office?

Appendix B: Important Code Segments

Following code segment of web.config file and shows connection string that use to connect SQL database.

Figure B.1 shows the code segment for SQL database connectivity.

Veb.config* | NWSDBServices.aspx.cs | Login.aspx

```
<?xml version="1.0"?>
<!--
  For more information on how to configure your ASP.NET application, please visit
  http://go.microsoft.com/fwlink/?LinkId=169433
  -->
<configuration>
  <configSections>
    <!-- For more information on Entity Framework configuration, visit http://go.microsoft.com/fwlink/?LinkID=237468 -->
    <section name="entityFramework" type="System.Data.Entity.Internal.ConfigFile.EntityFrameworkSection, EntityFramework,
    <section name="infragistics.web" type="System.Configuration.SingleTagSectionHandler,System, Version=1.0.3300.0, Cultu
  </configSections>
  <infragistics.web styleSetName="Default" styleSetPath="~/ig_res" />

  <connectionStrings>
    <add name="NWSDBCOMConnectionString" connectionString="Data Source=LAP-09\NWSDBCOM;Initial Catalog=NWSDBCOMNELUM;
        Persist Security Info=True;User ID=sa;Password=123@com" providerName="System.Data.SqlClient" />
    <add name="DefaultConnection" providerName="System.Data.SqlClient" connectionString="Data Source=.\SQLEXPRESS;
        Initial Catalog=aspnet-OnlineServices-20120923195451;Integrated Security=SSPI;
        AttachDBFilename=|DataDirectory|\aspnet-OnlineServices-20120923195451.mdf;User Instance=True" />
  </connectionStrings>

  <system.web>

    <compilation debug="true" targetFramework="4.0">
      <assemblies>
        <add assembly="System.Windows.Forms, Version=4.0.0.0, Culture=neutral, PublicKeyToken=B77A5C561934E089" />
        <add assembly="System.Design, Version=4.0.0.0, Culture=neutral, PublicKeyToken=B03F5F7F11D50A3A" />

      </assemblies>
```

Figure B.1 shows the code segment for SQL database connectivity.

Figure B.2 shows the code segment web method that use to register online users.

```
[WebMethod]
public static string RegisterNewConnectionDetails(string Name, string PostalAddress, string ServiceAddress, string NICNumber,
                                                   string MobileNumber, string District, string GNDDivision, string EmailAddress,
                                                   string RequiredCategory, string Remarks)
 {

        string  RefNumber = "";

        using (
            SqlConnection Conn =
                new SqlConnection(ConfigurationManager.ConnectionStrings["NWSDBCOMConnectionString"].ToString()))
        {
            using (SqlCommand Comm = new SqlCommand("SaveNewConnectionRequest", Conn))
            {
                Conn.Open();
                Comm.CommandType = CommandType.StoredProcedure;
                Comm.Parameters.Add("@Name", SqlDbType.NVarChar, 50).Value = Name;
                Comm.Parameters.Add("@PostalAddress", SqlDbType.NVarChar, 50).Value = PostalAddress;
                Comm.Parameters.Add("@ServiceAddress", SqlDbType.NVarChar, 50).Value = ServiceAddress;
                Comm.Parameters.Add("@NICNumber", SqlDbType.NVarChar, 50).Value = NICNumber;
                Comm.Parameters.Add("@MobileNumber", SqlDbType.NVarChar, 15).Value = MobileNumber;
                Comm.Parameters.Add("@District", SqlDbType.NChar, 15).Value = District;
                Comm.Parameters.Add("@GNDDivision", SqlDbType.NChar, 15).Value = GNDDivision;
                //Comm.Parameters.Add("@PresentStatus", SqlDbType.NVarChar, 50).Value = PresentStatus;
                Comm.Parameters.Add("@EmailAddress", SqlDbType.NVarChar, 25).Value = EmailAddress;
                Comm.Parameters.Add("@RequiredCategory", SqlDbType.VarChar, 20).Value = RequiredCategory;
                Comm.Parameters.Add("@Remarks", SqlDbType.VarChar,150).Value = Remarks;
                Comm.Parameters.Add("@RefNumber", SqlDbType.NVarChar, 15).Direction = ParameterDirection.Output;
                Comm.Parameters.Add("@RequestID", SqlDbType.Int).Direction = ParameterDirection.Output;
                Comm.ExecuteNonQuery();
                RefNumber = Convert.ToString(Comm.Parameters["@RefNumber"].Value);

             }
            MessageHandler ms = new MessageHandler();
            if (EmailAddress != "")
```

Figure B.2 Code Segment of web method

.

Figure B.3 Code Segment to SQL Stored Procedure of get current bill details

```
GO
/****** Object:  StoredProcedure [dbo].[GetBillDetails]    Script Date: 1/20/2017 10:39:56 PM ******/
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
ALTER PROCEDURE [dbo].[GetBillDetails]
    -- Add the parameters for the stored procedure here
    @AccountNo varchar(16),
    @FromRef varchar (10),
    @ToRef  varchar (10)
AS
BEGIN


    -- SET NOCOUNT ON added to prevent extra result sets from
    -- interfering with SELECT statements.
    SET NOCOUNT ON;
    declare  @FromYear int;
    declare  @FromMonth int;
    declare @ToYear int;
    declare @ToMonth int;

     set @FromYear = CAST(SUBSTRING(@FromRef, 1,4 ) as int);              --CAST(LEFT(userID, 4) AS int)
     set @FromMonth =  CAST(SUBSTRING(@FromRef ,6,2 )as int);
     set @ToYear =  CAST(SUBSTRING(@ToRef, 1,4 )as int);
     set @ToMonth  =  CAST(SUBSTRING(@ToRef, 6,2 )as int);

    print  @FromYear
    print @FromMonth
    print @ToYear
    print @ToMonth

    -- Insert statements for procedure here

    SELECT AccountNo,BillYear,BillMonth,WaterCharge,ServiceCharge,SewUsageCharge,SewServiceCharge,SewerageVAT,TotalDue from
    --where @AccountNo = AccountNo and BillYear between @FromYear and @ToYear and BillMonth between @FromMonth and  @ToM
    where @AccountNo = AccountNo and DatefromParts(BillYear,BillMonth,01) between DATEFROMPARTS(@FromYear,@FromMonth,01)
End
```

Figure B.3 Code Segment to SQL Stored Procedure

Figure B.4 Code Segment to jQuery that connect web method using url path using JSON objects

```
$.ajax({ type: "POST",
    contentType: "application/json; charset=utf-8",
    url: '/Account/NWSDBServices.aspx/GetNameChangeDetails',
    data: JSON.stringify(),
    processData: false,
    dataType: "json",
    success: function (response) {

        //                  $("#lblFirst").text(response.d.Initial);
        $("#lblName").text(response.d.UserName);
        //
    },
    error: function (a, b, c) {
        alert(a.responseText);
    }
});


$("#ddlAccount").on("change", function () {
    //               alert($('option:selected').text());
    var $accountNo = $('#ddlAccount option:selected').text();

    $.ajax({
        type: "POST",
        contentType: "application/json; charset=utf-8",
        url: '/Account/NWSDBServices.aspx/GetAccountNameChangeDetails',
        data: JSON.stringify({ accountNo: $accountNo }),

        processData: false,
        dataType: "json",
        success: function (response) {
            //                      alert("100");
```

