

**PTV LICENSE FEE MANAGEMENT SYSTEM
(WEB BASED APPLICATION)**



GroupID

CS16-90

MIQDAD RAZA

01-134132-096

SUPERVISOR

SIR SUROOR MEHDI ZAIDI

Bachelor of Science in Computer Science

Bahria University, Islamabad

2019

CERTIFICATE

We accept the work contained in this report as a confirmation to the required standard for the partial fulfillment of the degree of BS (CS).

Head of Department

Supervisor

Internal Examiner

External Examiner

Dedication

In the name of Allah Almighty, the Most Merciful, the Most Beneficent

To my beloved parents and teachers, without whose unwavering support and cooperation

A work of this magnitude would not have been possible

Acknowledgements

This work is dedicated to my parents and teachers. Without their support we would not have been able to complete this project. We have been lucky enough to get the support from our family members who provided us the resources to undertake this project. They have always remained a great source of motivation for us.

There is no success without the will of ALLAH ALMIGHTY. I am thankful to ALLAH, who has given me enough power, guidance and strength that enabled me to accomplish this task. Whatever I have achieved, I owe it to Him, in totality. I am also grateful to my parents and family and well-wishers for their admirable support. I would like to thank my supervisor Sir Suroor Mehdi Zaidi for his help and motivation throughout the course of our project. Without his help I would have not been able to accomplish this project. My family and Sir Suroor Mehdi Zaidi provided me with the opportunity to polish my technical skills and guided me into this area of learning.

Abstract

Existing database management system (DBMS) of PTV can efficiently handle the only basic or secondary type of information. However many application (like inspector commercial survey defaulter list chronically domestic and consumer defaulter...) also require access to another type of information such as previously 12 years database files of each company which cannot be efficiently stored and accessed by current DBMS's. As a result, different programs run by system suffer unacceptable errors and delays while some time information manually compiles from a variety of information sources. Another shortcoming of existing database is that each data file store only limited record (i.e 2GB) and simple constraints about data in the database. All programming checks are built into the application. However, this makes it extremely expensive to develop and change the program. This objective of these efforts is to develop and advanced DBMS with facilities to input, store, retrieve and output multiple information types. The feasibility of this challenging objective rests on technical insight.

Table of Contents

| | |
|---|-----------|
| 1. Introduction..... | 11 |
| 1.1 Project Background/Overview..... | 12 |
| 1.2 Problem Description..... | 12 |
| 1.3 Project Objectives..... | 12 |
| 1.4 Project Scope..... | 12 |
| 2. Literature Review..... | 13 |
| 2.1 Review..... | 14 |
| 3. Software Requirement Specification..... | 15 |
| 3.0 Existing System..... | 16 |
| 3.1 Proposed System..... | 16 |
| 3.2 Requirement Specifications..... | 16 |
| 3.2.1 Functional..... | 17 |
| 3.2.2 Non-Functional..... | 17 |
| 3.3 Use Cases..... | 17 |
| 3.3.1 Use Cases Diagram..... | 17 |
| 4. System Design..... | 22 |
| 4.1 System Architecture..... | 23 |
| 4.2 Software Components..... | 24 |
| 4.3 Hardware Components..... | 24 |
| 4.4 Design Constraints..... | 24 |
| 4.4.1 Design Methodology..... | 24 |
| 4.4.2 Conceptual or Logical..... | 24 |
| 4.5 Sequence Diagram..... | 25 |

| | |
|--|-----------|
| 4.5.1 Admin Login Sequence Diagram..... | 25 |
| 4.5.2 Converting .Txt file Sequence Diagram..... | 26 |
| 4.6 Process Model..... | 27 |
| 5. System Implementation..... | 28 |
| 5.1 System implementation..... | 29 |
| 5.2 System Architecture..... | 29 |
| 5.2.1 Tools and Technology Used..... | 29 |
| 5.2.2 Development Environment / Language Used..... | 29 |
| 5.2.3 Application Access Security..... | 30 |
| 5.2.4 Languages..... | 30 |
| 5.2.5 Algorithms..... | 30 |
| 6. System Testing..... | 31 |
| 6.1 System Testing..... | 32 |
| 6.1.1 Functional Testing..... | 32 |
| 6.1.2 Usability Testing..... | 32 |
| 6.1.3 Download Testing..... | 32 |
| 6.1.4 Performance Testing..... | 32 |
| 6.1.5 Security Testing..... | 33 |
| 6.1.6 Installation Testing..... | 33 |
| 6.2 Test Cases..... | 33 |
| 6.2.1 Installation of Testing..... | 34 |
| 6.2.2 Admin Login..... | 35 |
| 6.2.3 Data Storage | 36 |
| 6.2.4 Uninstalling Application..... | 37 |

| | |
|---------------------------|-----------|
| 7. Conclusion..... | 38 |
| 7.1 Conclusion..... | 39 |
| 7.2 Future Work..... | 39 |
| References..... | 40 |

List of Figures

| | |
|--|----|
| 3.4.1.1 Main Use Case Diagram..... | 18 |
| 3.4.1.2 Wapda Use Case Diagram..... | 19 |
| 3.4.1.3 Admin Use Case Diagram..... | 20 |
| 3.4.1.4 User Use Case Diagram..... | 21 |
| 4.1 System Architechture Diagram..... | 23 |
| 4.5.1 Admin login Sequence Diagram..... | 25 |
| 4.5.2 Converting .Txt file into Database Sequence Diagram..... | 26 |
| 4.6.1 Process Model Diagram..... | 27 |

List of Tables

| | |
|--|----|
| 3.4.1.1 Main Use Case | 18 |
| 3.4.1.2 Wapda Use Case | 19 |
| 3.4.1.3 Admin Use Case | 20 |
| 3.4.1.4 User Use Case | 21 |
| 6.2.1 TC_1: Installation of Testing | 34 |
| 6.2.2 TC_2: Admin Login Testing | 35 |
| 6.2.3 TC_3: Data Storage Testing | 36 |
| 6.2.4 TC_4: Uninstalling Application Testing | 37 |

Chapter: 1

Introduction

1. Introduction:

This project is about the “Pakistan Television License Fee Management System”. PTV receives PTV license fee through different companies of WAPDA (IESCO, LESCO, etc.). These companies collect PTV license fee on their electricity bills every month from their consumer (Domestic as well as Commercial). These companies sent data about PTV license fee collected by their consumers on CD-ROM through mail/currier to the PTV headquarter. The computer department of headquarter put data to their Database management system (DBMS). At present they are using FOXPRO which is command based DBMS which has limited storage capacity and command cannot be exceeded by 8 letters. The people working in the computer department enter commands for the retrieval of different types of information.

