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Call Center Management System

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Abstract: **Call Center Management System is an increasingly important skill as the use of call centers becomes a popular method of centralizing information services, streamlining order taking and providing valuable customer support. The skills required to successfully set -up and manage a call center encompasses everything from staff recruitment and personnel management, to technical understanding of the options available, and the al-important customer relationship management. From small customer service departments to large call centers, the importance of developing successful call center management is vital for building a valued relationship with the customers to support long- term business growth.**

This system (Call Center Management System) is useful to the organization, it maintains the information about the employees and it also contains the necessary information of the customer and their phone Numbers, their services also. It also maintains the employee roaster details.

This system will track the employee's login details. And also maintains the data the employee attends the call and his behavior with customer and the speech will be recorded into file. Sometimes customer request for service to the organization. This data also maintains the system.

Keywords: **Administrator, Availability, Confidentiality, Computer, Cyber, Debug, Employee, Implementation, Password, Privacy, Security, Testing, Username.**

1. INTRODUCTION

1.1 Introduction to Project:

In the final year of study at Information and Communications University, every student is required to come up with a project in a given area of research. I am a student in the Information and Communications Technology field of study and majoring in Communications Technology, and I have decided to come up with a Call Center Management System Project, specifically for the Zambia Telecommunications Company limited (Zamtel) Call Center, which is one of the Telecommunications Service providers in Zambia which has the unique mix of providing a total service solution to its customers i.e. GSM Mobile Services, Internet Service Provider Services and Fixed Lines Services. Hence because of the range of services Zamtel provides it users it need to have a robust and responsive Call Center Management System.

1.2 Purpose of the System:

A call center is a centralized office used for the purpose of receiving and transmitting large volume of requests by telephone. A call center is operated by an organization to administer incoming product support or information inquiries from consumers. Outgoing calls for telemarketing, clientele, product services, and debt collections are also made. In addition to the call center, collective handling of faxes, live chats, and e-mails at one location to be known as a contact center.

A call center is often operated through an extensive open work space for call center employee, with workstations that include a computer for each call center agent; telephone set / handset is connected to a telecomm switch, and one or more supervisor stations.

1.3 Problems in the existing system:

➢ The existing system is a manual system. Here the employees need to save their work and information on the excel sheets or external pens and disk drives.

- The existing systems have no file share which make the sharing of data impossible, if data is in form of paper and is on disk drives.
- The manual system gives us very less security for saving data; some data may be lost due to mismanagement.
- It is a limited system and it is not user friendly.
- Searching for particular information which is very critical takes a lot of time.
- It is very critical to maintain call records in the call center, but it become difficult to maintain call records when you are using a manual system. Because a call center receives huge number of calls per day.
- It is a tedious job to maintain different customer services who are asking for different services details, normally to solve this type of queries is not possible. That is why an automated system is needed.
- Every employee having different roasters, different shift timings, manually to handle these roaster is tough work.
- Searching for an employee roaster in call center system is a tedious job.

1.4 Solutions to these problem:

The development of this new call center management system contains the following activities, which will try to automate the entire process keeping in the view of database integration approach.

- User friendliness is provided in the application with various controls provided by system rich user interface.
- The system makes the overall project management much easier and flexible.
- This new call center management system call can be assessed over a corporate intranet.
- The user information can be stored in a centralized database which can be maintained by the system.
- This can give good security for user information because data is not on the client machine.
- Authentication is provided for this application only registered users can have access.
- There is no risk of data management at any level while the project development is under way.
- The automated system will provide to the customers' reliable services.
- The speed and accuracy of this system will improve more and more.

2. SYSTEM DESIGN

2.1 Introduction:

After analyzing the requirements of the task to performed, the next step is to analyze the problem and understand its context. The first activity in the phase is studying the existing system and the other is to understand the requirements and the domain of the new system. Both these activities are equally important, but the first activity serves as a basis of giving functional specifications and then successful design of the proposed system. Understanding the properties and requirements of a new systems is more difficult and requires creative thinking and understanding of the existing running system is also difficult, improper understanding of the present system can lead can to divert from the solution.

2.2 Analysis Model:

SDLC Methodologies:

This document plays a vital role in the development of life cycle (SDLC) as it describes the complete requirements of the system. It means for use by developers and will be the basic during testing phase. Any changes made to the requirements in the future will have to go through formal change approval process.

SPIRAL MODEL was defined by Barry Boehm in his 1988 article, "A spiral model of software development and enhancement. This model was not the first model to discuss iterative development. But it was the first model to explain why the iteration models.

As originally envisioned, the iteration were typically 6 months to 2 years long. Each phase starts with a design goal and ends with the client reviewing the progress thus far. Analysis and engineering efforts are applied at each phase of the project, with an eye towards the end goal of the project.

The steps for spiral model can be generalized as follows:

➢ The new system requirements are defined in as much details as possible.

This usually involves interviewing a number of users representing all the external and internal users and other aspects of the existing system.

➢ A preliminary design is created for the new system.

➢ A first prototype of a new system is constructed from the preliminary design. This is usually a scale-down system, and represents an approximation of the characteristics of the final product.

➢ A second prototype is evolved by a fourfold procedure:

- Evaluating the first prototype in terms of its strengths, weakness, and risks.
- Defining the requirements of the second prototype.
- Planning and designing the second prototype.
- Constructing and testing the second prototype.

➢ At the customer option, the entire project can be aborted if the risk is deemed too great. Risk factors might involve development cost overruns, operating-costs miscalculations, or any other factor that could, in the customer's judgement, result in a less- then-satisfactory final product.

➢ The existing prototype is evaluated in the same manner as was the previous prototype, and if necessary, another prototype is developed from it according to the fourfold procedure outline above.

➢ The preceding steps are iterated until the customer is satisfied that the refined prototype represents the final products desired.

➢ The final system is constructed, based on the refined prototype.

➢ The final system is thoroughly evaluated and tested. Routine maintenance is carried on a continuous basis to prevent large scale failures and to minimize on downtime.

The following diagram show how a spiral model act like:

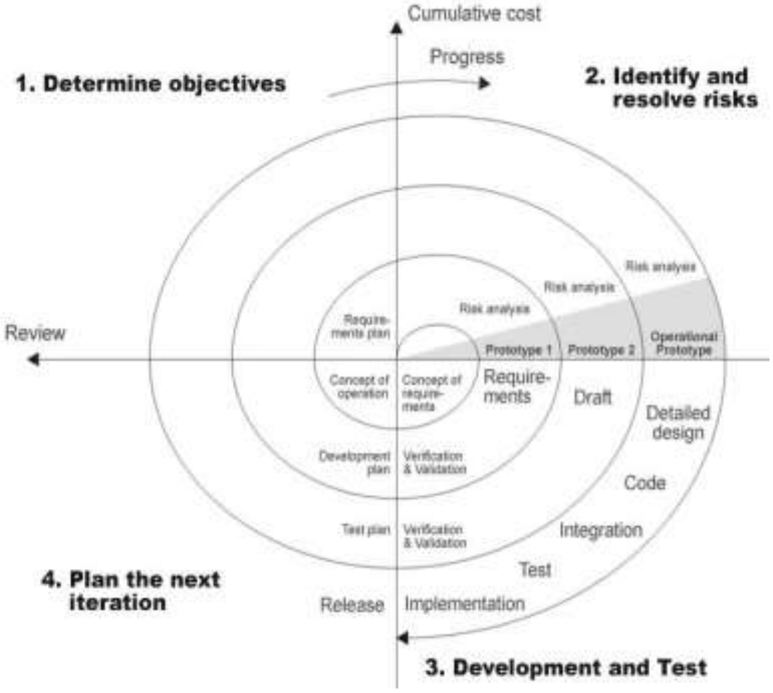


Fig 1.0 -Spiral Model

2.3 STUDY OF THE SYSTEM:

The system is flexible to the users and the system interface has been developed with a graphics concept in mind, associated through a browser interface. The Graphical User Interface at the top level has been categorized as

1. Administrative User Interface

2. The Operational or Employee User interface

The Administrative User Interface concentrates on the consistent information that is practical, part of the organizational activities which needs proper authentication for data collection. The interfaces help the administrator with all the transactional states like Data insertion, Data deletion, Data updating along with extensive data search capabilities.

The Operational or Employee user interface helps the users upon the system in transactions through the existing data and required services. The operational user interface also helps the ordinary users in managing their own information in a customized manner as per the assisted flexibilities.

NUMBER OF MODULES:

The system after careful analysis has been identified to presented with the following modules;

1. Administrator
2. Call Center Employee
3. Customers
4. Services
5. Employee Roasters
6. Reports

Administrator:

Administrator is the chief of the Call Center System Management. He can have all the privileges to anything in this system. Administrator can register new employees, and departments into the system, Administrator can keep track of employee's activities and their performance. For every call received the Administrator is taking feedback report. New services are introduced by the administrator into the Call Center Management System. Call activity done by the administrator, for every call the administrator captures the information of call id, date, time, attended employee id, his roaster id, customer information and recording voice.

Call Center Employees:

Here a term employee means they are maintaining the Call center, the major responsibility for the Call Center Employees is they have to receive the calls from the customers and process the customer's queries. The main issue is it is here the Call Center employee can give necessary answer to customer queries, because different customers are posting various services queries.

Customers:

Customers in the sense of service holders and users, while using the products and services the customers may/have to face any problem then they will automatically have to call the call center to login/ report their queries and find a solution.

Services:

Customer services also known as client services is the provision of service to customers before, during and after purchase of the services. Customer services is a series of activities designed to enhance a of level customer satisfaction. Here customer services maybe provided by a call center personal. Customer service is an integral part of a company's value proportions services in the sense of;

1. Clarifying the customer doubts

2. Processing the customer queries

3. Assigning new services to the customers

Employee Roasters:

The maintenance of employee roasters in a call center is a tough and tedious job. Every roaster has three shifts, roaster has a starting date and ending date and an in charge person will be there for every roaster. Call center employees need to follow their roaster and shifts; every roaster has holidays also. Administrator can keep track of employee's roaster and shifts means employees login date and time, and Log off date and time.

2.4 SYSTEM REQUIREMENTS SPECIFICATIONS:

Hardware Requirements:

- PIV 2.8 GHz processor and above
- RAM 1GB and above
- HDD 80GB hard disk space and above.

Software Requirements:

- Windows OS (7,8,8.1, and 10)
- Windows Server (2008,2008R2, 2012)
- Visual Studio .Net (2008/2012/2013 enterprise edition)
- Internet Information Server 6.0(IIS)
- Visual Studio .Net Framework (Minimal Deployment) version 3.5/4.5
- SQL Server 2008/2012 enterprise edition.

2.5 PROPOSED SYSTEM:

To debug the existing, the system, remove procedures that cause data redundancy, make navigational sequence proper. To provide information about users on different levels and also to reflect the current work status depending on organization. To build strong password mechanism.

NEED FOR COMPUTERIZATION:

We all know the importance of computerization, this world is moving ahead at a lightning speed and everyone is running short of time. One always wants to get the information and perform a task he/she/they desire(s) within a short period of time and too with amount of efficiency and accuracy. The application areas of computerization have been selected on the basis of the following factors:

- Minimizing the manual records kept at different location
- There will be more data integrity
- Facilitating desired information display, very quickly, by retrieving information from users.
- To reduce manual efforts in activities that involve repetitive work.
- Facilitating various statistical information which helps with decision-making?
- Updating and deletion of such Hugh amounts of data will be easier.

FUNCTIONAL FEATURES OF THE MODEL:

As far as the project is developed the functionality is simple, the objective of the proposal is to strengthen the functioning of Audit Status Monitoring and make them effective and better. The entire scope has been classified into five streams knowns as coordinator level, management level, Auditor level, User level, State Web level. The proposed software will cover the information needs with respect to each request of the user group viz. accepting the request, providing vulnerability document report and the current status of audit.

2.6 INPUT AND OUTPUT:

Inputs:

- Admin enter his user id and password for login.
- User enters his id and password for login.
- Admin enter user id or date for track the user login information
- New users give his/her completed personnel, address and phone details for registration.
- Admin gives different kind of user information to search the user data.
- User gives his/her id, hint question, answer for getting the forgotten password.
- Employee asking customer service details before they process the queries.
- Employee search the customer information while processing the queries.

Outputs:

- Admin can have his own home page.
- User enter their own home page.
- The user defined data can be stored in the centralized database.
- Admin will get the login information for a particular user.
- The new user's information will be stored in the centralized database.
- Admin get the search details of different criteria.
- User can his forgotten password

2.7 PROCESS MODEL USED WITH JUSTIFICATION:

ACCESS CONTROL FOR DATA WHICH REQUIRE USER AUTHENTICATION:

The following commands specify access control identifiers and they are typically used to authorize and authenticate the users (command codes are shown in parentheses)

USERNAME (USER):

The user identification is that which is required by the server to have access to its file system. This command will normally be the first command transmitted by the user after the connection controls are made (some server may require this).

PASSWORD (PASS):

This command must be immediately preceded by the username command, and, for some sites, completes user identification for access control. Since password information is quite sensitive, it is desirable in general to "mask" it or suppress type out.

3. FEASIBILITY REPORT

Preliminary investigations examine project feasibility, the likelihood that the system will be useful to the organization. The main objective of the feasibility study is to test Technical, Operational and Economical feasibility for adding new modules and debugging old running system. All systems are feasible if they are unlimited resources and infinite time. There are aspects in the feasibility study portion of the preliminary investigations:

- Technical Feasibility.
- Operational Feasibility.
- Economic Feasibility.

3.1 TECHNICAL FEASIBILITY:

The Technical issues usually raised during the feasibility stage of the investigations include the following:

- Does the necessary technology exist to do what it suggested?
- Do the proposed equipment have the technical capacity to hold the data required to use the new system?
- Will the proposed system provide adequate response to inquiries, regardless of the number or locations of users?
- Can the system be upgraded if developed?
- Are they technical guarantees of accuracy, reliability, ease of access and data security?

Earlier no system existed to cater to the needs of 'Secure Infrastructure Implementation System'. The current system developed is technically feasible, it is a web based user interface for audit work flow at Zamtel. Thus it provides an easy access to users. The database's purpose is to create, establish and maintain a workflow among various entities in order to facilitate all concerned users in their various capacities or roles. Permissions to the users would be granted based on the roles specified. Therefore, it provides technical guarantee of accuracy, reliability and security. The software and hardware requirements for the development of this project are not many and are already available in-house at Zamtel or are available as a free open source. The work for the project is done with the current equipment and existing software technology. Necessary bandwidth exists for providing a fast feedback to the user irrespective of the number of users using the system.