Figure B.4 Code Segment to jQuery

Appendix C: User Manual

Home page

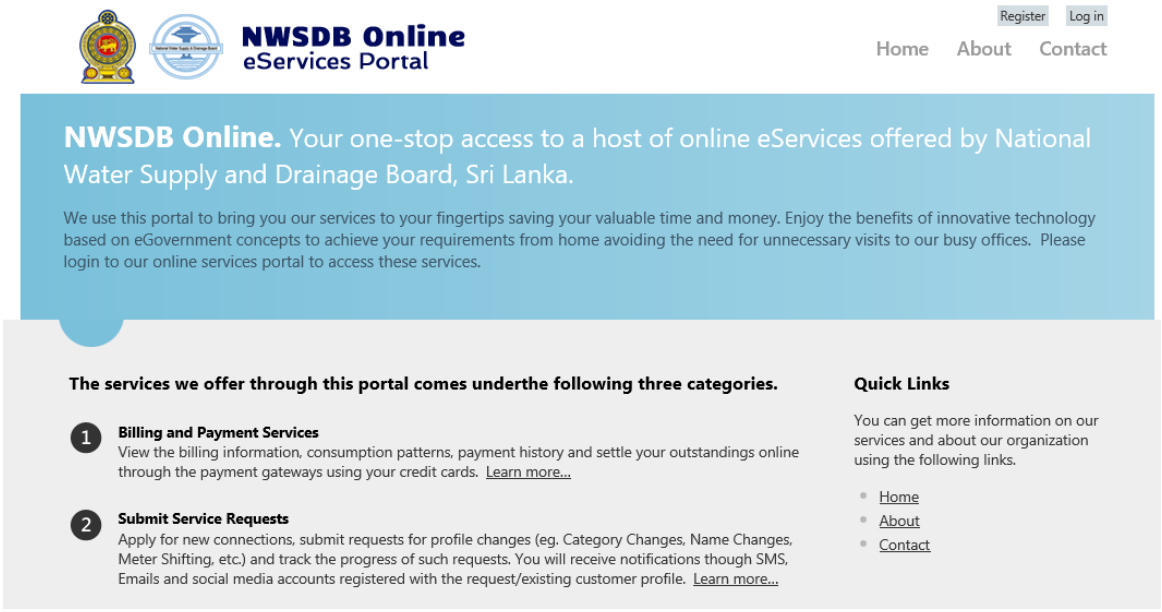


Figure C.1: Home page

For registered customer click the “Login” button. Then the system load login page

Login Page

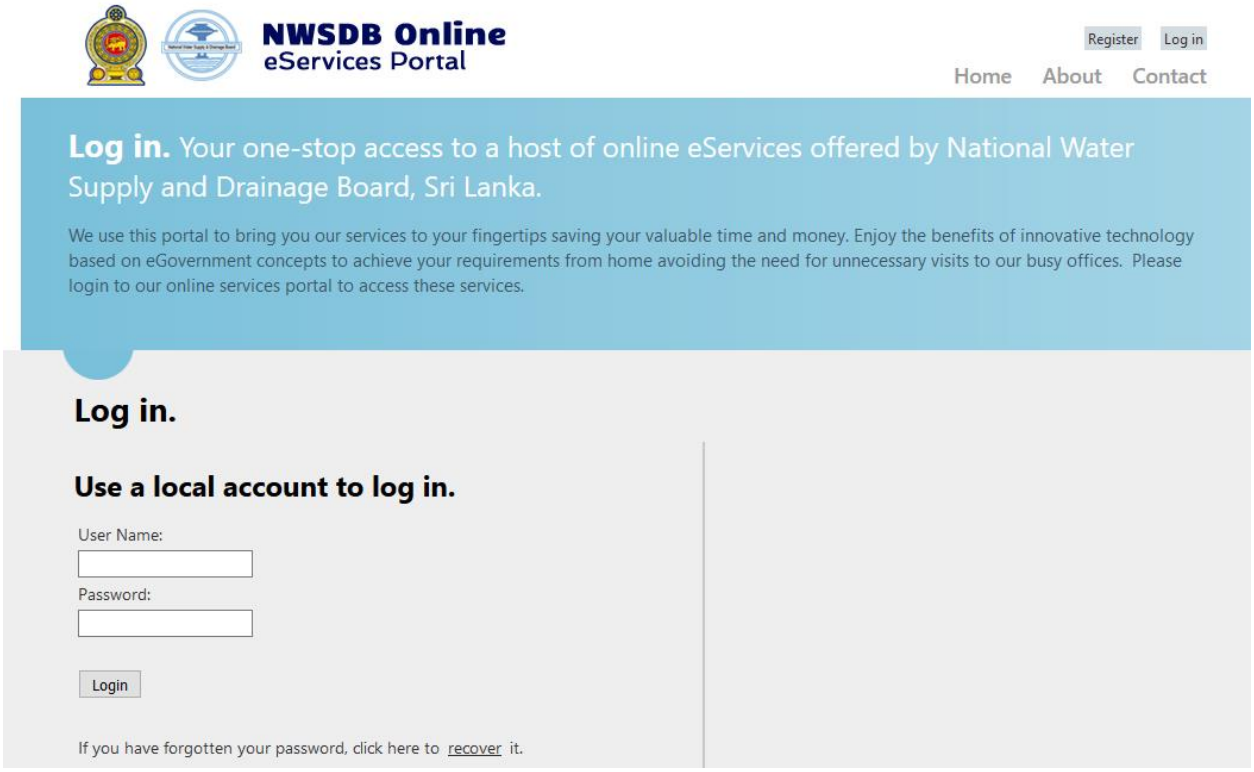


Figure C.2: Login page

User Registration

For new user have to register this portal. lick the top right “register” button. and click Submit Request button.