1.1 Project Background/Overview:

PTV headquarter is using very old software using FoxPro software for collecting PTV license fee. FoxPro is a very old software and there are many problems in this software. This software is command base and the interface is not user-friendly. They generate reports manually which is too much difficult for system analyst. This software is used by PTV from last 14 years.

1.2 Problem Description:

There are many problems in the existing system. Currently, FoxPro software is being used and faced many difficulties using this previous version of the software. The main problem in this software is non-relational data is stored in the database. There is a fixed size of the file that we cannot store data more than 2 GB in the database. Due to this problem, data is scattered in the database in different places. Using this software is time-consuming because it is command based software. This DBMS is so old that it is not compatible on 64 – bit operating systems. Data come from WAPDA is non-relational data and this is the main drawback of this software. The report is generated manual in this software due to which calculation is done manual and it takes too long. This system is not reliable. To retrieve data of any consumer of the previous month is very cumbersome.

1.3 Project Objectives:

The objective of this project is to design, develop and implement “PTV License fee Management System”. This system is based on a relational database management system (RDBMS). This system will be fast, secure, reliable and efficient. The proposed system can handle a large amount of data. The proposed system can support to retrieve previous data of any consumer if needed.

1.4 Project Scope:

This is desktop based as well as Web Based Application for PTV license fee management system. This application deals with relational database management System.

Chapter: 2

Literature Review

2. Literature Review:

A broadcast receiving licence or television licence is a method of payment for receiving television broadcasts signals in all developed countries. TV licencing fee is therefore effective taxcollection scheme which helps to earn money for funding public broadcasting, thus allowing public broadcasters to transmit television programmes with discounted rates.[1]Television license fee in Pakistan is Rs 420 per year. All consumers of electricity pay Rs 35 per month [2]. This TV licensing fee is collected to fund PTV.

The processes of collection of license fee transfer in 1991 from his home office to BBC, BBC takes all responsibility for the collection fee. The revenue of the license fee collected from the customer and transfer directly to the HM Consolidated fund. Department for Culture, Media and Sport (DCMS) is also submitted as an AID fund in BBC revenue. In the processes of collection of License Fee revenue BBC managed a number of prescribed schedules covering collection, management and prosecution of the License Fee, marketing, payment channel organization and retail networks. The trademark of the BBC is “TV LICENSING” used by the companies contracted by the BBC. Most of the administration is contracted to Capita Business Services Ltd under an undertaken which was signed in December 2011. Over-the-counter services are provided by Pay Point Plc in the UK and by the Post offices in the Isle of Man and the Channel Islands. Marketing and printing services were contracted by the company Proximity London Ltd. All the responsibilities regarding tv licensing functions are taken by the BBC. The BBC ensures their suppliers that the procedure for the collection of license fee revenue is consistent with the policies and regulations and offers the best opinion to the customers for paying their Tv License fee. the aim of the BBC is to offer a wide-ranging of patterns and payment methods for the customes to pay easily and simply.[3]

Chapter: 3

Requirement Specifications

3. Existing System:

This project is about the “Pakistan Television License Fee Management System”. PTV receives PTV license fee through different companies of WAPDA (IESCO, LESCO, etc.). These companies collect PTV license fee on their electricity bills every month from their consumer (Domestic as well as Commercial). These companies sent data about PTV license fee collected by their consumers on CD-ROM through mail/currier to the PTV headquarter. The computer department of headquarter put data to their Database management system (DBMS). At present they are using FOXPRO which is command based DBMS which has limited storage capacity and command cannot be exceeded by 8 letters. The people working in the computer department enter commands for the retrieval of different types of information.

3.1 Proposed System:

This system is based on a relational database management system (RDBMS). This system will be fast, secure, reliable and efficient. The proposed system can handle a large amount of data. The proposed system can support to retrieve previous data of any consumer if needed.

3.2 Requirement Specification:

3.2.1 Functional Requirements:

The Functional Requirements of my project are listed below:

- Huge data of different companies of WAPDA will be converted from flat files (.txt) into meaningful data.
- After converting huge data complex calculation will be done.
- The report will be generated after doing a complex calculation of different companies of WAPDA.
- Retrieval of data according to PTV headquarter demand.
- The output will be according to given input by the system analyst.

3.2.2 Non-Functional Requirements:

Non-Functional Requirements of my project are listed below:

Accessibility:

System should be accessible by the authorized user.

Performance:

System should respond fast while sending/receiving data to/from server.

Security:

System should be secure in regards of sensitive data from different viruses as well.

Availability:

System shall be available at the particular time when required.

Response Time:

The response time shall be in minutes.

Quality:

Product quality shall be obtained by making all the required features.

Interface:

Interface will be simple and user friendly.

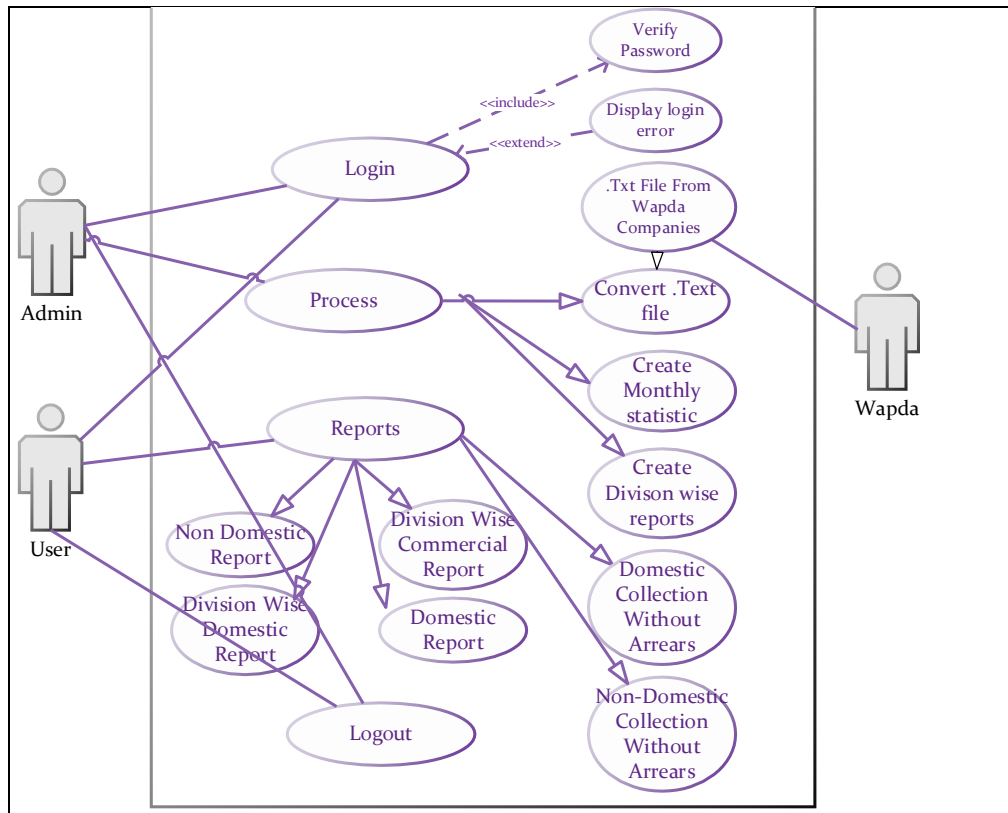
3.3 Use Case:

Use case diagrams show the interaction or relationship of the user with different parts of the proposed system and it helps us to show the functionality of our system. Usage cases are also useful to define the role of different users, along with their interaction with multiple activators.

3.4 Use Case Diagrams:

A use case is a list of actions or events which define the interaction between the actor and system to achieve a goal. The main use case diagram of a user interacting to the system is shown below. The actors in this use case is the User who will be using the system.

3.4.1.1 Main use case:



Figure

3.4.1.1: Main Use case

Detailed description of Use Case 1

| Use Case ID | UC-1 |
|----------------|---|
| Title | Main Use Case |
| Description | This use case representing the whole system. Wapda is sending data to Admin. Admin is login into to system and convert the .text file into the database file and creating different reports. User login into the system and can see reports as well as print the required report. |
| Primary Actor | Wapda,Admin,User |
| Pre-Condition | Admin & User Sign in. |
| Post-Condition | Admin and User see the web application features. |

Table 3.4.1.1:Main Use Case

3.4.1.2 Wapda Use Case:

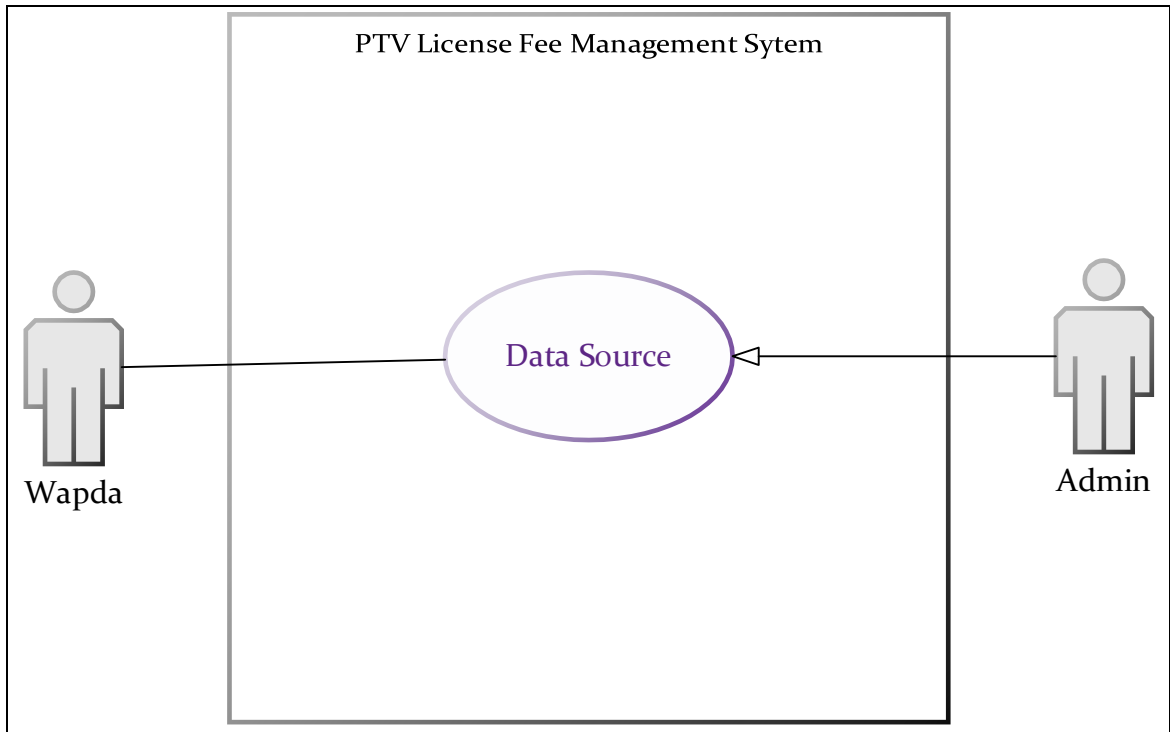


Figure 3.4.1.2: WapdaUse case

Detailed description of Use Case 2

| | |
|----------------------|--|
| Use Case ID | UC-2 |
| Title | Wapda Use Case |
| Description | Wapda, send the data of nine wapda companies to Admin. |
| Primary Actor | Wapda. |