3.2 OPERATIOAL FEASIBILITY:

The proposed projects are beneficial only if the can be turned out into information systems. That will meet the organization's operating requirements, operational feasibility aspects of the project are to taken as an important part of the project implementation. Some of the important issues raised are test the operational feasibility of a project includes the following:

- Is there sufficient support for the management from the user?
- Will the system be used and work properly if it is being developed and implemented?
- Will there be any resistance from the users that will undermine the possible applications benefit?

This system is targeted to be in accordance with the above mentioned issues. Beforehand, the management issues and user requirements have been taken into consideration. So there is no question of resistance from the users that can undermine the possible application benefits.

The well-planned design would ensure the optimal utilization of the computer resources and would help in the improvement of performance status.

3.3 ECONOMICAL FEASIBILITY:

A system can be developed technically and that will be used if installed must still be a good investment for the organization. In the economical feasibility, the development cost in creating a new system is evaluated against the ultimate benefit derived from the new systems. Financial benefits must equal or exceed the costs.

The system is economically feasible if it does not require any addition hardware and software, Since the interface of the system is developed using existing resources and technologies available at Zamtel, there is a nominal expenditure and economical feasibility for certain.

4. SOFTWARE REQUIREMENTS SPECIFICATION

The software, site explorer is designed for management of web sites from a remote location.

INTRODUCTION:

Purpose: The main purpose for preparing this document is to give a general insight into the analysis and requirements of the existing system or situation and for determining the operating characteristics of the system.

Scope: This document plays a vital role in the development life cycle (SDLC) and it describes the complete requirements for the system. It is meant for use by developers and will be the basis during testing phrase. Any changes made to requirements in future will have to go through formal change approval process.

DEVELOPER RESPONSIBILITIES AND OVERVIEW:

The developer is responsible for:

- Developing the system, which meets the SRS and solving all the requirements of the system?
- Demonstrating the system and installing the system at client's location after the acceptance testing is successful.
- Submitting the required user manual describing the system's interfaces to work on it and also the documents of the system.
- Conducting any user training that may be needed for using the system.
- Maintaining the system for a period of one year after installation.

4.1 FUNCTIONAL REQUIREMENTS

OUTPUT DESIGN:

Outputs from computer systems are required primarily to communicate the results of processing to users. They are also used to provide a permanent copy of the results for later consultations. The various type of outputs in general are:

- External outputs, whose destination is outside the organization.
- Internal outputs, whose destination is within the organization and they are the user's main interface with the computer.
- Operational outputs, whose use is purely within the computer department.
- Interface outputs, which involve the user in communicating directly.

OUTPUT DEFINITION:

The outputs should be defined in terms of the following points:

- Type of the output
- Content of the output
- Format of the output
- Location of the output
- Frequency of the output
- Volume of the output
- Sequence of the output

It is not always desirable to print or display data as it is held on a computer. It should be decided as which form out is the most suitable.

For example

- Will decimals points need to inserted?
- Should leading zeros be suppressed.

OUTPUT MEDIA:

In the next stage it is to be decided which medium is the most appropriate for the output. The main considerations when deciding about the output media are:

- The suitability for the device to the particular application.

- The need for a hard copy.
- The response time required.
- The Locations of the users.
- The software and hardware available.

Keeping in view the above description the project is to have outputs mainly coming under the category of internal outputs. The main outputs desired according to the requirements specifications are:

- The outputs where needed to be generated as a hot copy and as well as a query to viewed on the screen. Keeping in view these outputs, the format for the output is taken from the outputs which are currently being obtained after manual processing. The standard printer is to be used as out media for hard copies.

INPUT DESIGN

Input design is a part of overall system design. The main objective during the input design is as given below:

- To produce a cost-effective method of input.
- To achieve the highest possible level of accuracy.
- To ensure that the input is acceptable and understood by the user.

INPUT DESIGN:

The main input stages can be listed as below:

- Data recording.
- Data transcription.
- Data conversion.
- Data verification.
- Data control
- Data transmission.
- Data validation
- Data correction

INPUT TYPES:

It is necessary to determine the various type of inputs. Inputs can be categorized as follows:

- External inputs, which are prime inputs for the system.
- Internal inputs, which are user communications with the system.
- Operational, which computer are computer department’s communications to the system.
- Interactive, which are inputs entered during a dialogue.

INPUT MEDIA:

At this stage a choice has to be made about the input media. To conclude about the input media consideration has to be given to;

- Type of input
- Flexibility of format
- Speed
- Accuracy
- Verification methods

- Rejection rates
- Ease of correction
- Storage and handling requirements
- Security
- Easy to use
- Portability

Keeping in view the above description of the input types and input media, it can be said to that most of the inputs are of the form of internal and interactive. As input data is to the directly keyed in by the user, the keyboard can be considered to be the most suitable device.

ERROR AVOIDANCE:

At this stage care is to be taken to ensure that the input data remains accurate from the stage it is recorded up to the stage in which data is accepted by the system. This can be achieved only by careful control each time data is handled.

ERROR DETECTION:

Even though every effort is make to avoid the occurrence of errors, still a small proportion of errors is always likely to occur, these types of errors can be discovered by using validations to check the input data.

DATA VALIDATION:

Procedures are designed to detect errors in data at lower level of detail. Data validations have been included in the system in almost every area where there is a possibility for the user to commit errors. The system will not accept invalid data; whenever invalid data is keyed in the system immediately prompts the user and the user has to again key in the data and the system will only accept the data if it is correct. Validations have been included where necessary.

The Call Center Management System is designed to be user friendly one, in other words the call center management system has been designed to communicate effectively with the user. The system has been designed with popup menus.

USER INTERFACE DESIGN:

It is essential to consult the system users and discuss their needs while designing the user interface.

USER INTERFACE SYSTEMS CAN BE BROADLY CLASSIFIED AS:

- User initiated interface the user is in charge, controlling the progress of the user/system dialogue. In the computer initiated interface, the computer selects the next stage in the interaction.

- Computer initiated interface, in the computer initiated interfaces the computer guides the progress of the user/system dialogue. Information is displayed and the user response of the computer takes action or displays further information.

USER INITIATED INTERFACES

User initiated interfaces fall into two approximate classes:

- Command driven interfaces: in this types of interface the user inputs commands or queries which are interpreter by the computer.

- Forms oriented interfaces: the user calls up an image of the form to his/her screen and fills in the form. The form oriented interface is chosen because it is the best choice.

COMPUTER INITIATED INTERFACES:

The following computer initiated interfaces were used:

- The menu system for the user is presented with a list of alternatives and the user chooses one; of the alternatives.

- Questions – answer type dialogue system where the computer asks questions and takes action on the based on the basis of the user reply.

Right from the start the system is going to be menu driven, the opening menu displays the available options. Choosing one option gives another popup menu with more options. In this way every option leads the user to data entry form where the user can key in the data.

ERROR MESSAGE DESIGN:

The design of errors is an important part of the user interface design. As users is bound to commit some errors, therefore while designing a system the system should be designed to be helpful by providing the user with information regarding the error he/she has committed.

4.2 PERFORMANCE REQUIREMENTS:

Performance is measured in terms of the output provided by the application.

Requirements specifications plays an important part in the analysis of a system. Only when requirements specifications are properly given, it is possible to design a system, which will fit into the required environment. It rests largely in the part of the users of the existing system to give the requirements specifications because they are the people who finally use the system. This is because the requirements have to be known during the initial stages so that the system can be designed according to those requirements. It is very difficult and costly to keep on changing the system once it has been designed and on the other hand designing a system, which does not cater to the requirements of the user, is of no use.

The requirements specifications of any system can be broadly stated as given below:

- The system should be able to interface with the existing system.
- The system should be accurate
- The system should be better than the existing

The existing system is completely dependent on the user to perform all the duties.

5. SELECTED SOFTWARE

5.1 INTRODUCTION TO .NET FRAMEWORK:

The Microsoft .NET framework is a software technology that is available with several Microsoft windows operating systems. It includes a large library of pre-coded solutions to common programming problems and a virtual machine that manages the executions of programs written specifically for the framework. The .Net framework is a key Microsoft is offering and is intended to be used by newest applications created for windows platform.

The pre-coded solutions that form the framework's base class library cover a large range of programming needs in a number of areas, including user interface, data access, database connectivity, cryptography, web applications development, numeric algorithms and network communications. The class library is used by programmers, who combine it with own code to produce applications.

Programs written for the .NET framework execute in a software environment that manages the program runtime requirements. Also part of the .NET framework, this runtime environment is known as the Common Language Runtime (CLR). The CLR provides the appearance of an application virtual machine so that programmers need not to consider the capabilities of the specific CPU that will execute the program. The CLR also provides other important services such as security, memory management, and exception handling. The class library and the Common Language Runtime(CLR) together compose the .NET framework.

Principal Design features:

Interoperability:

Because interaction between older and new applications is commonly required, the .NET framework provides means to access functionalities that is implemented in the programs that are executed outside the .NET framework environment. Access to Com component is provided in the System Runtime Interop Services and System Enterprise Services namespaces of the framework; access to other functionality is provided using the P/invoke features.

Common Runtime Engine:

The common language runtime (CLR) is the virtual machine components the .NET framework. All .NET programs execute under the supervision of the CLR, guaranteeing certain properties and behavior in the areas of memory management, security, and exception handling.

Base Class library:

The base class library (BCL), part of the framework class library (FCL), is a library of functionality available to all languages using the .NET framework. The (BCL) provides classes which encapsulates a number of common functions, including file reading and writing, graphic rendering, database interaction and XML documents manipulations.

Simplified Deployment:

Installations of computer software must be carefully managed to ensure that it does not interfere with previous installed software, and that it conforms to security requirements. The .NET framework includes design features and tools that help address these requirements.

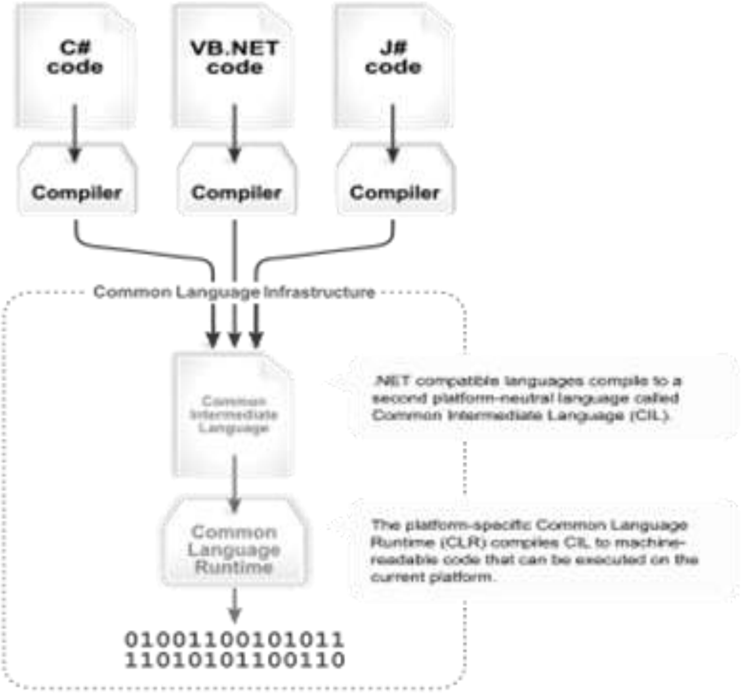
Security:

The design is meant to address some of the vulnerabilities, such as buffer overflows, that have been exploited by malicious software. Additionally, .NET provides a common security model for all applications.

Portability:

The design of the .NET framework allows it to theoretically be platform agnostic, and thus cross-platform compatible. That is, a program written to used framework should run without change on any type of system on which the framework is implemented. Microsoft commercial implementations of the framework cover Windows, Windows CE, and the Xbox. In addition, Microsoft submits the specifications for the common language infrastructure (which includes the core class libraries, common type system and the common immediate language), the C# language, and the C++/CLI language to both ECMA and the ISO, making them available as open standards. This makes it possible for third parties to create compatible implementations of the framework and it languages on other platforms.

Architecture:



.NET compatible languages compile to a second platform-neutral language called Common Intermediate Language (CIL).

The platform-specific Common Language Runtime (CLR) compiles CIL to machine-readable code that can be executed on the current platform.

Visual overview of the common language Infrastructure (CLI)

Common Language Infrastructure:

The core aspects of the .NET framework lie within the common language infrastructure, or CLI. The purpose of the CLI is to provide a language neutral platform for application development and execution, including functions for exception handling, garbage collection, security, and interoperability. Microsoft implementation of the CLI is called Common Language Runtime or CLR.

Assemblies:

The intermediate CIL code is housed in .NET assemblies. As mandated by specification, assemblies are stored in the Portable Executable (PE) format, common on the Windows platform for all DLL and EXE files. The assembly consists of one or more files, one of which must contain the manifest, which has the metadata for the assembly. The complete name of an assembly (not to be confused with the filename on disk) contains its simple text name, version number, culture, and public key token. The public key token is a unique hash generated when the assembly is compiled, thus two assemblies with the same public key token are guaranteed to be identical from the point of view of the framework. A private key can also be specified known only to the creator of the assembly and can be used for strong naming and to guarantee that the assembly is from the same author when a new version of the assembly is compiled (required to add an assembly to the Global Assembly Cache).

Metadata:

All CLI is self-describing through .NET metadata. The CLR checks the metadata to ensure that the correct method is called. Metadata is usually generated by language compilers but developers can create their own metadata through custom attributes. Metadata contains information about the assembly, and is also used to implement the reflective programming capabilities of .NET Framework.

Security:

.NET has its own security mechanism with two general features: Code Access Security (CAS), and validation and verification. Code Access Security is based on evidence that is associated with a specific assembly. Typically, the evidence is the source of the assembly (whether it is installed on the local machine or has been downloaded from the intranet or Internet). Code Access Security uses evidence to determine the permissions granted to the code. Other code can demand that calling code is granted a specified permission. The demand causes the CLR to perform a call stack walk: every assembly of each method in the call stack is checked for the required permission; if any assembly is not granted the permission a security exception is thrown.

When an assembly is loaded the CLR performs various tests. Two such tests are validation and verification. During validation the CLR checks that the assembly contains valid metadata and CIL, and whether the internal tables are correct. Verification is not so exact. The verification mechanism checks to see if the code does anything that is 'unsafe'. The algorithm used is quite conservative; hence occasionally code that is 'safe' does not pass. Unsafe code will only be executed if the assembly has the 'skip verification' permission, which generally means code that is installed on the local machine.