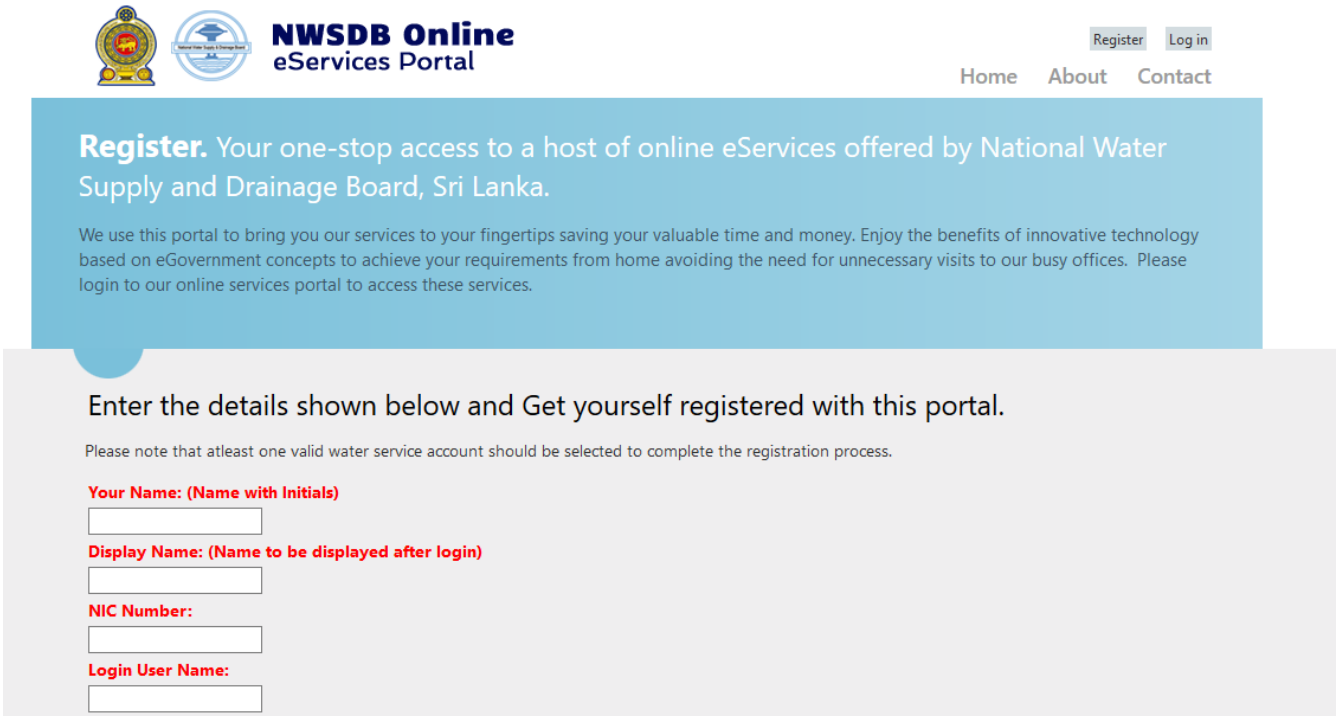


Figure C.3: Registration page

Menu list

Successful login direct to the service list

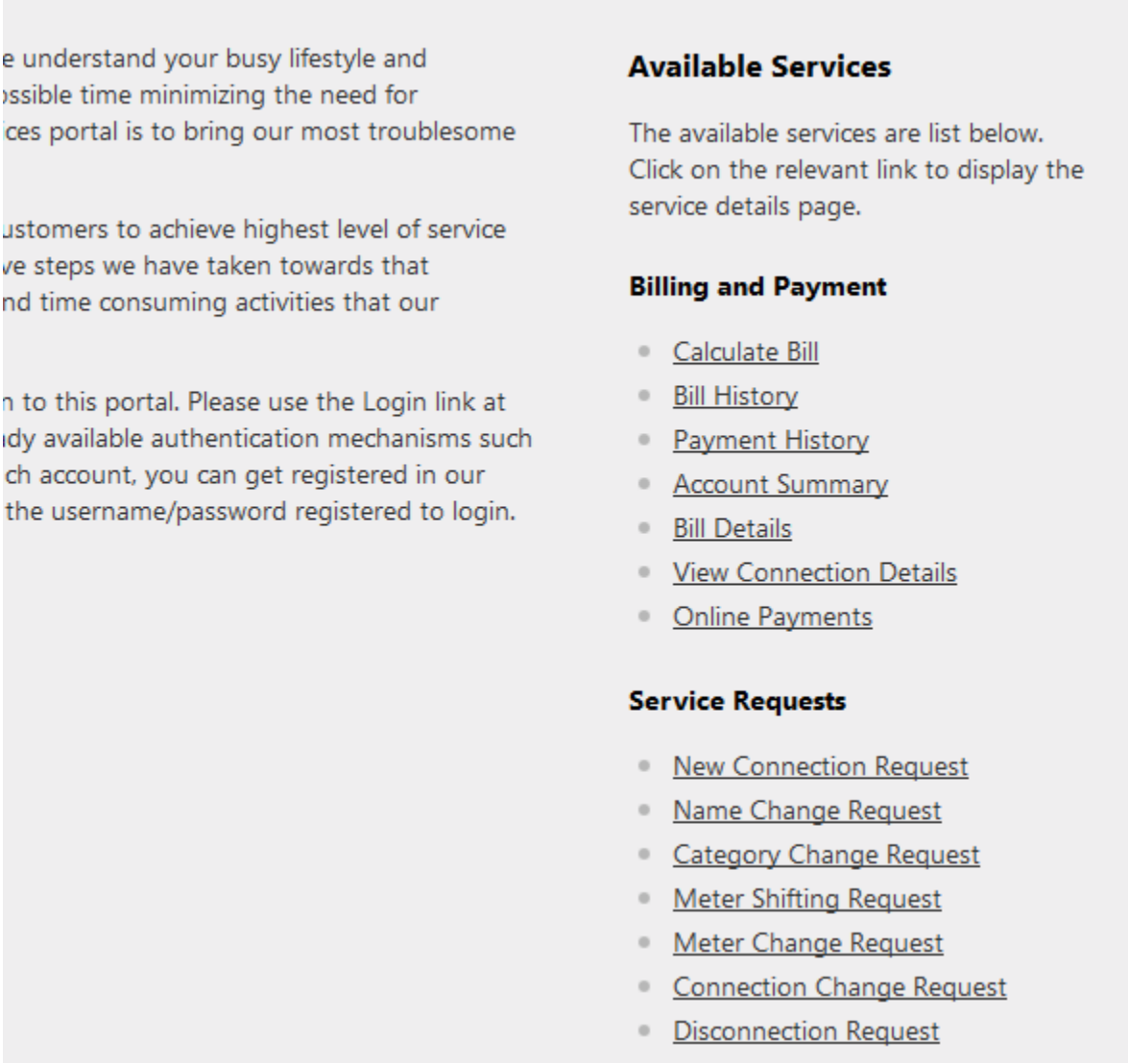
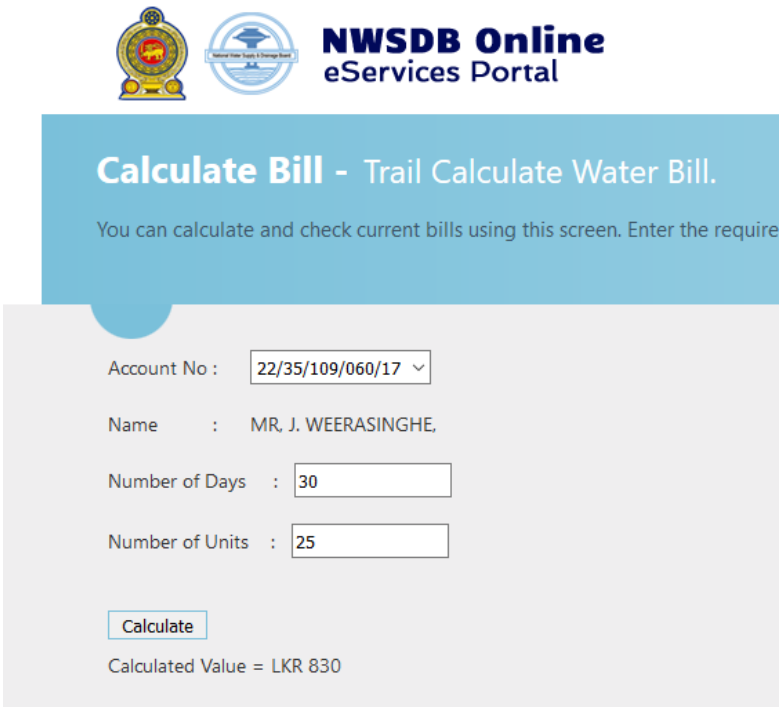