Table 3.4.1.2: WapdaUse case

3.4.1.3 Admin Use Case:

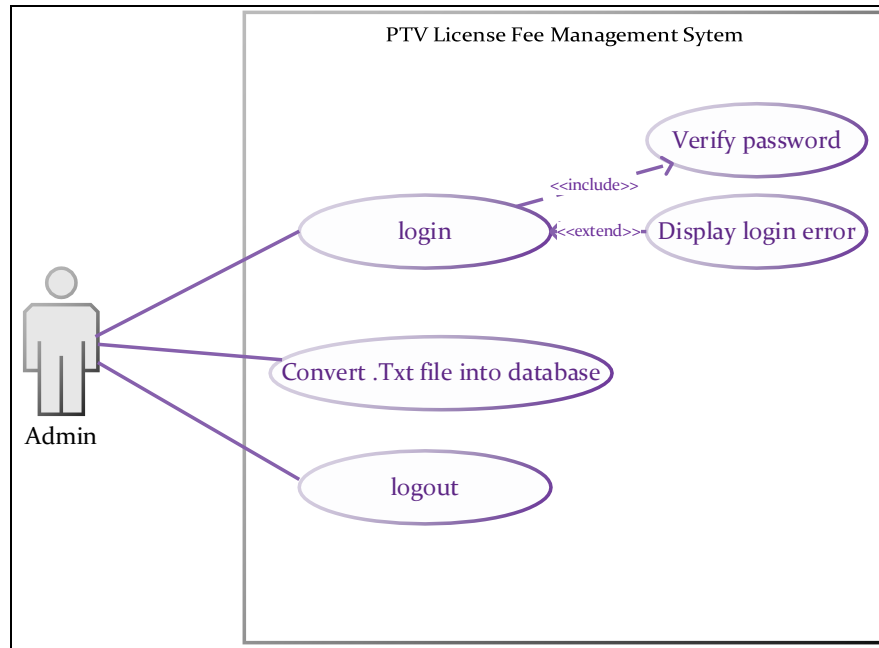


Figure 3.4.1.3: Admin Use Case

Detailed description of Use Case 3

| | |
|-----------------------|---|
| Use Case ID | UC-3 |
| Title | Admin Login |
| Description | Admin login to the website to convert the .text file into the database. |
| Primary Actor | Admin |
| Pre-Condition | Admin Sign in. |
| Post-Condition | Admin can access the web application Features. |

Table 3.4.1.3: Admin Use Case

3.4.1.4 User Use Case:

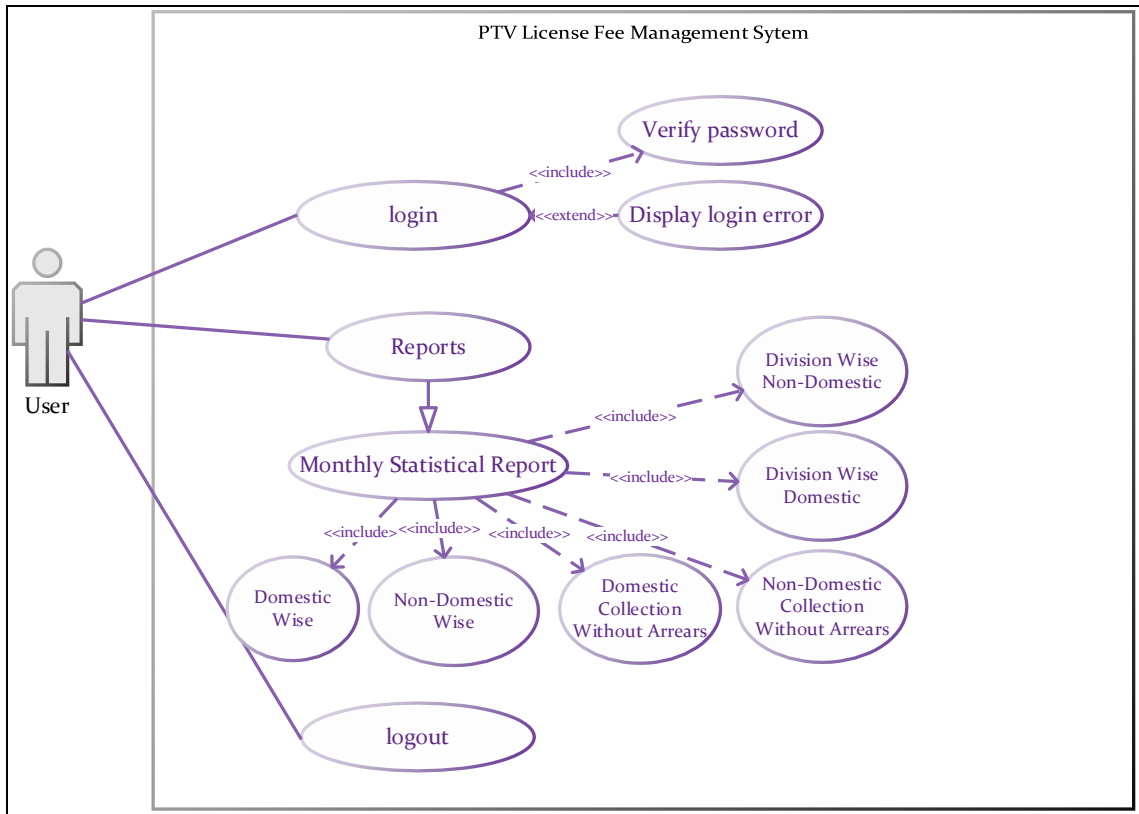


Figure 3.4.1.4: User Use Case

Detailed description of Use Case 4

| | |
|-----------------------|---|
| Use Case ID | UC-4 |
| Title | User Main Use Case |
| Description | User Sign in into this system to see and generate required reports. |
| Primary Actor | User |
| Pre-Condition | User Sign in. |
| Post-Condition | User can access the web application features. |

Table 3.4.1.4: User Use Case

Chapter:4

System Design

4.1 System Architecture:

It is the overall structural design of the system, how the system works and it basically implements the high-level design of the system. In this system, user can see different reports. The architecture of the desired system is shown below:

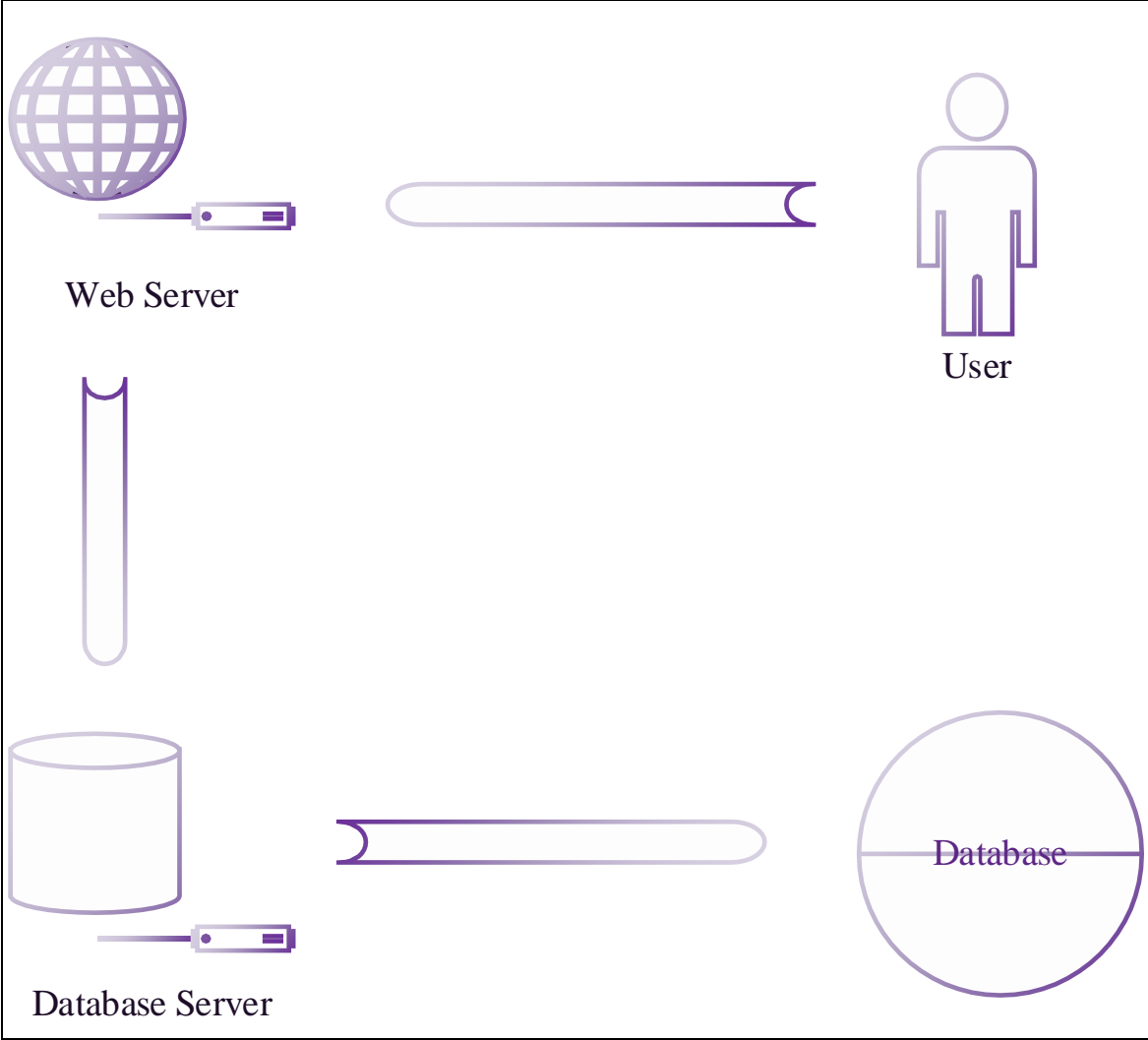


Figure 4.1: System Architecture

Figure 4.1 describes how the system works. When user want to see any report on web he will login into to website. The user request will sent into web server and web server will search from the database server and then database server will fetch required data from database. The desired data will display on the screen and then user can see reports.

4.2 Software Components

The project contains the following software components:

PTV LICENSE FEE MANAGEMENT SYSTEM

- **Operating Systems**
 - Personal Computers.
- **Software**
 - Microsoft Visual Studio 2013
 - MySQL Server 2014
- **Language**
 - ASP.Net

4.3 Hardware Components

- Processor Core i5 or above
- Processor Speed: 2.66 GHz or above
- RAM: 3 GB or above
- HARD DISK: 500 GB or above

4.4 Design Constraints:

Due to the limitations and implementation restrictions discussed in previous sections, certain adjustments were made were discussed in the proposal.

4.4.1 Design Methodology:

The entire project has been developed in ASP.Net and SQL Server and we have three modules of the project that connect the modules and the database. The following diagrams explain the complete design methodology of our system.

4.4.2 Conceptual or Logical:

The conceptual design is basically how the system works conceptually. Our system has three modules and it connects to each other and basically in the diagram below is shown how different modules communicate with each other during the execution of the system and explained in detail in the diagram below and each module has sub modules communicating with each other from the sign in to log out.

4.5 Sequence Diagram:

Sequence diagram is an interaction diagram that shows how objects operate with one and another and in what order.

4.5.1 Admin Login Sequence Diagram:

The figure 4.5.1 shows the sequence of Admin login. The admin enter the name and password as an input. Admin detail will be check in the database. If the information will be correct admin will be login and homepage will be appear.