.NET Framework uses app domains as a mechanism for isolating code running in a process. App domains can be created and code loaded into or unloaded from them independent of other appdomains. This helps increase the fault tolerance of the application, as faults or crashes in one appdomain do not affect rest of the application. Appdomains can also be configured independently with different security privileges. This can help increase the security of the application by isolating potentially unsafe code. The developer, however, has to split the application into sub domains; it is not done by the CLR.

Class library

Namespaces in the BCL
System
System. CodeDom
System. Collections
System. Diagnostics

System. Globalization System. IO System. Resources System. Text System.Text.RegularExpressions

Microsoft **.NET Framework** includes a set of standard **class libraries**. The class library is organized in a hierarchy of namespaces. Most of the built in APIs are part of either System.* or Microsoft.* namespaces. It encapsulates a large number of common functions, such as file reading and writing, graphic rendering, database interaction, and XML document manipulation, among others. The .NET class libraries are available to all .NET languages. The .NET Framework class library is divided into two parts: the **Base Class Library** and the **Framework Class Library**.

The **Base Class Library** (BCL) includes a small subset of the entire class library and is the core set of classes that serve as the basic API of the Common Language Runtime. The classes in mscorlib.dll and some of the classes in System.dll and System.core.dll are considered to be a part of the BCL. The BCL classes are available in both .NET Framework as well as its alternative implementations including .NET Compact Framework, Microsoft Silver light and Mono.

The **Framework Class Library** (FCL) is a superset of the BCL classes and refers to the entire class library that ships with .NET Framework. It includes an expanded set of libraries, including Win Forms, ADO.NET, ASP.NET, Language Integrated Query, Windows Presentation Foundation, Windows Communication Foundation among others. The FCL is much larger in scope than standard libraries for languages like C++, and comparable in scope to the standard libraries of Java.

Memory management:

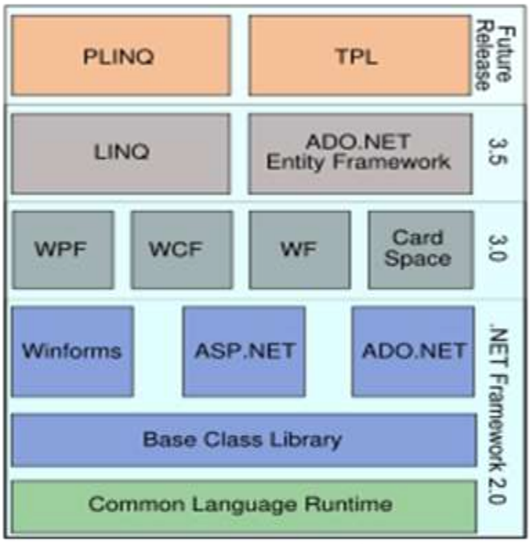
The .NET Framework CLR frees the developer from the burden of managing memory (allocating and freeing up when done); instead it does the memory management itself. To this end, the memory allocated to instantiations of .NET types (objects) is done contiguously from the managed heap, a pool of memory managed by the CLR. As long as there exists a reference to an object, which might be either a direct reference to an object or via a graph of objects, the object is considered to be in use by the CLR. When there is no reference to an object, and it cannot be reached or used, it becomes garbage. However, it still holds on to the memory allocated to it. .NET Framework includes a garbage collector which runs periodically, on a separate thread from the application's thread, that enumerates all the unusable objects and reclaims the memory allocated to them.

The .NET Garbage Collector (GC) is a non-deterministic, compacting, mark-and-sweep garbage collector. The GC runs only when a certain amount of memory has been used or there is enough pressure for memory on the system. Since it is not guaranteed when the conditions to reclaim memory are reached, the GC runs are non-deterministic. Each .NET application has a set of roots, which are pointers to objects on the managed heap (*managed objects*). These include references to static objects and objects defined as local variables or method parameters currently in scope, as well as objects referred to by CPU registers. When the GC runs, it pauses the application, and for each object referred to in the root, it recursively enumerates all the objects reachable from the root objects and marks them as reachable. It uses .NET metadata and reflection to discover the objects encapsulated by an object, and then recursively walk them. It then enumerates all the objects on the heap (which were initially allocated contiguously) using reflection. All objects not marked as reachable are garbage. This is the *mark* phase. Since the memory held by garbage is not of any consequence, it is considered free space. However, this leaves chunks of free space between objects which were initially contiguous. The objects are then *compacted* together, by using memory ^{to} copy them over to the free space to make them contiguous again. Any reference to an object invalidated by moving the object is updated to reflect the new location by the GC. The application is resumed after the garbage collection is over.

The GC used by .NET Framework is actually *generational*. Objects are assigned a *generation*; newly created objects belong to *Generation 0*. The objects that survive a garbage collection are tagged as *Generation 1*, and the Generation 1 objects that survive another collection are *Generation 2* objects. The .NET Framework uses up to Generation 2 objects. Higher generation objects are garbage collected less frequently than lower generation objects. This helps increase the efficiency of garbage collection; as older objects tend to have a larger lifetime than newer objects. Thus, by removing older (and thus more likely to survive a collection) objects from the scope of a collection run, fewer objects need to be checked and compacted.

Versions:

Microsoft started development on the .NET Framework in the late 1990s originally under the name of Next Generation Windows Services (NGWS). By late 2000 the first beta versions of .NET 1.0 were released.



The .NET Framework Stack

The **.NET Framework** stack

Version	Version Number	Release Date
1.0	1.0.3705.0	2002-01-05
1.1	1.1.4322.573	2003-04-01
2.0	2.0.50727.42	2005-11-07
3.0	3.0.4506.30	2006-11-06
3.5	3.5.21022.8	2007-11-09

5.2 ASP.NET:

SERVER APPLICATION DEVELOPMENT:

Server-side applications in the managed world are implemented through runtime hosts. Unmanaged applications host the common language runtime, which allows your custom managed code to control the behavior of the server. This model provides you with all the features of the common language runtime and class library while gaining the performance and scalability of the host server.

The following illustration shows a basic network schema with managed code running in different server environments. Servers such as IIS and SQL Server can perform standard operations while your application logic executes through the managed code.

SERVER-SIDE MANAGED CODE:

ASP.NET is the hosting environment that enables developers to use the .NET Framework to target Web-based applications. However, ASP.NET is more than just a runtime host; it is a complete architecture for developing Web sites and Internet-distributed objects using managed code. Both Web Forms and XML Web services use IIS and ASP.NET as the publishing mechanism for applications, and both have a collection of supporting classes in the .NET Framework.

XML Web services, an important evolution in Web-based technology, are distributed, server-side application components similar to common Web sites. However, unlike Web-based applications, XML Web services components have no UI and are not targeted for browsers such as Internet Explorer and Netscape Navigator. Instead, XML Web services consist of reusable software components designed to be consumed by other applications, such as traditional client applications, Web-based applications, or even other XML Web services. As a result, XML Web services technology is rapidly moving application development and deployment into the highly distributed environment of the Internet.

If you have used earlier versions of ASP technology, you will immediately notice the improvements that ASP.NET and Web Forms offers. For example, you can develop Web Forms pages in any language that supports the .NET Framework. In addition, your code no longer needs to share the same file with your HTTP text (although it can continue to do so if you prefer). Web Forms pages execute in native machine language because, like any other managed application, they take full advantage of the runtime. In contrast, unmanaged ASP pages are always scripted and interpreted. ASP.NET pages are faster, more functional, and easier to develop than unmanaged ASP pages because they interact with the runtime like any managed application.

The .NET Framework also provides a collection of classes and tools to aid in development and consumption of XML Web services applications. XML Web services are built on standards such as SOAP (a remote procedure-call protocol), XML (an extensible data format), and WSDL (the Web Services Description Language). The .NET Framework is built on these standards to promote interoperability with non-Microsoft solutions.

For example, the Web Services Description Language tool included with the .NET Framework SDK can query an XML Web service published on the Web, parse its WSDL description, and produce C# or Visual Basic source code that your application can use to become a client of the XML Web service. The source code can create classes derived from classes in the class library that handle all the underlying communication using SOAP and XML parsing. Although you can use the class library to consume XML Web services directly, the Web Services Description Language tool and the other tools contained in the SDK facilitate your development efforts with the .NET Framework.

If you develop and publish your own XML Web service, the .NET Framework provides a set of classes that conform to all the underlying communication standards, such as SOAP, WSDL, and XML. Using those classes enables you to focus on the logic of your service, without concerning yourself with the communications infrastructure required by distributed software development.

Finally, like Web Forms pages in the managed environment, your XML Web service will run with the speed of native machine language using the scalable communication of IIS.

ACTIVE SERVER PAGES.NET:

ASP.NET is a programming framework built on the common language runtime that can be used on a server to build powerful Web applications. ASP.NET offers several important advantages over previous Web development models:

➢ **Enhanced Performance.** ASP.NET is compiled common language runtime code running on the server. Unlike its interpreted predecessors, ASP.NET can take advantage of early binding, just-in-time compilation, native optimization, and caching services right out of the box. This amounts to dramatically better performance before you ever write a line of code.

➢ **World-Class Tool Support.** The ASP.NET framework is complemented by a rich toolbox and designer in the Visual Studio integrated development environment. WYSIWYG editing, drag-and-drop server controls, and automatic deployment are just a few of the features this powerful tool provides.

➢ **Power and Flexibility.** Because ASP.NET is based on the common language runtime, the power and flexibility of that entire platform is available to Web application developers. The .NET Framework class library, Messaging, and Data Access solutions are all seamlessly accessible from the Web. ASP.NET is also language-independent, so you can choose the language that best applies to your application or partition your application across many languages. Further, common language runtime interoperability guarantees that your existing investment in COM-based development is preserved when migrating to ASP.NET.

- **Simplicity.** ASP.NET makes it easy to perform common tasks, from simple form submission and client authentication to deployment and site configuration. For example, the ASP.NET page framework allows you to build user interfaces that cleanly separate application logic from presentation code and to handle events in a simple, Visual Basic - like forms processing model. Additionally, the common language runtime simplifies development, with managed code services such as automatic reference counting and garbage collection.

- **Manageability.** ASP.NET employs a text-based, hierarchical configuration system, which simplifies applying settings to your server environment and Web applications. Because configuration information is stored as plain text, new settings may be applied without the aid of local administration tools. This "zero local administration" philosophy extends to deploying ASP.NET Framework applications as well. An ASP.NET Framework application is deployed to a server simply by copying the necessary files to the server. No server restart is required, even to deploy or replace running compiled code.

- **Scalability and Availability.** ASP.NET has been designed with scalability in mind, with features specifically tailored to improve performance in clustered and multiprocessor environments. Further, processes are closely monitored and managed by the ASP.NET runtime, so that if one misbehaves (leaks, deadlocks), a new process can be created in its place, which helps keep your application constantly available to handle requests.

- **Customizability and Extensibility.** ASP.NET delivers a well-factored architecture that allows developers to "plug-in" their code at the appropriate level. In fact, it is possible to extend or replace any subcomponent of the ASP.NET runtime with your own custom-written component. Implementing custom authentication or state services has never been easier.

- **Security.** With built in Windows authentication and per-application configuration, you can be assured that your applications are secure.

LANGUAGE SUPPORT:

The Microsoft .NET Platform currently offers built-in support for three languages: C#, Visual Basic, and Java Script.

WHAT IS ASP.NET WEB FORMS?

The ASP.NET Web Forms page framework is a scalable common language runtime programming model that can be used on the server to dynamically generate Web pages.

Intended as a logical evolution of ASP (ASP.NET provides syntax compatibility with existing pages), the ASP.NET Web Forms framework has been specifically designed to address a number of key deficiencies in the previous model. In particular, it provides:

- The ability to create and use reusable UI controls that can encapsulate common functionality and thus reduce the amount of code that a page developer has to write.
- The ability for developers to cleanly structure their page logic in an orderly fashion (not "spaghetti code").
- The ability for development tools to provide strong WYSIWYG design support for pages (existing ASP code is opaque to tools).

ASP.NET Web Forms pages are text files with an .aspx file name extension. They can be deployed throughout an IIS virtual root directory tree. When a browser client requests .aspx resources, the ASP.NET runtime parses and compiles the target file into a .NET Framework class. This class can then be used to dynamically process incoming requests. (Note that the .aspx file is compiled only the first time it is accessed; the compiled type instance is then reused across multiple requests).

An ASP.NET page can be created simply by taking an existing HTML file and changing its file name extension to .aspx (no modification of code is required). For example, the following sample demonstrates a simple HTML page that collects a user's name and category preference and then performs a form post back to the originating page when a button is clicked:

ASP.NET provides syntax compatibility with existing ASP pages. This includes support for <% %> code render blocks that can be intermixed with HTML content within an .aspx file. These code blocks execute in a top-down manner at page render time.

CODE-BEHIND WEB FORMS:

ASP.NET supports two methods of authoring dynamic pages. The first is the method shown in the preceding samples, where the page code is physically declared within the originating .aspx file. An alternative approach--known as the code-behind method--enables the page code to be more cleanly separated from the HTML content into an entirely separate file.

INTRODUCTION TO ASP.NET SERVER CONTROLS

In addition to (or instead of) using <% %> code blocks to program dynamic content, ASP.NET page developers can use ASP.NET server controls to program Web pages. Server controls are declared within an .aspx file using custom tags or intrinsic HTML tags that contain a **runat="server"** attributes value. Intrinsic HTML tags are handled by one of the controls in the **System.Web.UI.HtmlControls** namespace. Any tag that doesn't explicitly map to one of the controls is assigned the type of **System.Web.UI.HtmlControls.HtmlGenericControl**.

Server controls automatically maintain any client-entered values between round trips to the server. This control state is not stored on the server (it is instead stored within an **<input type="hidden">** form field that is round-tripped between requests). Note also that no client-side script is required.

In addition to supporting standard HTML input controls, ASP.NET enables developers to utilize richer custom controls on their pages. For example, the following sample demonstrates how the **<asp:adrotator>** control can be used to dynamically display rotating ads on a page.

- ASP.NET Web Forms provide an easy and powerful way to build dynamic Web UI.
- ASP.NET Web Forms pages can target any browser client (there are no script library or cookie requirements).
- ASP.NET Web Forms pages provide syntax compatibility with existing ASP pages.
- ASP.NET server controls provide an easy way to encapsulate common functionality.
- ASP.NET ships with 45 built-in server controls. Developers can also use controls built by third parties.
- ASP.NET server controls can automatically project both uplevel and downlevel HTML.
- ASP.NET templates provide an easy way to customize the look and feel of list server controls.
- ASP.NET validation controls provide an easy way to do declarative client or server data validation.