Figure C.4: Menu list

Click the required service which are listed in Billing and payment or Service Request categories

Online Calculate Water Bill

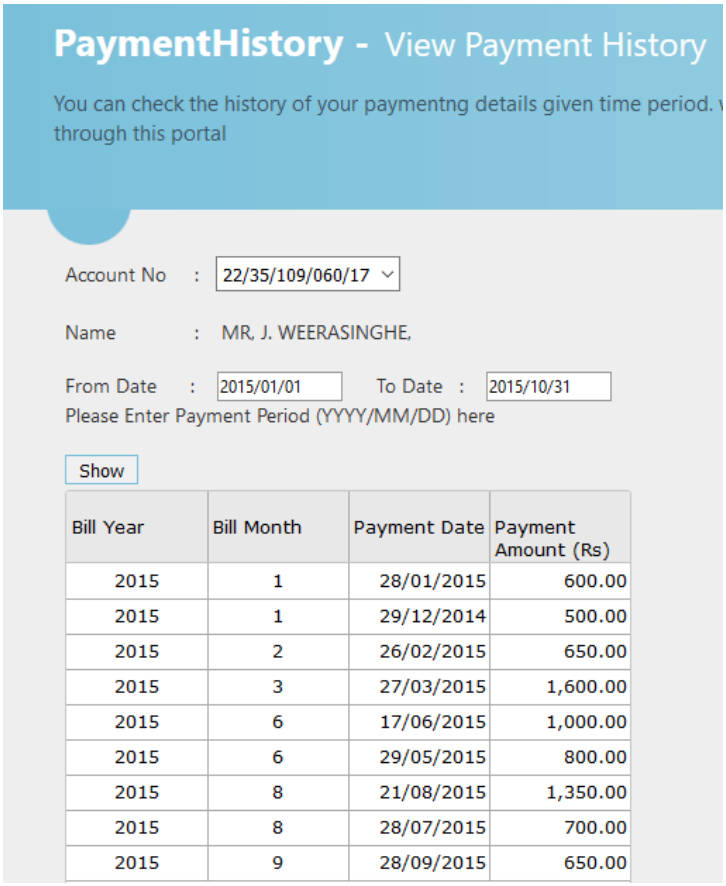
Click Calculate Bill link. The following screen loarded with customer account number and Name . user has to enter nuber of unita and number of days only.



The figure C.5 Online Calculate water Bill

Payment History

User has to enter From date and To date

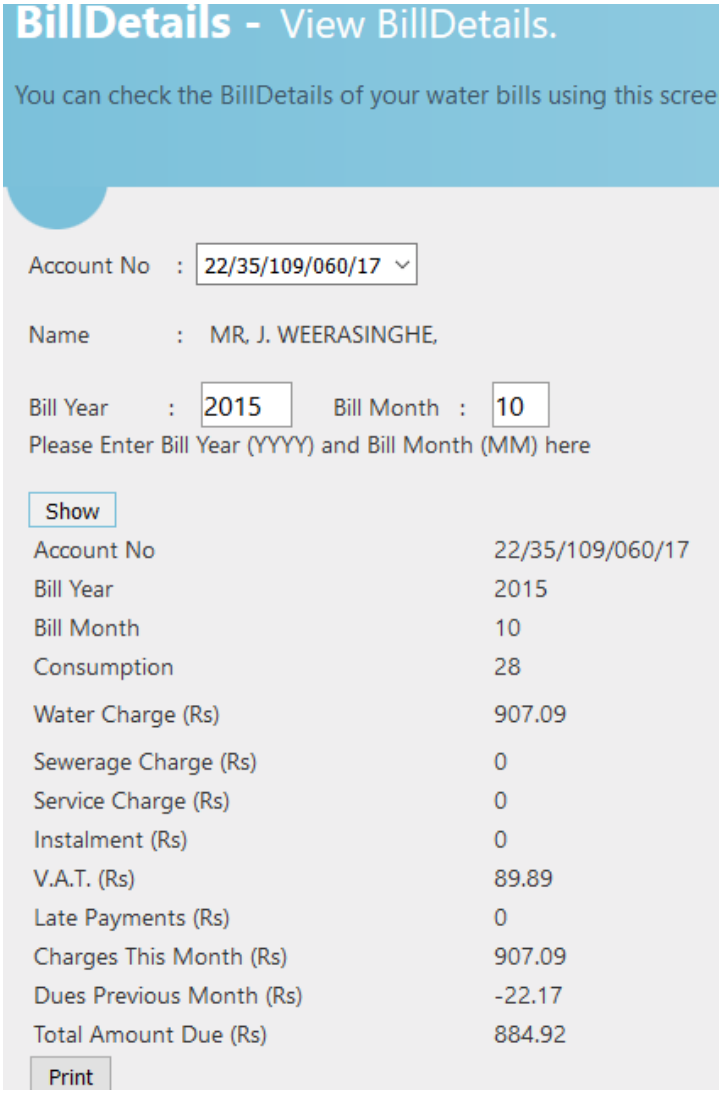


Bill Year	Bill Month	Payment Date	Payment Amount (Rs)
2015	1	28/01/2015	600.00
2015	1	29/12/2014	500.00
2015	2	26/02/2015	650.00
2015	3	27/03/2015	1,600.00
2015	6	17/06/2015	1,000.00
2015	6	29/05/2015	800.00
2015	8	21/08/2015	1,350.00
2015	8	28/07/2015	700.00
2015	9	28/09/2015	650.00