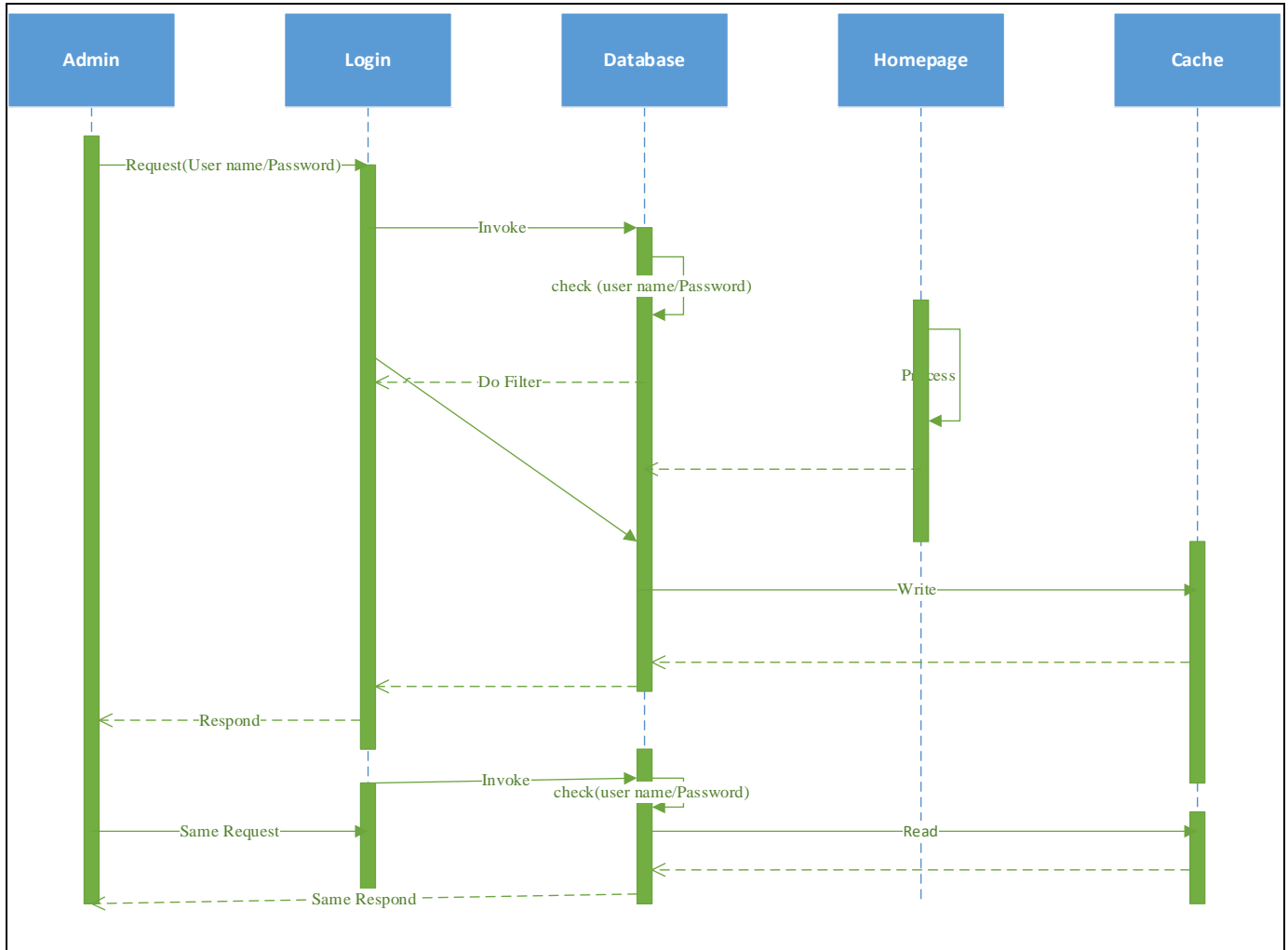


Figure 4.5.1:Admin Login Sequence Diagram

4.5.2 Converting .Txt File Sequence Diagram:

The figure 4.5.2 shows the sequence of converting .Txt file. When admin login into the application then he send request to convert the .text file from web server and when request is approved file is converted in to database server and database is updated.

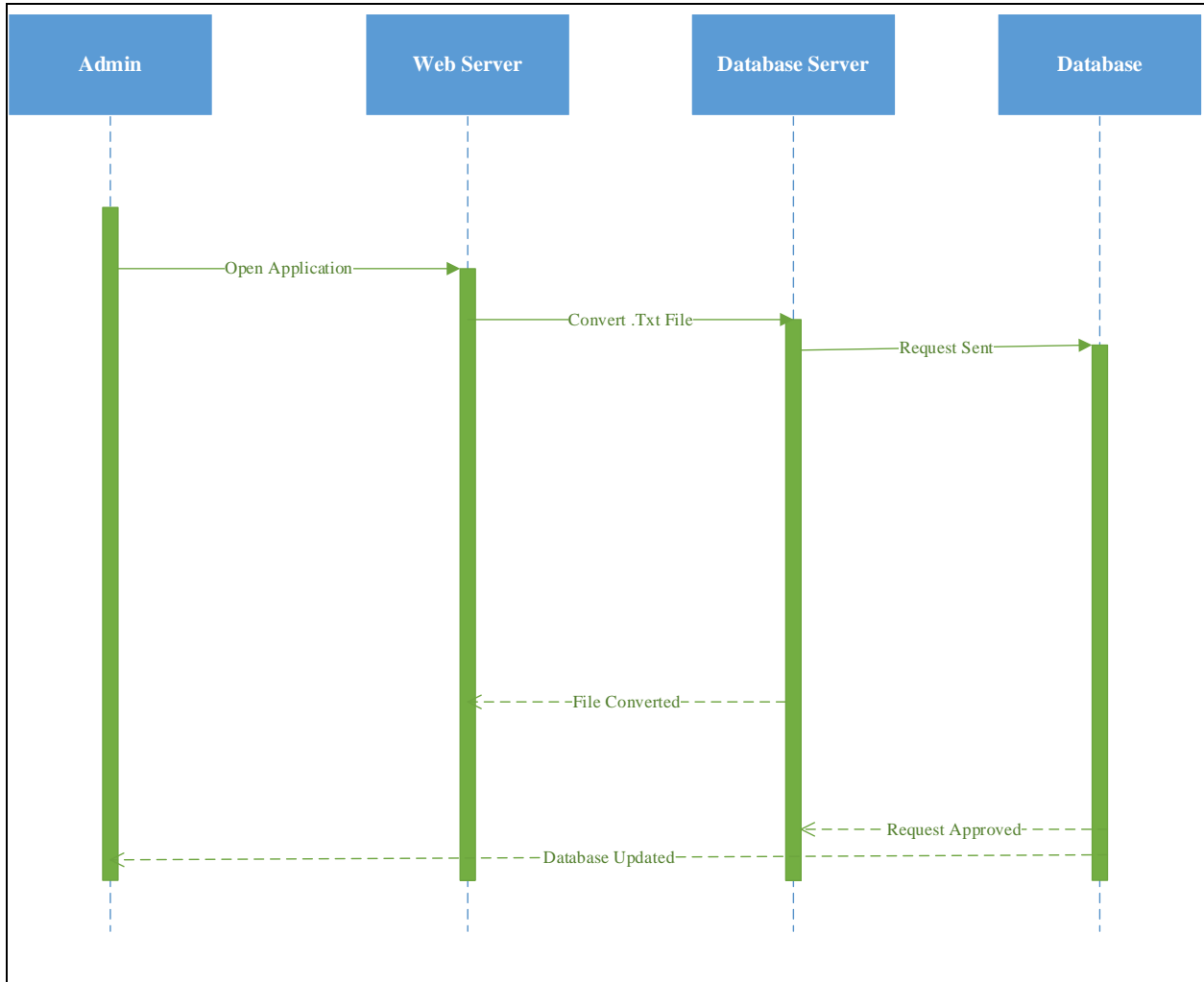


Figure 4.5.2: Convert .Txt File into Database

4.6 Process Model:

This system is designed Desktop based as well as Web based application and composed of different features so we must follow Incremental Model. This model will help in increasing of new features on every increment and also developed described model.