5.3 C#.NET:

ADO.NET OVERVIEW:

ADO.NET is an evolution of the ADO data access model that directly addresses user requirements for developing scalable applications. It was designed specifically for the web with scalability, statelessness, and XML in mind.

ADO.NET uses some ADO objects, such as the **Connection** and **Command** objects, and also introduces new objects. Key new ADO.NET objects include the **Dataset**, **Data Reader**, and **Data Adapter**.

The important distinction between this evolved stage of ADO.NET and previous data architectures is that there exists an object -- the **DataSet** -- that is separate and distinct from any data stores. Because of that, the **DataSet** functions as a standalone entity. You can think of the DataSet as an always disconnected recordset that knows nothing about the source or destination of the data it contains. Inside a **DataSet**, much like in a database, there are tables, columns, relationships, constraints, views, and so forth.

A **DataAdapter** is the object that connects to the database to fill the **DataSet**. Then, it connects back to the database to update the data there, based on operations performed while the **DataSet** held the data. In the past, data processing has been primarily connection-based. Now, in an effort to make multi-tiered apps more efficient, data processing is turning to a message-based approach that revolves around chunks of information. At the center of this approach is the **DataAdapter**, which provides a bridge to retrieve and save data between a **DataSet** and its source data store. It accomplishes this by means of requests to the appropriate SQL commands made against the data store.

The XML-based **DataSet** object provides a consistent programming model that works with all models of data storage: flat, relational, and hierarchical. It does this by having no 'knowledge' of the source of its data, and by representing the data that it holds as collections and data types. No matter what the source of the data within the **DataSet** is, it is manipulated through the same set of standard APIs exposed through the **DataSet** and its subordinate objects.

While the **DataSet** has no knowledge of the source of its data, the managed provider has detailed and specific information. The role of the managed provider is to connect, fill, and persist the **DataSet** to and from data stores. The OLE DB and SQL Server .NET Data Providers (System.Data.OleDb and System.Data.SqlClient) that are part of the .Net Framework provide four basic objects: the **Command**, **Connection**, **DataReader** and **DataAdapter**. In the remaining sections of this document, we'll walk through each part of the **DataSet** and the OLE DB/SQL Server .NET Data Providers explaining what they are, and how to program against them.

The following sections will introduce you to some objects that have evolved, and some that are new. These objects are:

- **Connections**. For connection to and managing transactions against a database.
- **Commands**. For issuing SQL commands against a database.
- **DataReaders**. For reading a forward-only stream of data records from a SQL Server data source.
- **DataSet**. For storing, Remoting and programming against flat data, XML data and relational data.
- **DataAdapters**. For pushing data into a **DataSet**, and reconciling data against a database.

When dealing with connections to a database, there are two different options: SQL Server .NET Data Provider (System.Data.SqlClient) and OLE DB .NET Data Provider (System.Data.OleDb). In these samples we will use the SQL Server .NET Data Provider. These are written to talk directly to Microsoft SQL Server. The OLE DB .NET Data Provider is used to talk to any OLE DB provider (as it uses OLE DB underneath).

Connections:

Connections are used to 'talk to' databases, and are represented by provider-specific classes such as **SqlConnection**. Commands travel over connections and resultsets are returned in the form of streams which can be read by a **DataReader** object, or pushed into a **DataSet** object.

Commands:

Commands contain the information that is submitted to a database, and are represented by provider-specific classes such as **SqlCommand**. A command can be a stored procedure call, an UPDATE statement, or a statement that returns results. You can also use input and output parameters, and return values as part of your command syntax. The example below shows how to issue an INSERT statement against the **Northwind** database.

DataReaders:

The **DataReader** object is somewhat synonymous with a read-only/forward-only cursor over data. The **DataReader** API supports flat as well as hierarchical data. A **DataReader** object is returned after executing a command against a database. The format of the returned **DataReader** object is different from a recordset. For example, you might use the **DataReader** to show the results of a search list in a web page.

DATASETS AND DATAADAPTERS:

Datasets:

The **Dataset** object is similar to the ADO **Record set** object, but more powerful, and with one other important distinction: The **Dataset** is always disconnected. The **Dataset** object represents a cache of data, with database-like structures such as tables, columns, relationships, and constraints. However, though a **DataSet** can and does behave much like a database, it is important to remember that **DataSet** objects do not interact directly with databases, or other source data. This allows the developer to work with a programming model that is always consistent, regardless of where the source data resides. Data coming from a database, an XML file, from code, or user input can all be placed into **DataSet** objects. Then, as changes are made to the **DataSet** they can be tracked and verified before updating the source data. The **GetChanges** method of the **DataSet** object actually creates a second **DataSet** that contains only the changes to the data. This **DataSet** is then used by a **DataAdapter** (or other objects) to update the original data source.

The **DataSet** has many XML characteristics, including the ability to produce and consume XML data and XML schemas. XML schemas can be used to describe schemas interchanged via WebServices. In fact, a **DataSet** with a schema can actually be compiled for type safety and statement completion.

DATAADAPTERS (OLEDB/SQL):

The **DataAdapter** object works as a bridge between the **DataSet** and the source data. Using the provider-specific **SqlDataAdapter** (along with its associated **SqlCommand** and **SqlConnection**) can increase overall performance when working with a Microsoft SQL Server databases. For other OLE DB-supported databases, you would use the **OleDbDataAdapter** object and its associated **OleDbCommand** and **OleDbConnection** objects.

The **DataAdapter** object uses commands to update the data source after changes have been made to the **DataSet**. Using the **Fill** method of the **DataAdapter** calls the SELECT command; using the **Update** method calls the INSERT, UPDATE or DELETE command for each changed row. You can explicitly set these commands in order to control the statements used at runtime to resolve changes, including the use of stored procedures. For ad-hoc scenarios, a **CommandBuilder** object can generate these at run-time based upon a select statement. However, this run-time generation requires an extra round-trip to the server in order to gather required metadata, so explicitly providing the INSERT, UPDATE, and DELETE commands at design time will result in better run-time performance.

- ADO.NET is the next evolution of ADO for the .Net Framework.

- ADO.NET was created with n-Tier, statelessness and XML in the forefront. Two new objects, the **DataSet** and **DataAdapter**, are provided for these scenarios.

- ADO.NET can be used to get data from a stream, or to store data in a cache for updates.

- There is a lot more information about ADO.NET in the documentation.

- Remember, you can execute a command directly against the database in order to do inserts, updates, and deletes. You don't need to first put data into a **DataSet** in order to insert, update, or delete it.

Also, you can use a **DataSet** to bind to the data, move through the data, and navigate data relationships

5.4 SQL SERVER -2005:

A database management, or DBMS, gives the user access to their data and helps them transform the data into information. Such database management systems include dBase, paradox, IMS, SQL Server and SQL Server. These systems allow users to create, update and extract information from their database.

A database is a structured collection of data. Data refers to the characteristics of people, things and events. SQL Server stores each data item in its own fields. In SQL Server, the fields relating to a particular person, thing or event are bundled together to form a single complete unit of data, called a record (it can also be referred to as raw or an occurrence). Each record is made up of a number of fields. No two fields in a record can have the same field name.

During an SQL Server Database design project, the analysis of your business needs identifies all the fields or attributes of interest. If your business needs change over time, you define any additional fields or change the definition of existing fields.

SQL SERVER TABLES:

SQL Server stores records relating to each other in a table. Different tables are created for the various groups of information. Related tables are grouped together to form a database.

PRIMARY KEY:

Every table in SQL Server has a field or a combination of fields that uniquely identifies each record in the table. The Unique identifier is called the Primary Key, or simply the Key. The primary key provides the means to distinguish one record from all other in a table. It allows the user and the database system to identify, locate and refer to one particular record in the database.

RELATIONAL DATABASE:

Sometimes all the information of interest to a business operation can be stored in one table. SQL Server makes it very easy to link the data in multiple tables. Matching an employee to the department in which they work is one example. This is what makes SQL Server a relational database management system, or RDBMS. It stores data in two or more tables and enables you to define relationships between the table and enables you to define relationships between the tables.

FOREIGN KEY:

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

REFERENTIAL INTEGRITY:

Not only does SQL Server allow you to link multiple tables, it also maintains consistency between them. Ensuring that the data among related tables is correctly matched is referred to as maintaining referential integrity.

DATA ABSTRACTION:

A major purpose of a database system is to provide users with an abstract view of the data. This system hides certain details of how the data is stored and maintained. Data abstraction is divided into three levels.

Physical level: This is the lowest level of abstraction at which one describes how the data are actually stored.

Conceptual Level: At this level of database abstraction all the attributed and what data are actually stored is described and entries and relationship among them.

View level: This is the highest level of abstraction at which one describes only part of the database.

ADVANTAGES OF RDBMS:

- Redundancy can be avoided
- Inconsistency can be eliminated
- Data can be Shared
- Standards can be enforced
- Security restrictions can be applied
- Integrity can be maintained
- Conflicting requirements can be balanced
- Data independence can be achieved.

DISADVANTAGES OF DBMS:

A significant disadvantage of the DBMS system is cost. In addition to the cost of purchasing of developing the software, the hardware has to be upgraded to allow for the extensive programs and the workspace required for their execution and storage. While centralization reduces duplication, the lack of duplication requires that the database be adequately backed up so that in case of failure the data can be recovered.

FEATURES OF SQL SERVER (RDBMS):

SQL SERVER is one of the leading database management systems (DBMS) because it is the only Database that meets the uncompromising requirements of today's most demanding information systems. From complex decision support systems (DSS) to the most rigorous online transaction processing (OLTP) application, even application that require simultaneous DSS and OLTP access to the same critical data, SQL Server leads the industry in both performance and capability.

SQL SERVER is a truly portable, distributed, and open DBMS that delivers unmatched performance, continuous operation and support for every database.

SQL SERVER RDBMS is high performance fault tolerant DBMS which is specially designed for online transactions processing and for handling large database application.

SQL SERVER with transactions processing option offers two features which contribute to very high level of transaction processing throughput, which are

- The row level lock manager

ENTERPRISE WIDE DATA SHARING:

The unrivaled portability and connectivity of the SQL SERVER DBMS enables all the systems in the organization to be linked into a singular, integrated computing resource.

PORTABILITY:

SQL SERVER is fully portable to more than 80 distinct hardware and operating systems platforms, including UNIX, MSDOS, OS/2, Macintosh and dozens of proprietary platforms. This portability gives complete freedom to choose the database server platform that meets the system requirements.

OPEN SYSTEMS:

SQL SERVER offers a leading implementation of industry –standard SQL. SQL Server's open architecture integrates SQL SERVER and non –SQL SERVER DBMS with industry's most comprehensive collection of tools, application, and third party software products SQL Server's Open architecture provides transparent access to data from other relational database and even non-relational database.

DISTRIBUTED DATA SHARING:

SQL Server's networking and distributed database capabilities to access data stored on remote server with the same ease as if the information was stored on a single local computer. A single SQL statement can access data at multiple sites. You can store data where system requirements such as performance, security or availability dictate.

UNMATCHED PERFORMANCE:

The most advanced architecture in the industry allows the SQL SERVER DBMS to deliver unmatched performance.

SOPHISTICATED CONCURRENCY CONTROL:

Real World applications demand access to critical data. With most database Systems application becomes "contention bound" – which performance is limited not by the CPU power or by disk I/O, but user waiting on one another for data access. SQL Server employs full, unrestricted row-level locking and contention free queries to minimize and in many cases entirely eliminates contention wait times.

NO I/O BOTTLENECKS:

SQL Server's fast commit groups commit and deferred write technologies dramatically reduce disk I/O bottlenecks. While some database writes whole data block to disk at commit time, SQL Server commits transactions with at most sequential log file on disk at commit time, on high throughput systems, one sequential writes typically group commit multiple transactions. Data read by the transaction remains as shared memory so that other transactions may access that data without reading it again from disk. Since fast commits write all data necessary to the recovery to the log file, modified blocks are written back to the database independently of the transaction commit, when written from memory to disk.

6. SYSTEM DESIGN

6.1. INTRODUCTION:

Software design sits at the technical kernel of the software engineering process and is applied regardless of the development paradigm and area of application. Design is the first step in the development phase for any engineered product or system. The designer's goal is to produce a model or representation of an entity that will later be built.

Beginning, once system requirement have been specified and analyzed, system design is the first of the three technical activities -design, code and test that is required to build and verify software.

The importance can be stated with a single word “Quality”. Design is the place where quality is fostered in software development. Design provides us with representations of software that can assess for quality. Design is the only way that we can accurately translate a customer’s view into a finished software product or system. Software design serves as a foundation for all the software engineering steps that follow. Without a strong design we risk building an unstable system – one that will be difficult to test, one whose quality cannot be assessed until the last stage.

During design, progressive refinement of data structure, program structure, and procedural details are developed reviewed and documented. System design can be viewed from either technical or project management perspective. From the technical point of view, design is comprised of four activities – architectural design, data structure design, interface design and procedural design.

6.2 NORMALIZATION:

It is a process of converting a relation to a standard form. The process is used to handle the problems that can arise due to data redundancy i.e. repetition of data in the database, maintain data integrity as well as handling problems that can arise due to insertion, updating, deletion anomalies.

Decomposing is the process of splitting relations into multiple relations to eliminate anomalies and maintain anomalies and maintain data integrity. To do this we use normal forms or rules for structuring relation.

Insertion anomaly: Inability to add data to the database due to absence of other data.

Deletion anomaly: Unintended loss of data due to deletion of other data.

Update anomaly: Data inconsistency resulting from data redundancy and partial update

Normal Forms: These are the rules for structuring relations that eliminate anomalies.

FIRST NORMAL FORM:

A relation is said to be in first normal form if the values in the relation are atomic for every attribute in the relation. By this we mean simply that no attribute value can be a set of values or, as it is sometimes expressed, a repeating group.

SECOND NORMAL FORM:

A relation is said to be in second Normal form is it is in first normal form and it should satisfy any one of the following rules.

- Primary key is a not a composite primary key
- No non key attributes are present
- Every non key attribute is fully functionally dependent on full set of primary key.

THIRD NORMAL FORM:

A relation is said to be in third normal form if their exits no transitive dependencies.

Transitive Dependency: If two non-key attributes depend on each other as well as on the primary key then they are said to be transitively dependent.