The figure C.6 payment History

Bill Detail

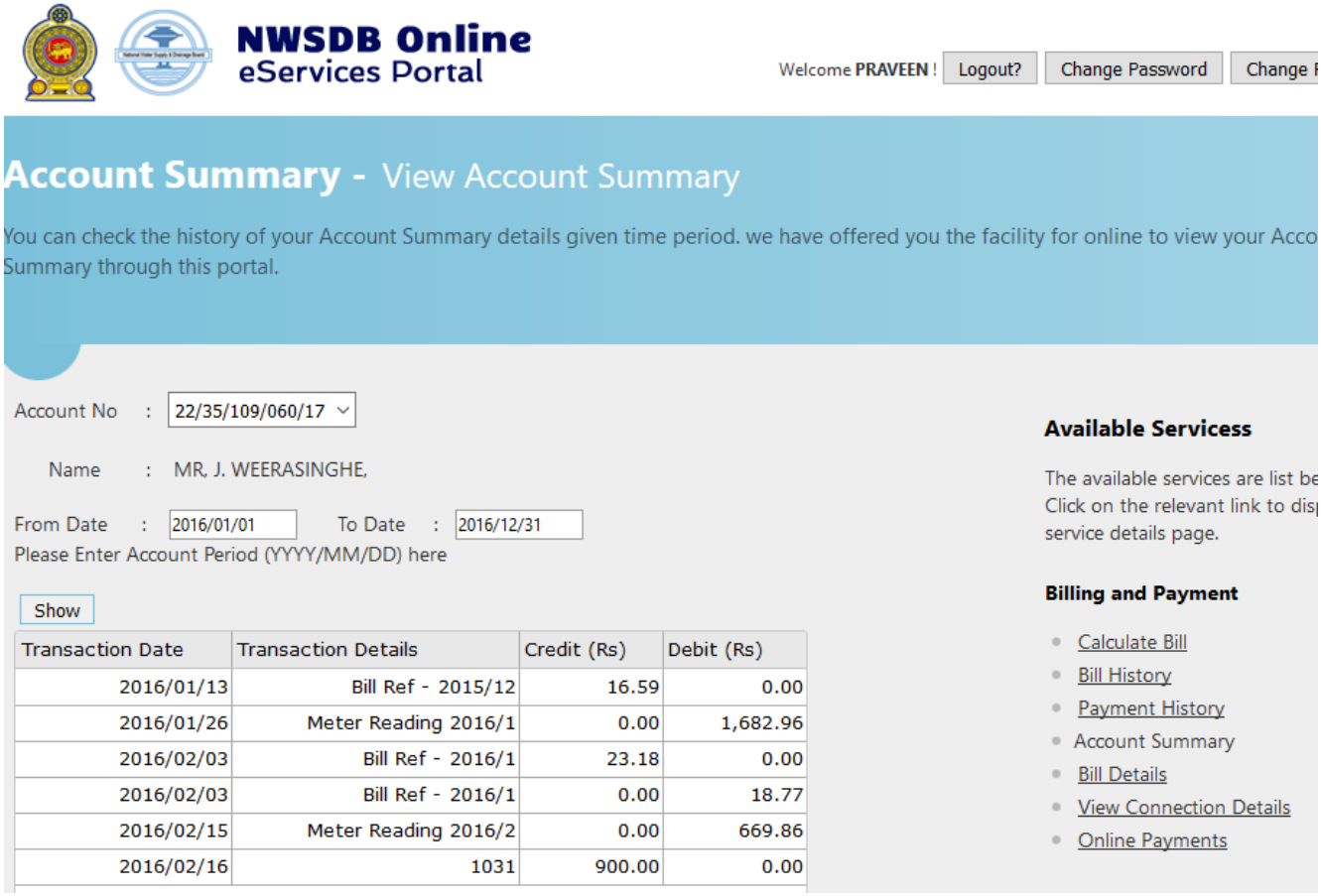
User has to enter Bill year and Bill month. This screen include water bill detail .ie. duplicate of water bill. Click print button to get hard copy of the bill



The figure C.7 Bill Detail

Account Summery

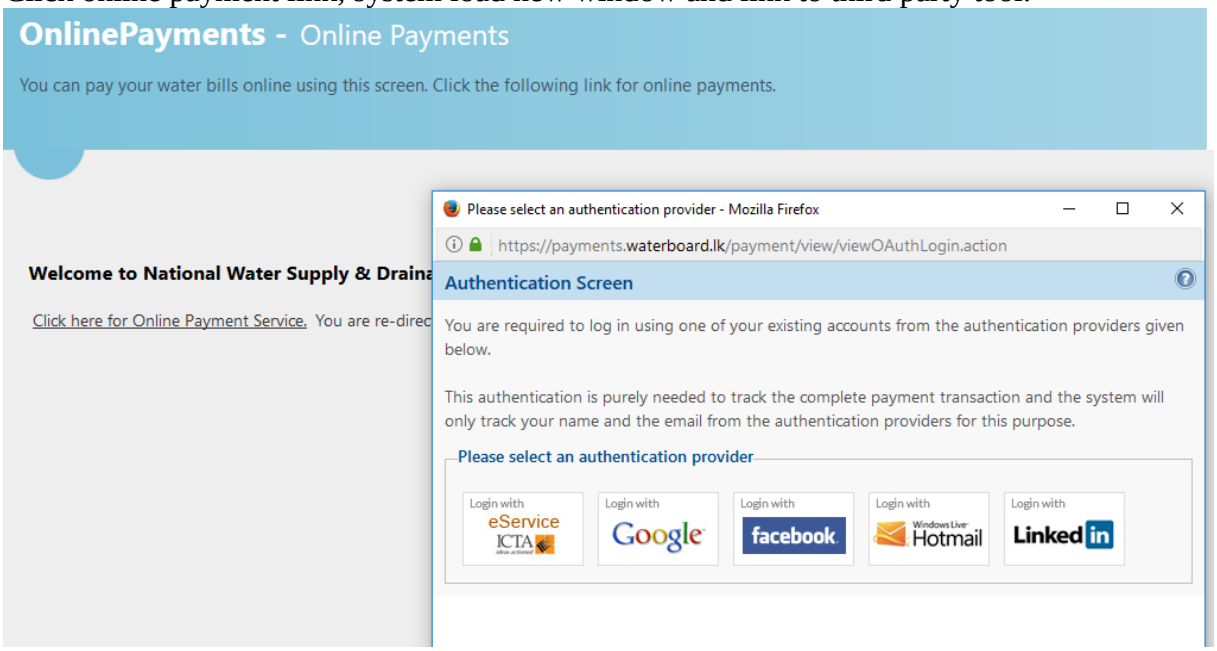
Customer Account summery detail can view. Enter only date period



The figure C.8 Account summery

Online Payment

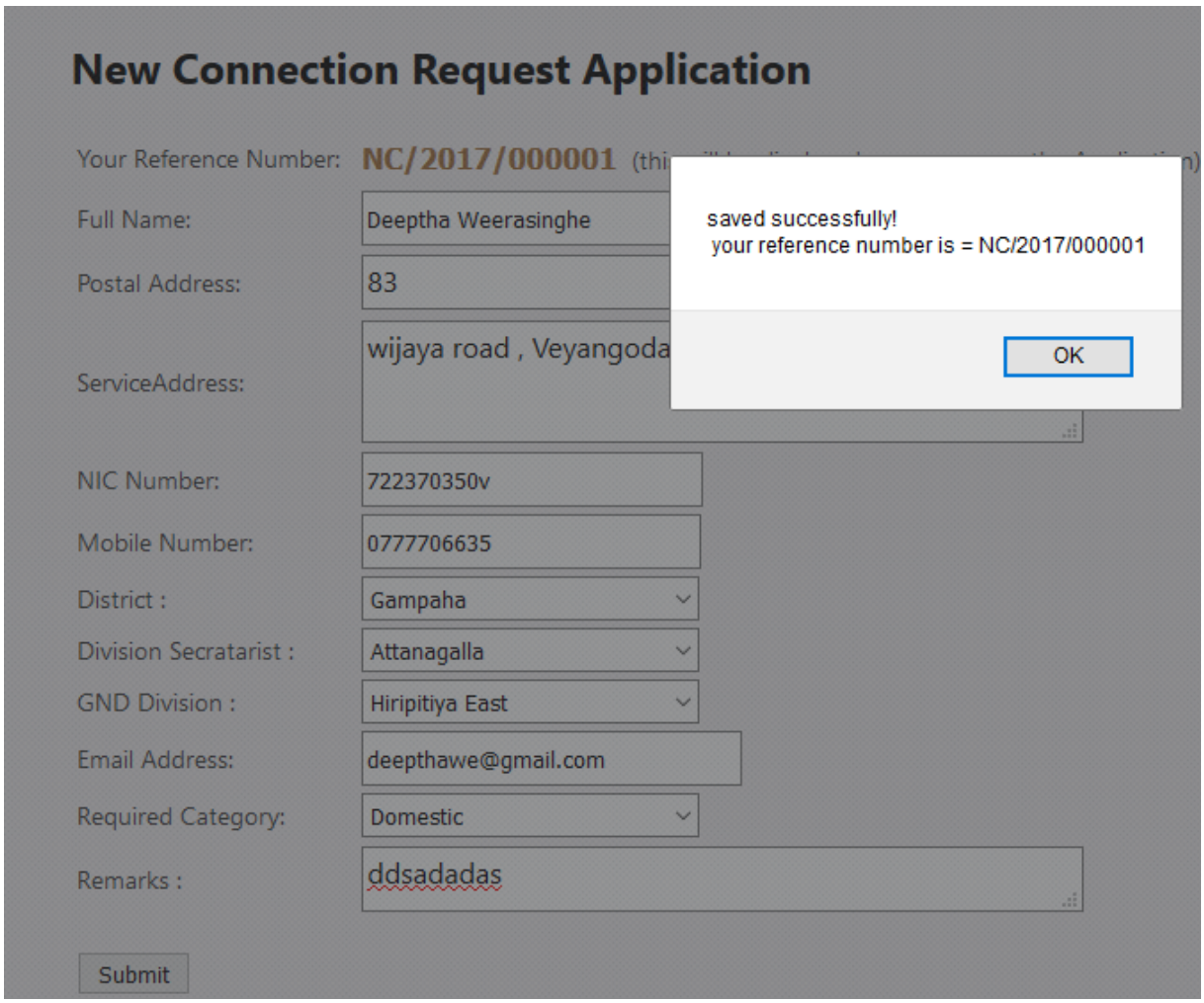
Click online payment link, system load new window and link to third party tool.