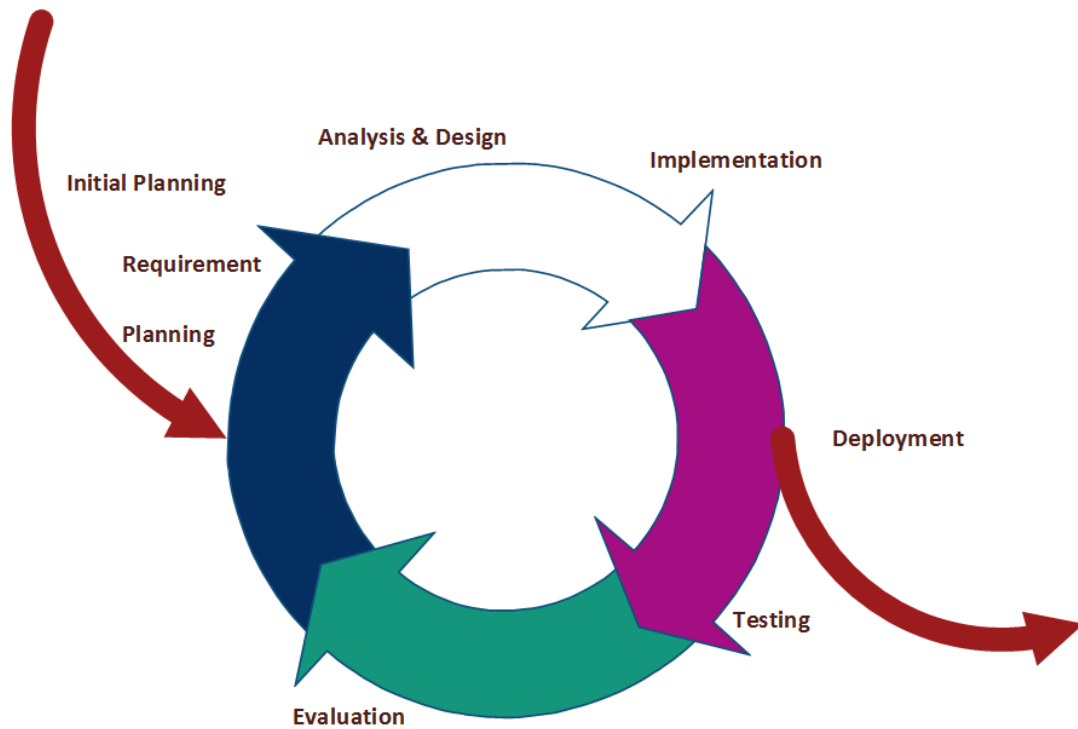


Figure 4.6.1 : Process Model

Figure 4.6.1 shows the process model of web application. In first phase we gather all the necessary information related to the project. In second phase I analysis and design the front-end and back-end of project. I make different usecases and sequence diagram which shows the working of the system. When final design is done implementation phase is started. In implementation phase I use Asp.Net for designing front-end of the project and use Sql Server for back-end to store data in database. After completing this phase testing phase comes. In this phase I test my each module separately to ensures that each module of the product works and delivers results according to the requirements. After testing separate modules I tested whole application to ensure that its meets the user requirements. In evaluation phase whole system is evaluated and feedback comes from the user.

Chapter:5

SYSTEM

IMPLEMENTATION

5.1 System Implementation:

This system consists of two parts, one is web-based application and the other one is a Desktop Based Application. Web application fully linked to the desktop application. This was the first phase of implementation. Then the second phase is data coming from different companies of Wapda. This data is shown on the web application. Then the last phase of the project is to generate different reports of different companies of Wapda. Details of the system are discussed later in this chapter.

5.2 Software Architecture:

It describes the structural design e.g. in term of System Internal Components, Functionality of the Modules, and Communication between the modules.

5.2.1 Tools and Technology Used

Following tools are used:

- Microsoft Visual Studio 2013
- Microsoft SQL Server 2014
- Microsoft Visio 2013

5.2.2 Development Environment/Languages Used

Following languages / environments used:

- ASP.Net
- JQuery
- Bootstrap

5.2.3 Application Access Security:

As far as security is concerned, we have a proper login password for admin/users and at the user cannot access the source code. They will only be provided with the executable application of the software and the source code remains with me.

5.2.4 Languages:

The languages that have been used for the implementation of this system are popular and widely used Asp.net have been used for implementing the front hand of the system. Whereas jQuery, bootstrap and HTML with CSS, are used for creating a web site module of the system

5.2.5 Algorithms:

The basic purpose of this application is to store huge amount of data in database and shown onweb application, so the algorithm used in this application is called B-Tree algorithm. Binary Search Hierarchy is a B-Tree data structure which is based on the principal of binary Search. Records are set in sorted order. Inserting or deleting take an average time. This algorithm is faster than the linear time algorithm.[4][5] B-trees are mostly used to establish long term storage such as Databases and file system.[6]

Chapter: 6

SYSTEM TESTING

6.1 System Testing:

This section is meant for the validation and verification of the software according to the established and proposed requirements. This phase has significant importance in the development life cycle because past has proven that a minute bug in the software may result loss of money and human life due to the carelessness in the testing phase.

Testing confirms that each component of the product works and provides results according to the needs. Each of the individual components of the application is individually verified and the full application is also tested. The key purpose of testing is to verify that the developed application complies with the compulsory quality values or not. Tests are also aimed at determining whether the application provides the desired outcome. Tests can be of many types as set out below:

6.1.1 Functional Testing:

Functional testing is a process in which business requirements of the system are tested, whether or not according to customer requirements.

6.1.2 Usability Testing:

Usability testing is marked at calculating the easiness with which the system can be used. It is a process in which an application is tested in the user-centred environment. Usability testing focuses on measuring the capacity of a man-made product to measure and meet his intended purpose. Later the feedback of the users can be recorded to identify the usability issues and resolve them.

6.1.3 Download Testing:

Download testing is performed to determine the behaviour of an application under normal load and the expected peak load conditions.

6.1.4 Performance Testing:

Performance testing is well-defined as a test of an application to determine how a system enters in terms of awareness and stability under a particular amount of work.

6.1.5 Security Testing:

Security testing is well-defined as the test of an application to determine that an information system protects its data or not. Some basic concepts in security testing are:

- Confidentiality
- Verification
- Integrity
- Availability
- Verification

6.1.6 Installation of Testing:

Installation testing is a process in which the tester software installs on the platform on which it was installed. This app has been tested on different computers. The program has been installed and successfully executed.