The above normalization principles were applied to decompose the data in multiple tables thereby making the data to be maintained in a consistent state.**D**

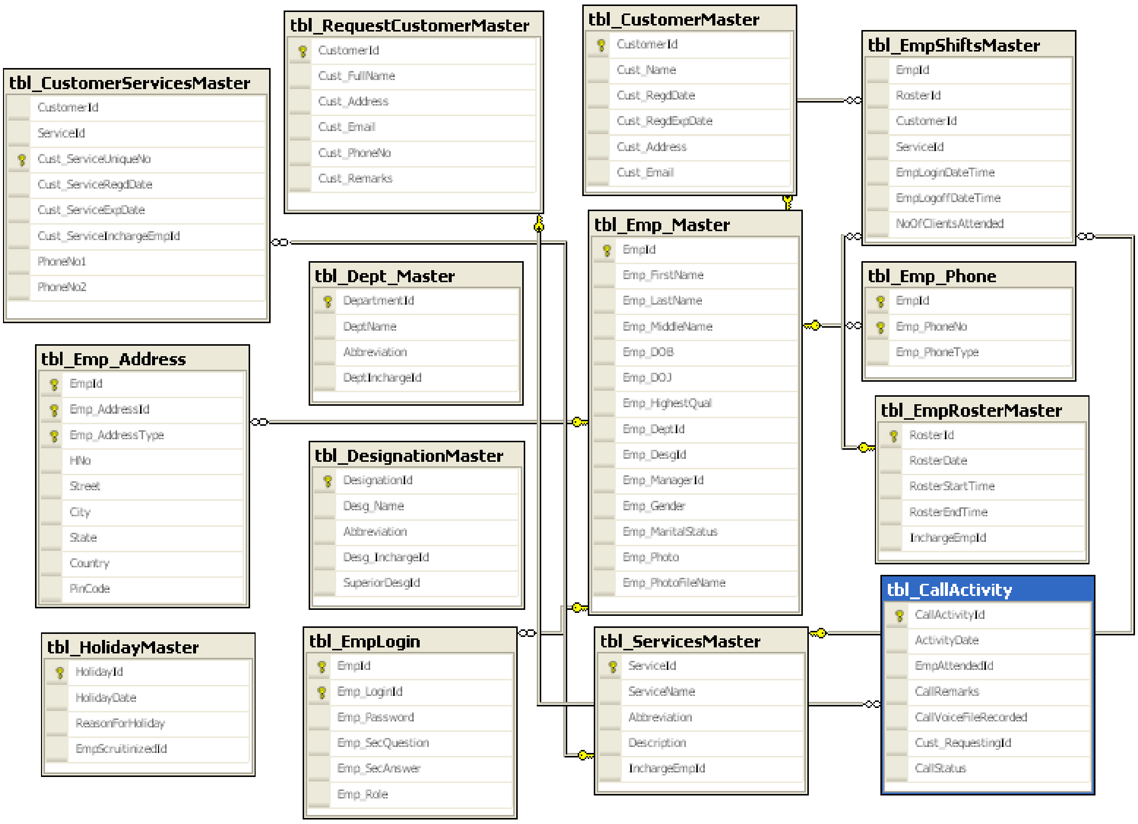
6.3E-R Diagrams:

- The relation upon the system is structure through a conceptual ER-Diagram, which not only specifics the existential entities but also the standard relations through which the system exists and the cardinalities that are necessary for the system state to continue.

- ➢ The entity Relationship Diagram (ERD) depicts the relationship between the data objects. The ERD is the notation that is used to conduct the date modeling activity the attributes of each data object noted is the ERD can be described resign a data object description.
- ➢ The set of primary components that are identified by the ERD are
- ➢ Data object
- ➢ Relationships
- ➢ Attributes
- ➢ Various types of indicators.

The primary purpose of the ERD is to represent data objects and their relationships.

E-R Diagram:



6.4 DATA FLOW DIAGRAMS:

A data flow diagram is graphical tool used to describe and analyze movement of data through a system. These are the central tool and the basis from which the other components are developed. The transformation of data from input to output, through processed, may be described logically and independently of physical components associated with the system. These are known as the logical data flow diagrams. The physical data flow diagrams show the actual implements and movement of data between people, departments and workstations. A full description of a system actually consists of a set of data flow diagrams. Using two familiar notations Yourdon, Gane and Sarson notation develops the data flow diagrams. Each component in a DFD is labeled with a descriptive name. Process is further identified with a number that will be used for identification purpose. The development of DFD'S is done in several levels. Each process in lower level diagrams can be broken down into a more detailed DFD in the next level. The lop-level diagram is often called context diagram. It consists a single process bit, which plays vital role in studying the current system. The process in the context level diagram is exploded into other process at the first level DFD.

The idea behind the explosion of a process into more process is that understanding at one level of detail is exploded into greater detail at the next level. This is done until further explosion is necessary and an adequate amount of detail is described for analyst to understand the process.

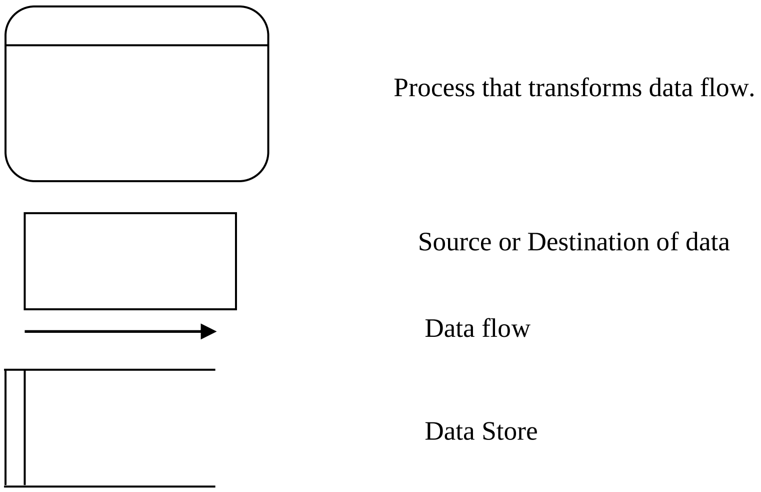
Larry Constantine first developed the DFD as a way of expressing system requirements in a graphical from, this lead to the modular design.

A DFD is also known as a "bubble Chart" has the purpose of clarifying system requirements and identifying major transformations that will become programs in system design. So it is the starting point of the design to the lowest level of detail. A DFD consists of a series of bubbles joined by data flows in the system.

DFD SYMBOLS:

In the DFD, there are four symbols

1. A square defines a source(originator) or destination of system data
2. An arrow identifies data flow. It is the pipeline through which the information flows
3. A circle or a bubble represents a process that transforms incoming data flow into outgoing data flows.
4. An open rectangle is a data store, data at rest or a temporary repository of data


Process that transforms data flow.
Source or Destination of data
Data flow
Data Store

CONSTRUCTING A DFD:

Several rules of thumb are used in drawing DFD'S:

1. Process should be named and numbered for an easy reference. Each name should be representative of the process.

2. The direction of flow is from top to bottom and from left to right. Data traditionally flow from source to the destination although they may flow back to the source. One way to indicate this is to draw long flow line back to a source. An alternative way is to repeat the source symbol as a destination. Since it is used more than once in the DFD it is marked with a short diagonal.

3. When a process is exploded into lower level details, they are numbered.

4. The names of data stores and destinations are written in capital letters. Process and dataflow names have the first letter of each work capitalized.

A DFD typically shows the minimum contents of data store. Each data store should contain all the data elements that flow in and out.

Questionnaires should contain all the data elements that flow in and out. Missing interfaces redundancies and like is then accounted for often through interviews.

SAILENT FEATURES OF DFD'S:

1. The DFD shows flow of data, not of control loops and decision are controlled considerations do not appear on a DFD.

2. The DFD does not indicate the time factor involved in any process whether the dataflow take place daily, weekly, monthly or yearly.

3. The sequence of events is not brought out on the DFD.

TYPES OF DATA FLOW DIAGRAMS:

1. Current Physical
2. Current Logical
3. New Logical
4. New Physical

CURRENT PHYSICAL:

In Current Physical DFD process label include the name of people or their positions or the names of computer systems that might provide some of the overall system-processing label includes an identification of the technology used to process the data. Similarly, data flows and data stores are often labels with the names of the actual physical media on which data are stored such as file folders, computer files, business forms or computer tapes.

CURRENT LOGICAL:

The physical aspects at the system are removed as much as possible so that the current system is reduced to its essence to the data and the processors that transforms them regardless of actual physical form.

NEW LOGICAL:

This is exactly like a current logical model if the user were completely happy with the user were completely happy with the functionality of the current system but had problems with how it was implemented typically through the new logical model will differ from current logical model while having additional functions, absolute function removal and inefficient flows recognized.

NEW PHYSICAL:

The new physical represents only the physical implementation of the new system.

RULES GOVERNING THE DFD'S

PROCESS:

1) No process can have only outputs.

2) No process can have only inputs. If an object has only inputs than it must be a sink.

3) A process has a verb phrase label.

DATA STORE:

1) Data cannot move directly from one data store to another data store, a process must move data.

2) Data cannot move directly from an outside source to a data store, a process, which receives, must move data from the source and place the data into data store

3) A data store has a noun phrase label.

SOURCE OR SINK:

The origin and /or destination of data.

1) Data cannot move direly from a source to sink it must be moved by a process

2) A source and /or sink has a noun phrase land

DATA FLOW:

1) A Data Flow has only one direction of flow between symbols. It may flow in both directions between a process and a data store to show a read before an update. The later is usually indicated however by two separate arrows since these happen at different type.

2) A join in DFD means that exactly the same data comes from any of two or more different processes data store or sink to a common location.

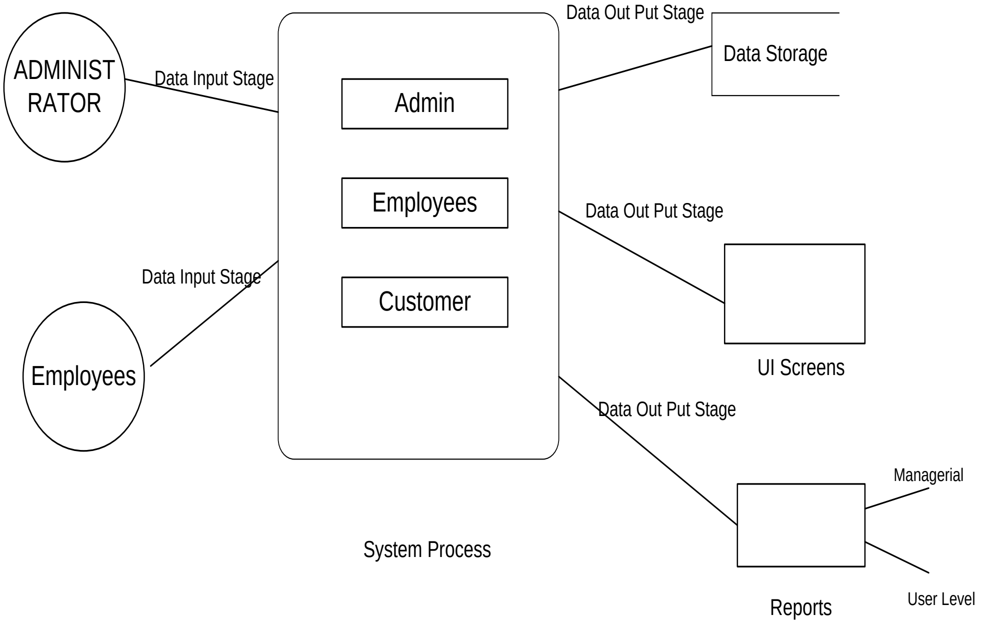
3) A data flow cannot go directly back to the same process it leads. There must be at least one other process that handles the data flow produce some other data flow returns the original data into the beginning process.

4) A Data flow to a data store means update (delete or change).

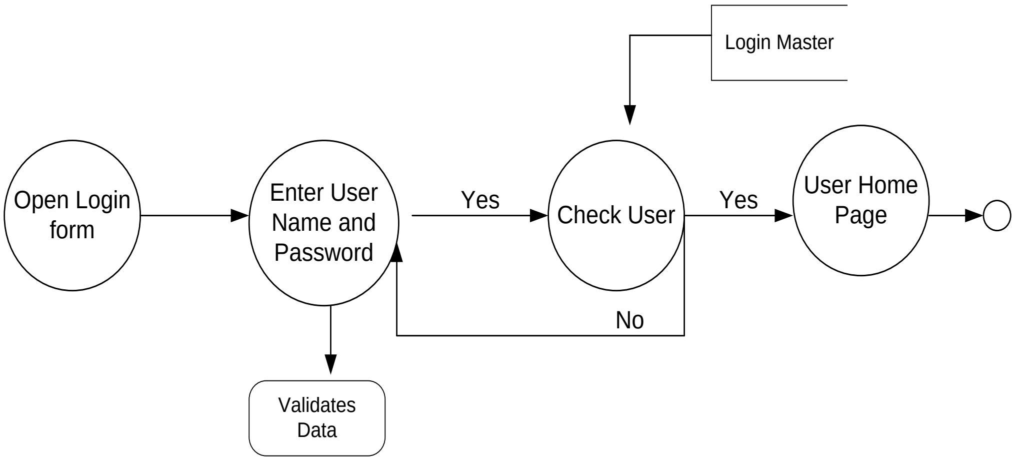
5) A data Flow from a data store means retrieve or use.

A data flow has a noun phrase label more than one data flow noun phrase can appear on a single arrow as long as all of the flows on the same arrow move together as one package.