The figure C.9 online payment

New Connection Request

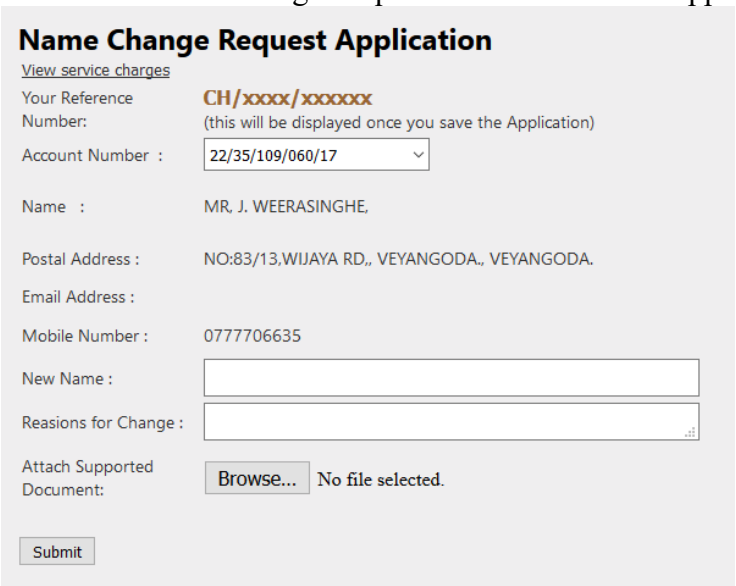
To get new water connection click the “New connection Request” link and enter detail and submit application the system generate reference number and user received SMS and email massages



The figure C.10 New Connection Application

Name Change Request

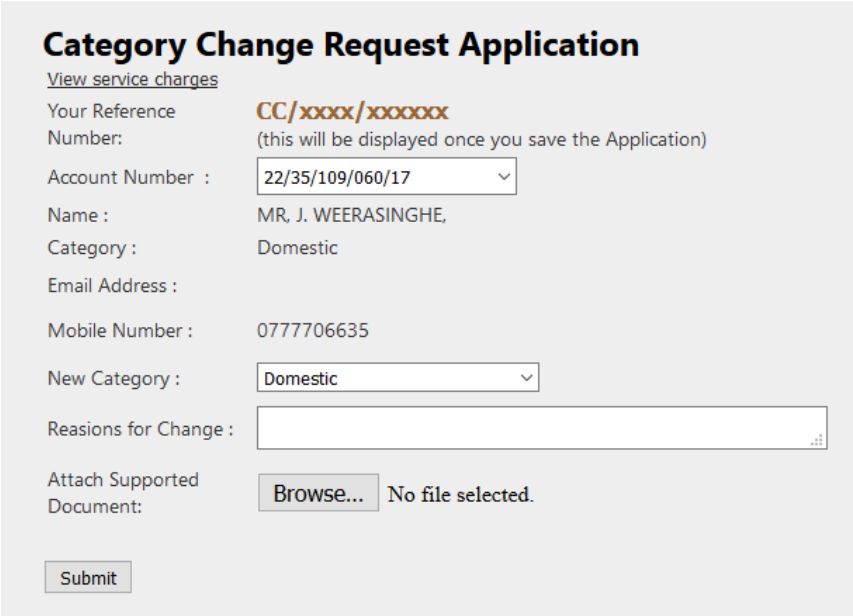
Customer can request for change water connection ownership name.
Click the "Name Change Request" Link and submit application.