6.2 Test Cases:

Test cases are basically a few conditions or scenarios that ensure that the system works correctly.

6.2.1 Installation of testing:

| | |
|----------------------|--|
| Test Case Id | TC-1 |
| Unit of Test | The test is used to verify the installation of Application |
| Pre-Req | <ul style="list-style-type: none"> • Personal Computer / Laptop • Core i5 processor or more |
| Steps to be Executed | <ul style="list-style-type: none"> • Save the whole folder having system files • Run the.Exe file and run as Administrator • Follow the instruction and complete the installation |
| Expected Result | The application should be installed successfully |
| Actual Result | Application successfully installed |

| | |
|---------------|-------------|
| Status | Pass |
|---------------|-------------|

Table 6.2.1: Installtion Of Testing

| | |
|----------------------|--|
| Test case ID | TC-1.1 |
| Unit of Test | The test is used to confirm the installation of Application |
| Pre-Req | <ul style="list-style-type: none"> • Personal Computer / Laptop • Core i5 processor or more |
| Steps to be Executed | <ul style="list-style-type: none"> • Save the whole folder having system files • Run the.Exe file and run as Administrator • Follow the instruction and complete the installation |
| Expected Result | The application should installed successfully |
| Actual Result | Application successfully installed |
| Status | pass |

Table 6.2.1: Installtion Of Testing

6.2.2 Admin login Test Case:

| | |
|----------------------|--|
| Test Case ID | TC 2 |
| Unit of Test | The test is used to confirm the admin login |
| Pre- Req | <ul style="list-style-type: none"> • The home server must be started • Listening to incoming connection continuously |
| Steps to be Executed | <ul style="list-style-type: none"> • Start the application • Enter user name/password • Click Login button |
| Expected Result | Admin should login in to Application |
| Actual Result | Admin successfully login into the application |
| Status | Pass |

Table 6.2.2: Admin Login Test Case

| | |
|----------------------|---|
| Test Case ID | TC 2-1 |
| Unit of Test | The test is used to confirm the admin login |
| Pre- Req | <ul style="list-style-type: none"> • The web server must be started • Listening to incoming connection continuously |
| Steps to be Executed | <ul style="list-style-type: none"> • Start the application • Enter user name/password • Click Login button |
| Expected Result | Admin should login into Application |
| Actual Result | Admin was unable to login into the application |
| Status | Fail |

Table 6.2.2: Admin Login Test Case

6.2.3 Data Storage:

| | |
|----------------------|---|
| Test Case ID | TC 3 |
| Unit of Test | Checking if the application sends data to its database |
| Pre-Req | <ul style="list-style-type: none"> • The application must be running • The application server must be working |
| Steps to be Executed | <ul style="list-style-type: none"> • Start web application • Check Database |
| Expected Result | The application should send data to the database for storage |
| Actual Result | Data stored in database successfully |
| Status | Pass |

Table 6.2.3: Data Storage Test Case

| | |
|----------------------|--|
| Test Case ID | TC 3-1 |
| Unit of Test | Checking if the application sends data to its database |
| Pre-Req | <ul style="list-style-type: none"> • The application must be running • The application server must be working • The database server must be working |
| Steps to be Executed | <ul style="list-style-type: none"> • Start web application • Check database |
| Expected Result | The application should send data to the database for storage |
| Actual Result | Unable to store database successfully |
| Status | Fail |

Table 6.2.3: Data Storage Test Case

6.2.4 Uninstalling Application:

| | |
|----------------------|--|
| Test Case ID | TC 4 |
| Unit of Test | Checking if the application can be uninstalled from the device |
| Pre-Req | The application must be installed |
| Steps to be Executed | Uninstall from a personal computer |
| Expected Result | Application must uninstall |
| Actual Result | Application uninstalled successfully |
| Status | Pass |

Table 6.2.4: Uninstalling Application Test Case

| | |
|----------------------|--|
| Test Case ID | TC 4-1 |
| Unit of Test | Checking if the application can be uninstalled from the device |
| Pre-Req | The application must be installed |
| Steps to be Executed | Uninstall from a personal computer |
| Expected Result | Application must uninstall |
| Actual Result | Application uninstalled successfully |
| Status | Fail |

Table 6.2.4: Uninstalling Application Test Case

Chapter:7

CONCLUSION

7.1 Conclusion:

My project is an industrial base project. The purpose of implementation this system is to handle a large amount of data received by Wapda to PTV Headquarter Islamabad. In this system,the TV fee is collected by PTV Headquarter from all over Pakistan. Different reports are generated by the user. This system is desktop based as well as web-based system. I use ASP.Net language to make a front-end of this system and use SQL Server on the back-end to store a large amount of data. With time, with the introduction of new technology, changes occur in applications. The basic version of this application has been developed by me but there is a long way to improve this application and more user-friendly and easy to use.More, I learnt short term project project planning and implementation which includes:

- Gathering Requirements
- System Design
- Implementation and basic functional and quality testing
- GUI Design
- Interaction with different tools and technologies
- Time Management

It was because of the blessings of Allah Almighty and the prayer of our love that we have achieved.

7.2 Future Work:

Another important thing to do will connect this program to Cloud Database, as we know that Cloud computing is the current era, and the conversion of normal database to Cloud Database will be good for application, especially for data management.

References:

- [1] "SATKurier.pl / TVP / Kosztzizyski TVP jakotelewizijpublicznej". *Satkurier.pl*. Retrieved 12 July 2015.
- [2] "AsiaMedia:: PAKISTAN: PTV to earn Rs4bn through licence fee: New collection system". *Asiamedia.ucla.edu*. 15 June 2004. Archived from the original on 17 September 2011. Retrieved 13 January 2011.
- [3] https://en.wikipedia.org/wiki/Television_licence#cite_note-ectt-cets-132-2
- [4] Beame, Paul; Fich, Faith E. (2001). "Optimal bounds for the predecessor problem and related problems". *Journal of Computer and System Sciences*. **65** (1): 38–72. doi:10.1006/jcss.2002.1822. Archived from the original on 6 March 2017. Retrieved 3 April 2016.
- [5] Sedgewick & Wayne 2011, §3.2 ("Binary Search Trees"), subsection "Order-based methods and deletion"
- [6] Knuth 1998, §5.4.9 ("Disks and Drums")