Context Level Diagram

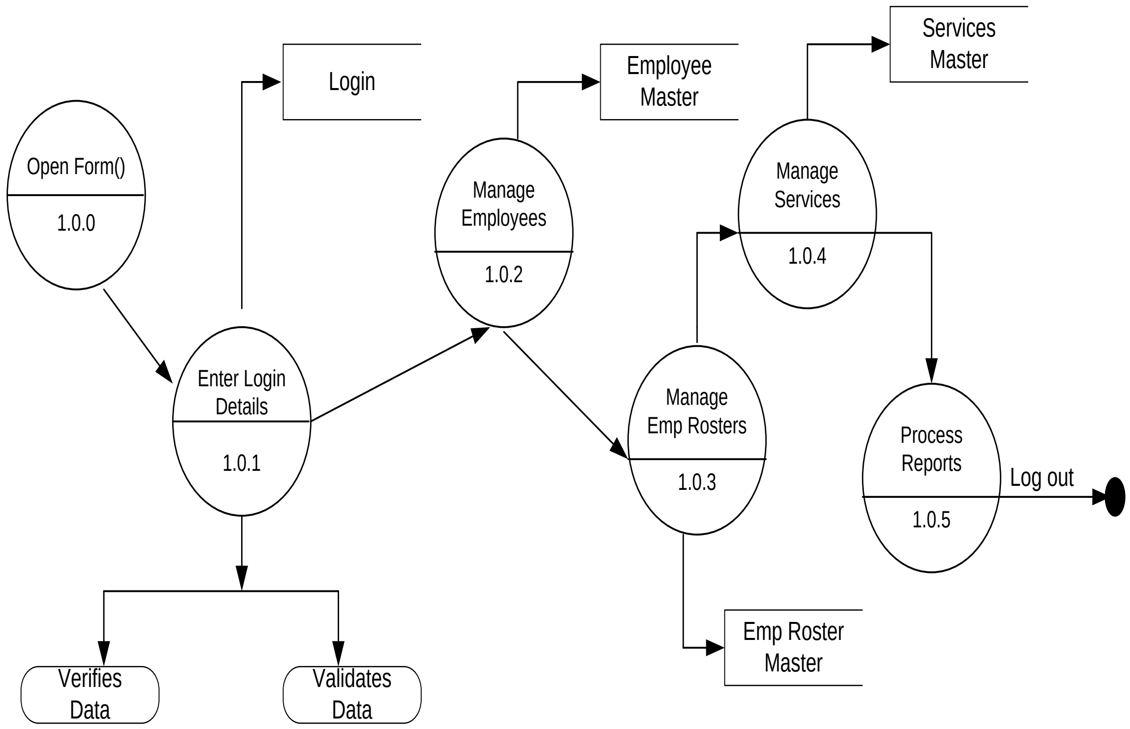


Login DFD Diagram:

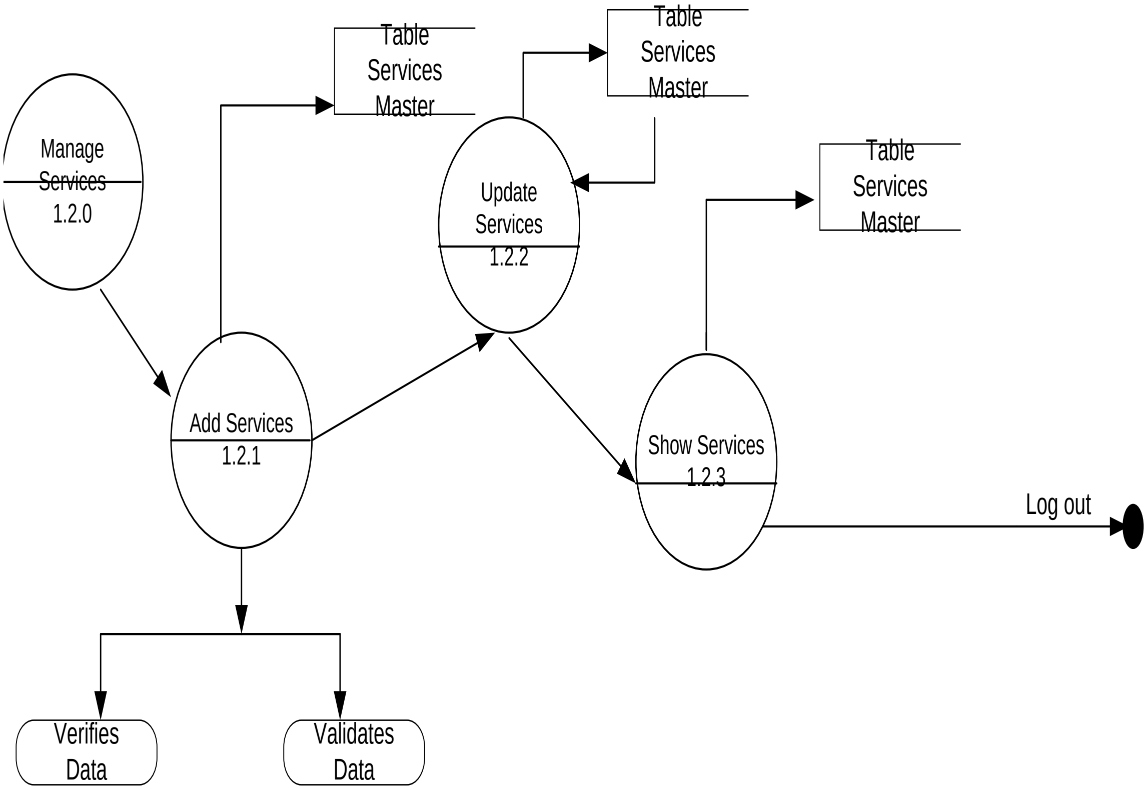


Admin Details Data Flow:

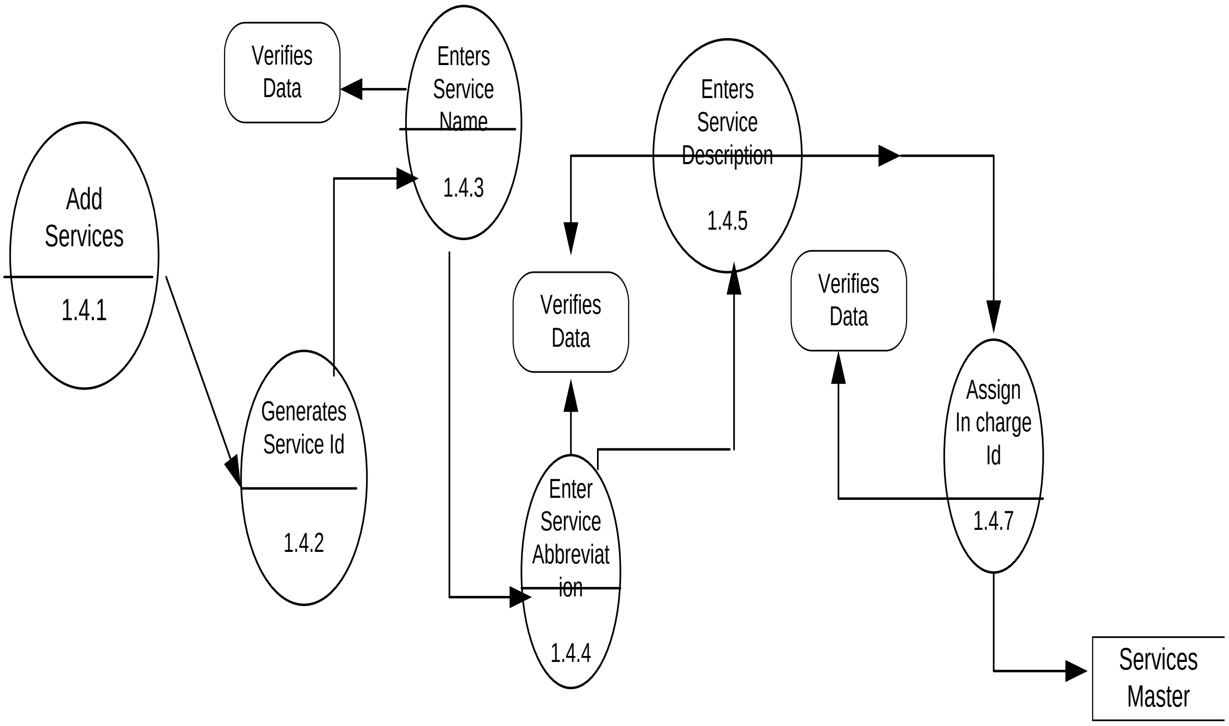
1st Level DFD Diagram:



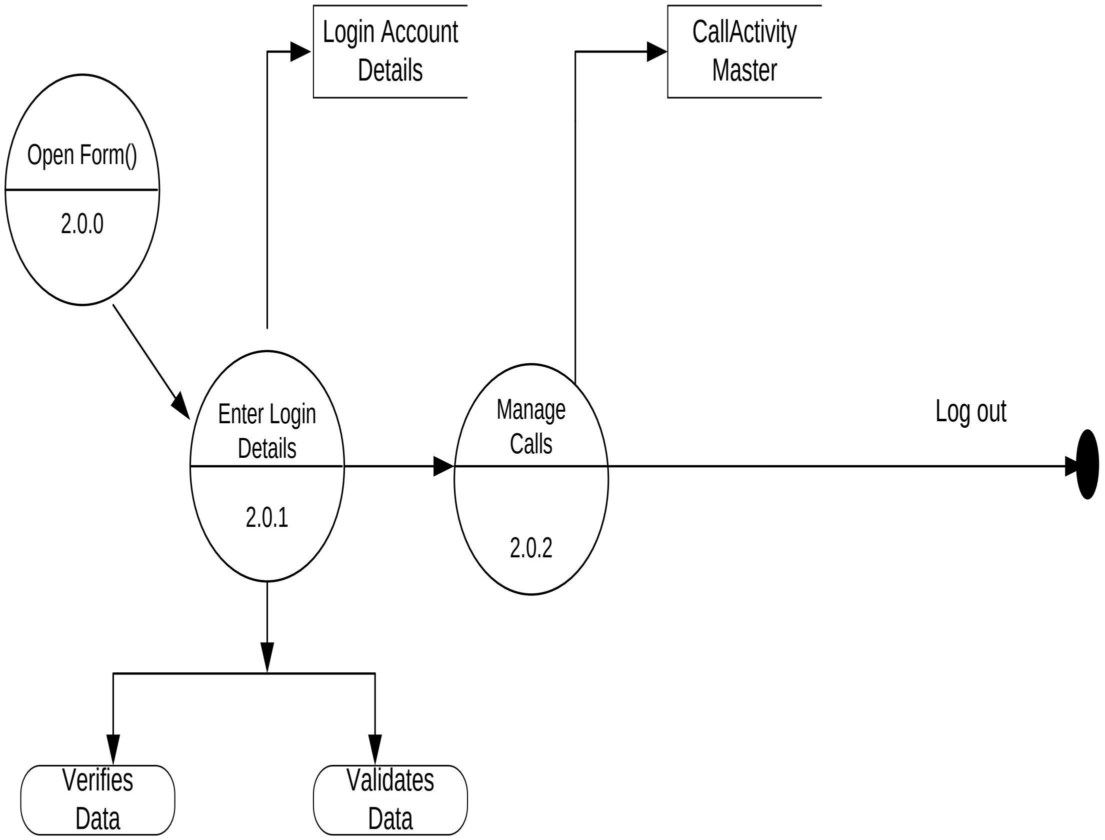
2nd Level DFD:



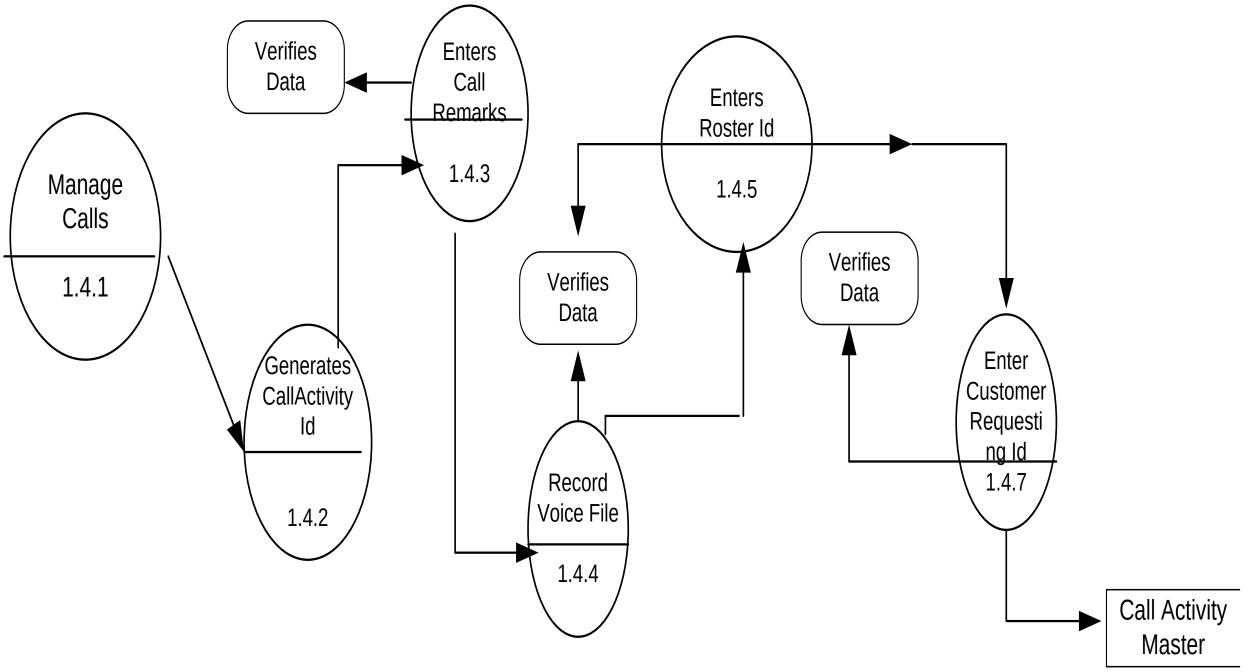
3 rd Level DFD



Emp Operations

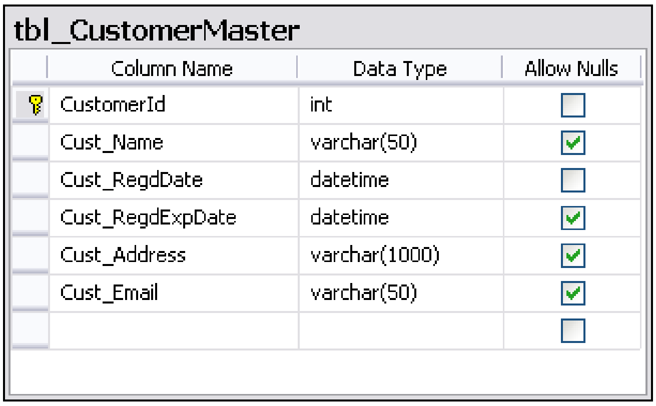


Emp Operations



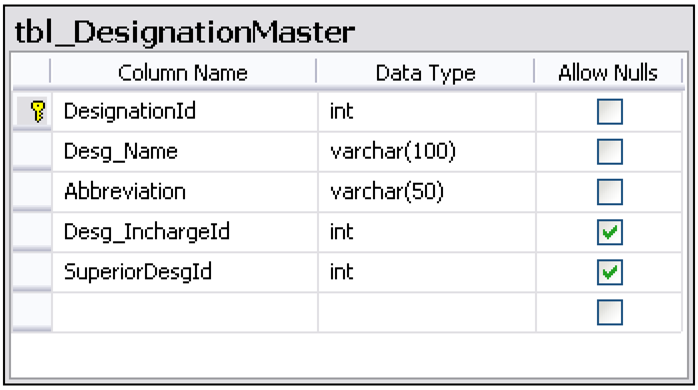
6.5DATA DICTIONARY:

After carefully understanding the requirements of the client the entire data storage requirements are divided into tables. The below tables are normalized to avoid any anomalies during the course of data entry.