The figure C.11 Name Change Request Application

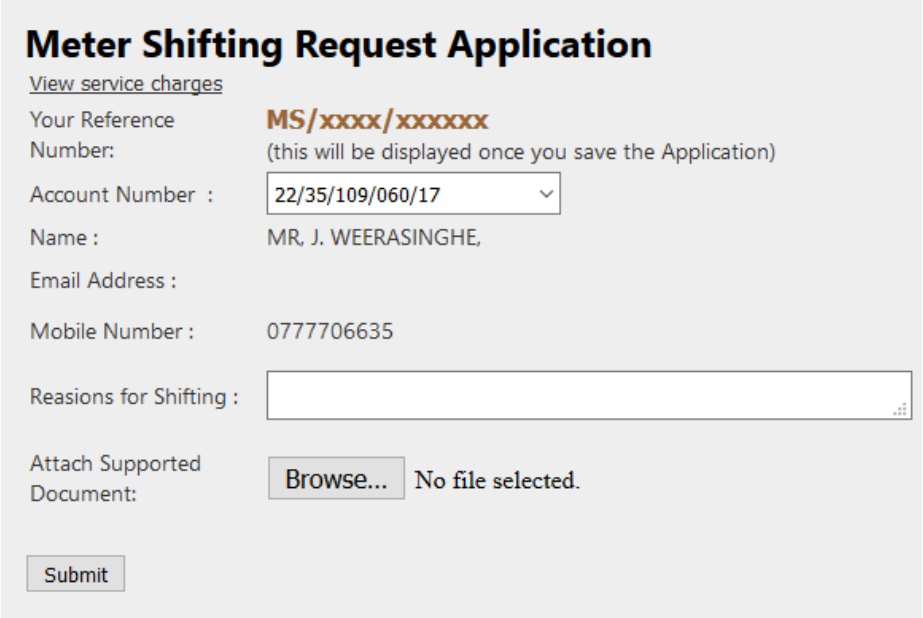
Category Change

Select Category change Request link and fill the application and submit



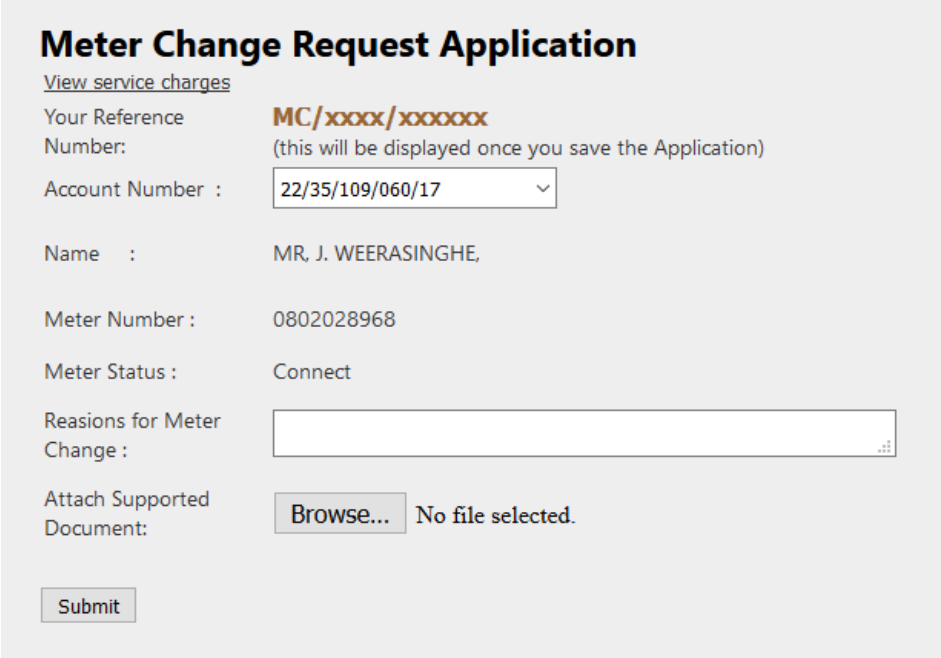
The figure C.12 Category Change Request Application

Meter Shifting Request



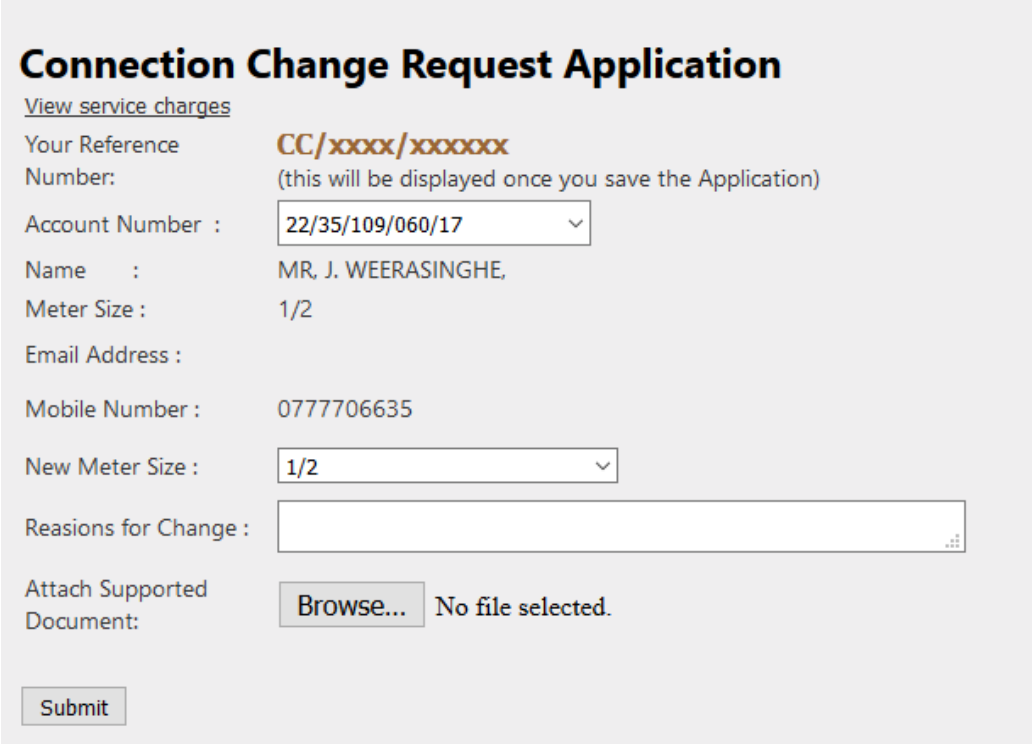
The figure C.13 Meter Shifting Request Application

Meter Change Request



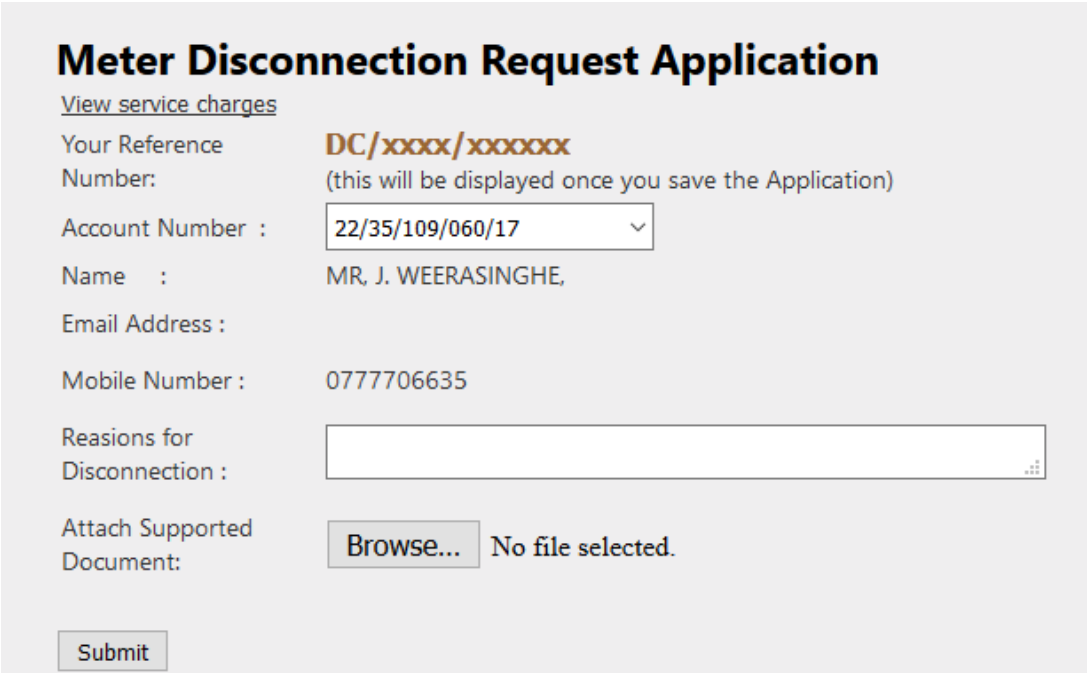
The figure C.14 Meter Change Request Application