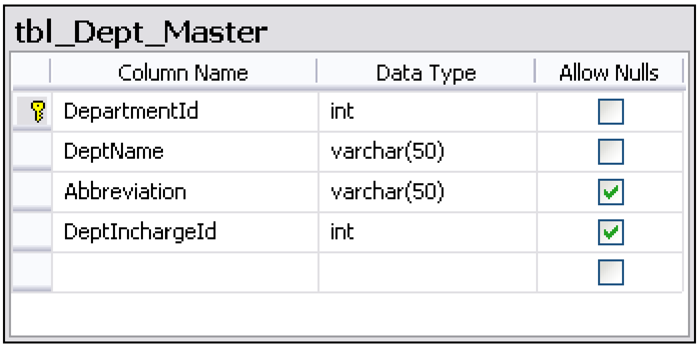
tbl_CustomerMaster

Column Name	Data Type	Allow Nulls
CustomerId	int	☐
Cust_Name	varchar(50)	☑
Cust_RegdDate	datetime	☐
Cust_RegdExpDate	datetime	☑
Cust_Address	varchar(1000)	☑
Cust_Email	varchar(50)	☑
		☐



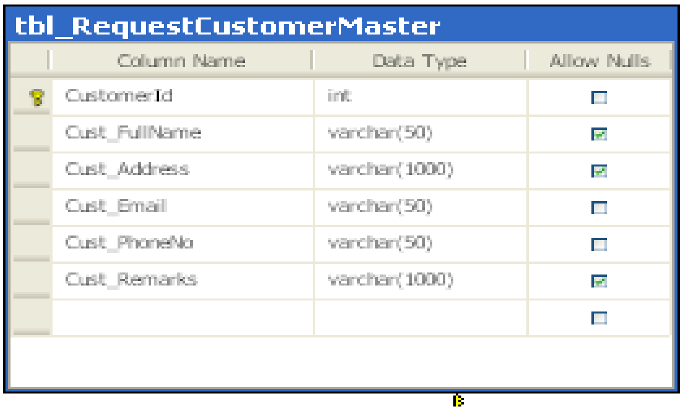
tbl_DesignationMaster

Column Name	Data Type	Allow Nulls
DesignationId	int	☐
Desg_Name	varchar(100)	☐
Abbreviation	varchar(50)	☐
Desg_InchargeId	int	☑
SuperiorDesgId	int	☑
		☐



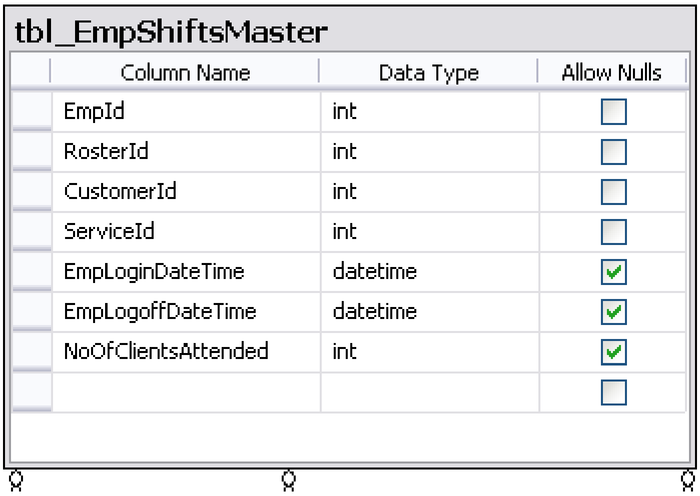
tbl_Dept_Master

	Column Name	Data Type	Allow Nulls
🔑	DepartmentId	int	□
	DeptName	varchar(50)	□
	Abbreviation	varchar(50)	☑
	DeptInchargeId	int	☑
			□



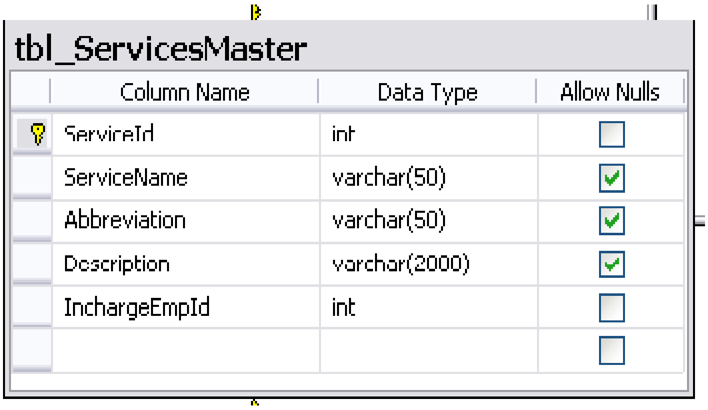
tbl_RequestCustomerMaster

	Column Name	Data Type	Allow Nulls
🔑	CustomerId	int	□
	Cust_FullName	varchar(50)	☑
	Cust_Address	varchar(1000)	☑
	Cust_Email	varchar(50)	□
	Cust_PhoneNo	varchar(50)	□
	Cust_Remarks	varchar(1000)	☑
			□



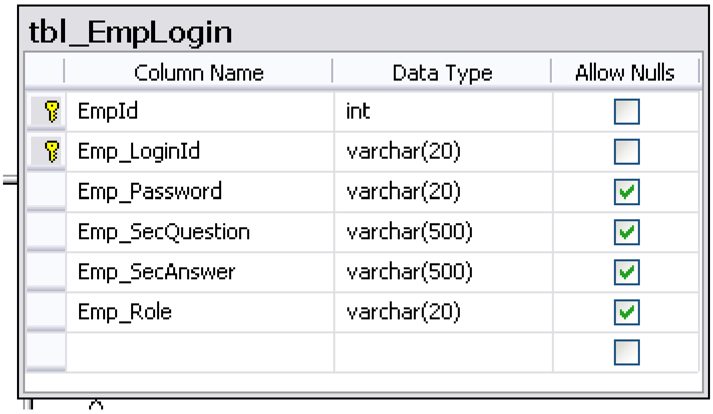
tbl_EmpShiftsMaster

	Column Name	Data Type	Allow Nulls
	EmpId	int	□
	RosterId	int	□
	CustomerId	int	□
	ServiceId	int	□
	EmpLoginDateTime	datetime	☑
	EmpLogoffDateTime	datetime	☑
	NoOfClientsAttended	int	☑
			□



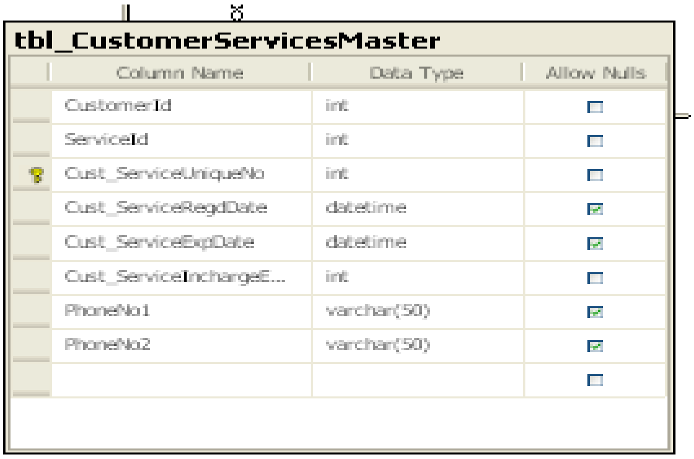
tbl_ServicesMaster

	Column Name	Data Type	Allow Nulls
🔑	ServiceId	int	□
	ServiceName	varchar(50)	☑
	Abbreviation	varchar(50)	☑
	Description	varchar(2000)	☑
	InchargeEmpId	int	□
			□



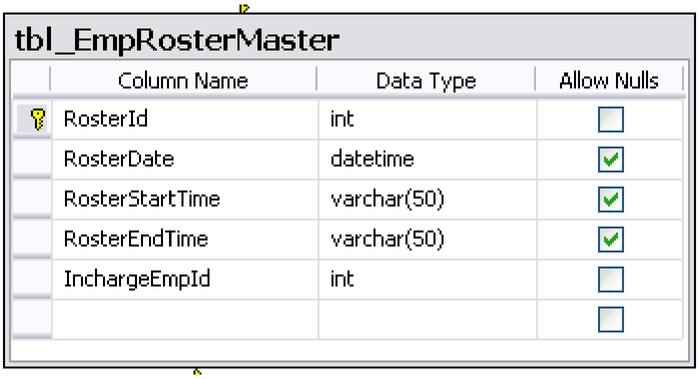
tbl_EmpLogin

	Column Name	Data Type	Allow Nulls
🔑	EmpId	int	□
🔑	Emp_LoginId	varchar(20)	□
	Emp_Password	varchar(20)	☑
	Emp_SecQuestion	varchar(500)	☑
	Emp_SecAnswer	varchar(500)	☑
	Emp_Role	varchar(20)	☑
			□



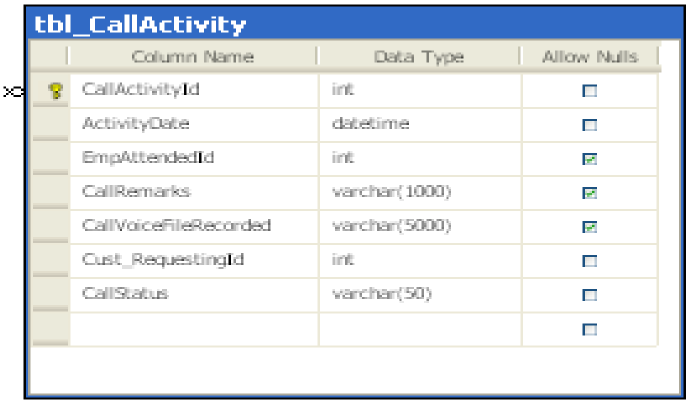
tbl_CustomerServicesMaster

	Column Name	Data Type	Allow Nulls
	CustomerId	int	□
	ServiceId	int	□
🔑	Cust_ServiceUniqueNo	int	□
	Cust_ServiceRegdDate	datetime	☑
	Cust_ServiceExpDate	datetime	☑
	Cust_ServiceInchargeE...	int	□
	PhoneNo1	varchar(50)	☑
	PhoneNo2	varchar(50)	☑
			□



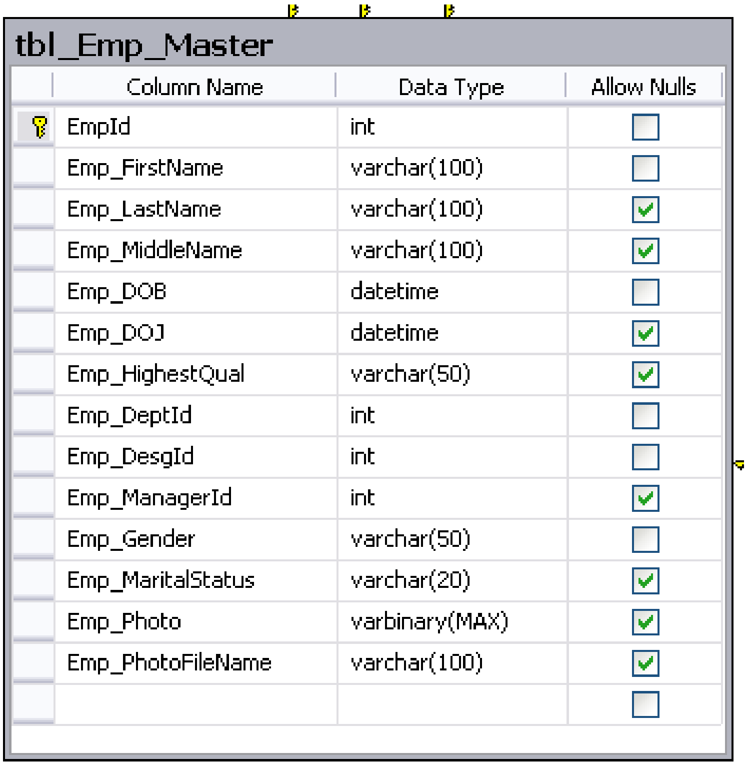
tbl_EmpRosterMaster

	Column Name	Data Type	Allow Nulls
🔑	RosterId	int	□
	RosterDate	datetime	☑
	RosterStartTime	varchar(50)	☑
	RosterEndTime	varchar(50)	☑
	InchargeEmpId	int	□
			□



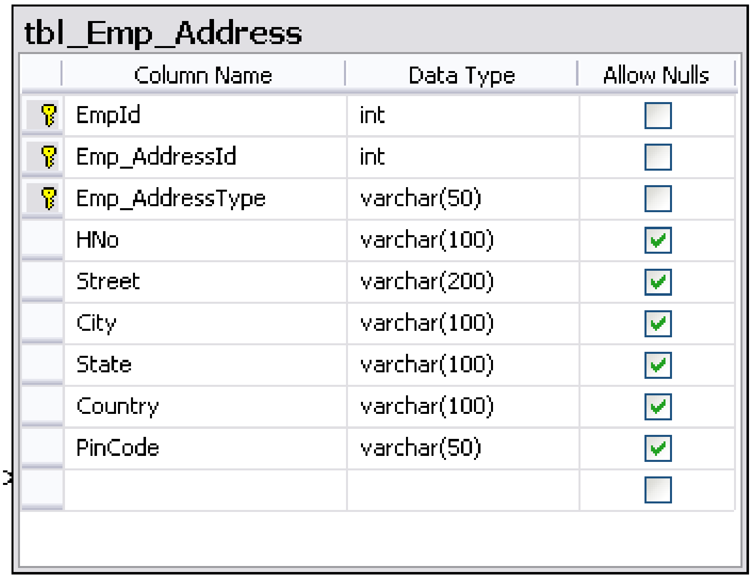
tbl_CallActivity

	Column Name	Data Type	Allow Nulls
🔑	CallActivityId	int	□
	ActivityDate	datetime	□
	EmpAttendedId	int	☑
	CallRemarks	varchar(1000)	☑
	CallVoiceFileRecorded	varchar(5000)	☑
	Cust_RequestingId	int	□
	CallStatus	varchar(50)	□
			□