Connection Change



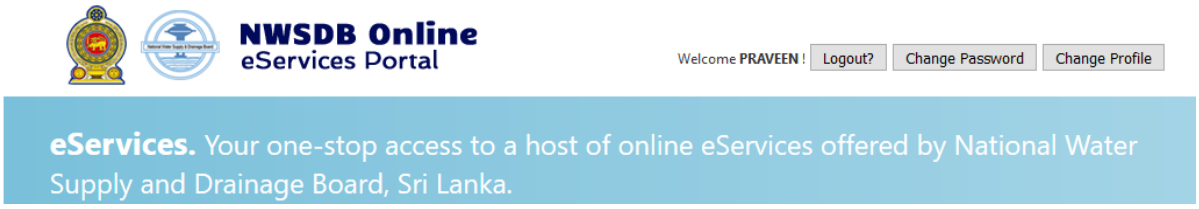
The figure C.15 Connection Change Request Application

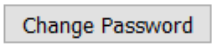
Meter Disconnection



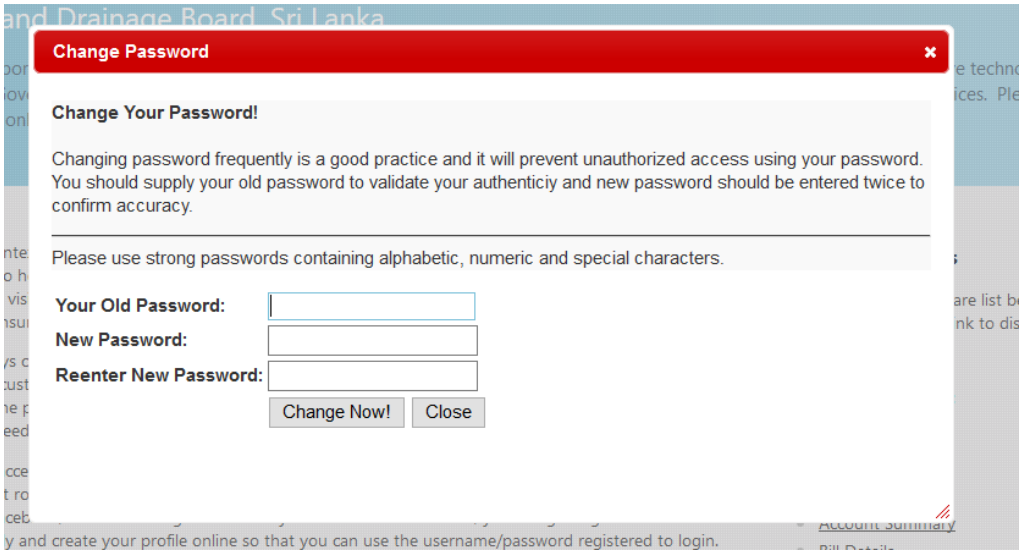
The figure C.16 Meter Disconnection Request Application

Change password



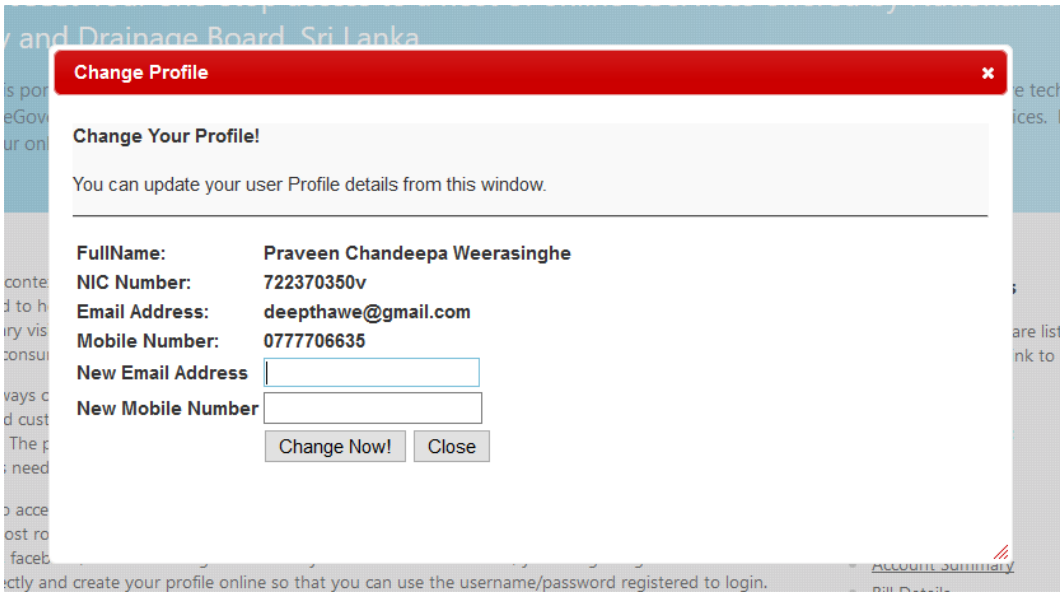
Click the 

button. popup window load the system .



The figure C.17 Change Password

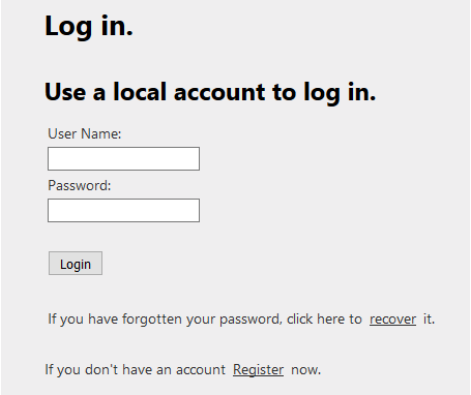
Change Profile



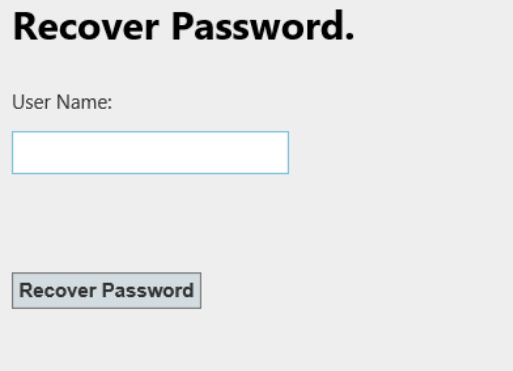
The figure C.18 Change Profile

Recover Password

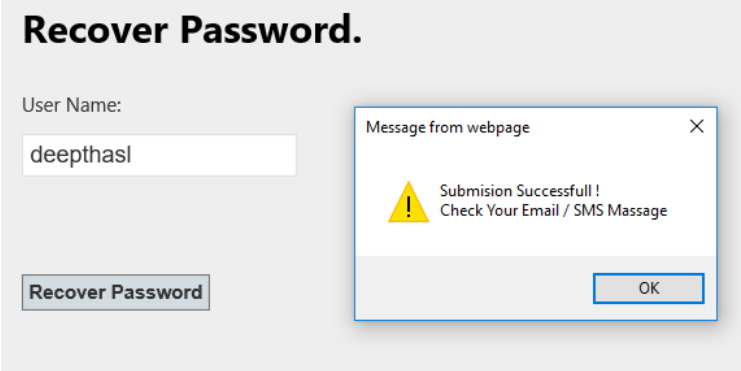
To recover password, click the Recover link at the login page. Password will receive through email and SMS



The figure C.19 Recover Password 1



The figure C.20 Recover Password 2



The figure C.21 Recover Password 3