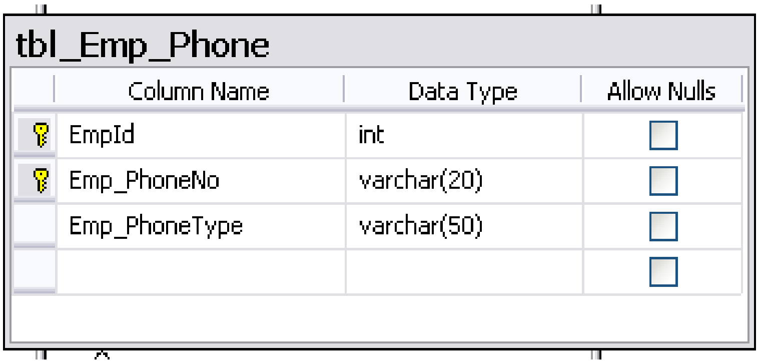
tbl_Emp_Master

	Column Name	Data Type	Allow Nulls
🔑	EmpId	int	☐
	Emp_FirstName	varchar(100)	☐
	Emp_LastName	varchar(100)	☑
	Emp_MiddleName	varchar(100)	☑
	Emp_DOB	datetime	☐
	Emp_DOJ	datetime	☑
	Emp_HighestQual	varchar(50)	☑
	Emp_DeptId	int	☐
	Emp_DesgId	int	☐
	Emp_ManagerId	int	☑
	Emp_Gender	varchar(50)	☐
	Emp_MaritalStatus	varchar(20)	☑
	Emp_Photo	varbinary(MAX)	☑
	Emp_PhotoFileName	varchar(100)	☑
			☐



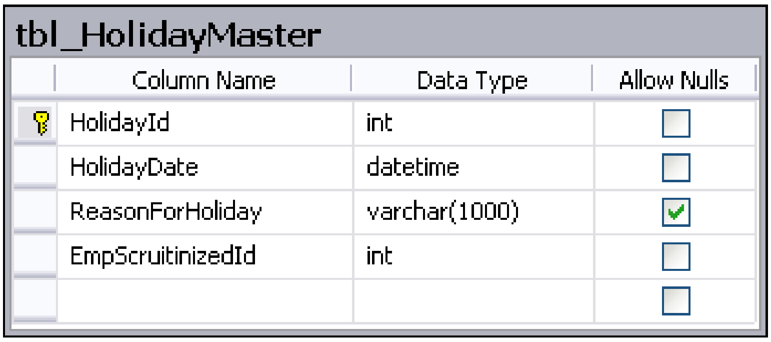
tbl_Emp_Address

	Column Name	Data Type	Allow Nulls
🔑	EmpId	int	☐
🔑	Emp_AddressId	int	☐
🔑	Emp_AddressType	varchar(50)	☐
	HNo	varchar(100)	☑
	Street	varchar(200)	☑
	City	varchar(100)	☑
	State	varchar(100)	☑
	Country	varchar(100)	☑
	PinCode	varchar(50)	☑
			☐



tbl_Emp_Phone

	Column Name	Data Type	Allow Nulls
🔑	EmpId	int	☐
🔑	Emp_PhoneNo	varchar(20)	☐
	Emp_PhoneType	varchar(50)	☐
			☐



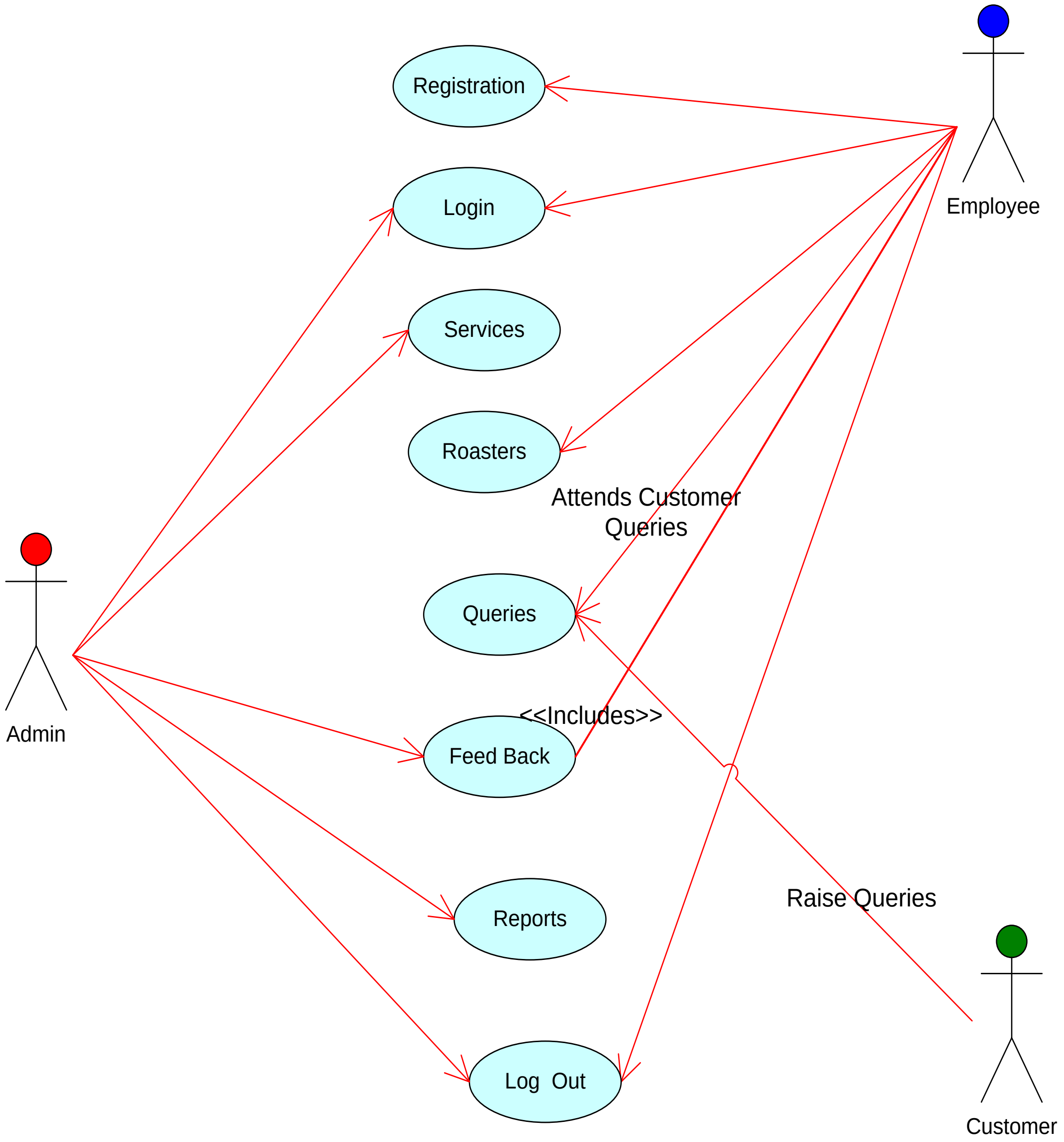
tbl_HolidayMaster

	Column Name	Data Type	Allow Nulls
🔑	HolidayId	int	☐
	HolidayDate	datetime	☐
	ReasonForHoliday	varchar(1000)	☑
	EmpScruitinizedId	int	☐
			☐

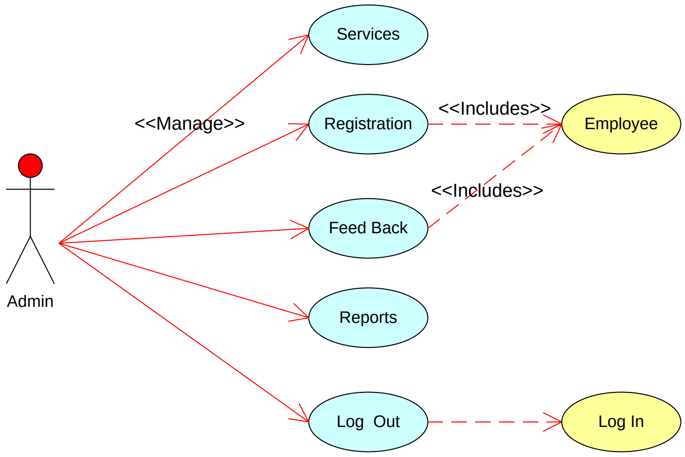
6.6 UML DIAGRAMS:

Use Case Diagrams:

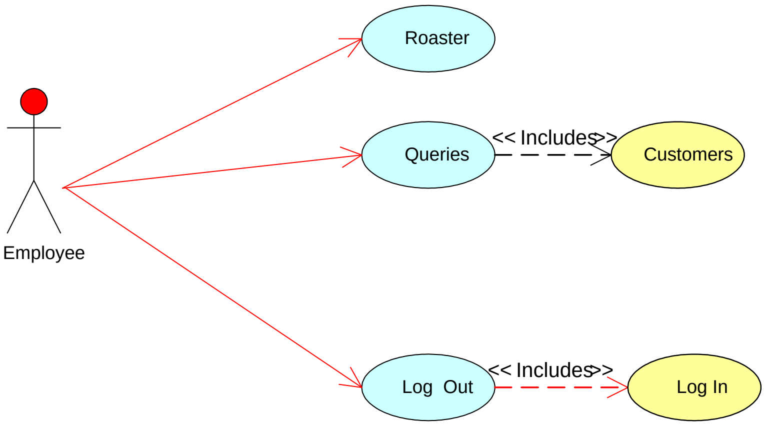
Over View Use Case Diagrams:



Admin Use Case Diagram:

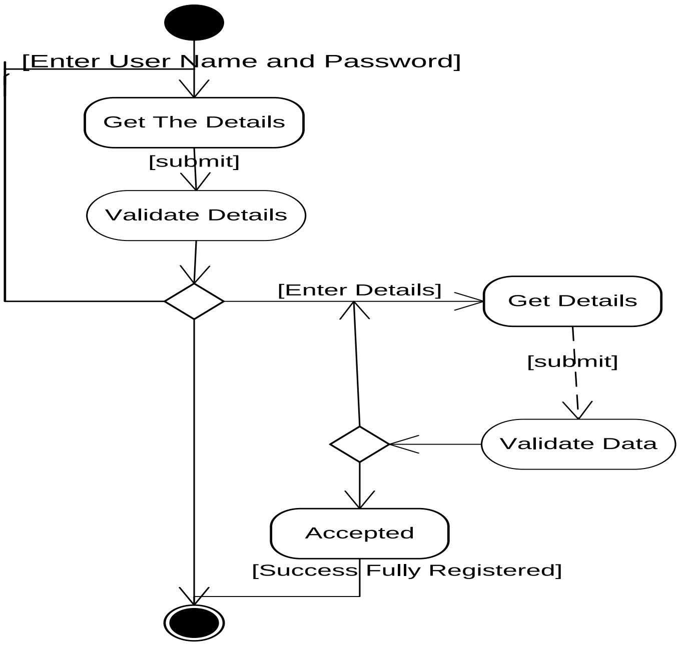


Employee Use Case Diagram:

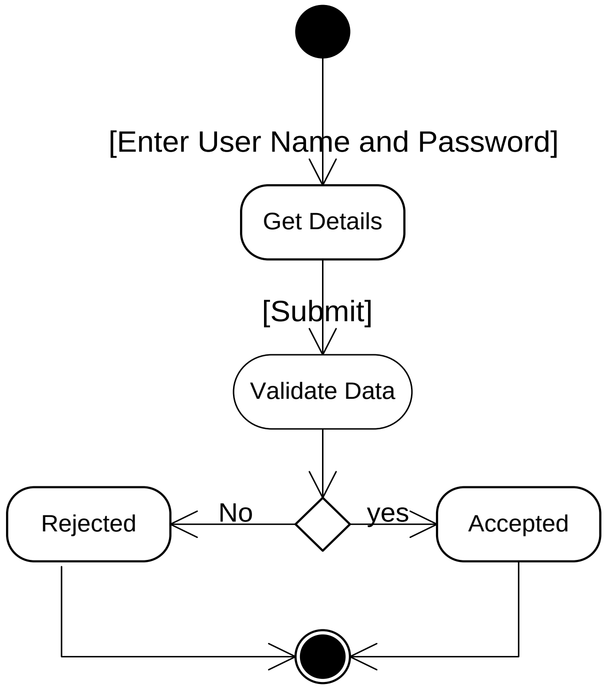


Activity Diagrams:

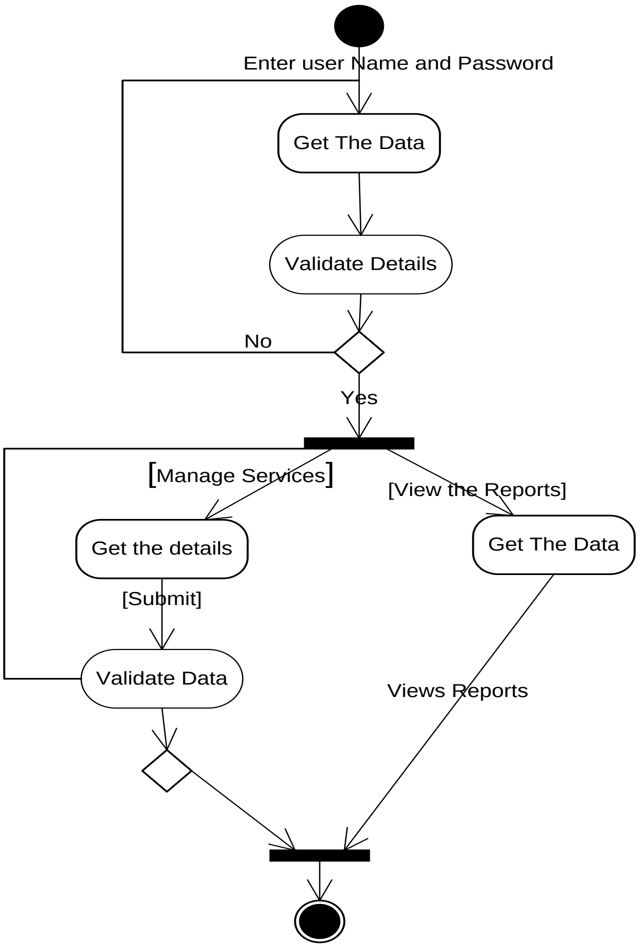
Registration Activity Diagram:



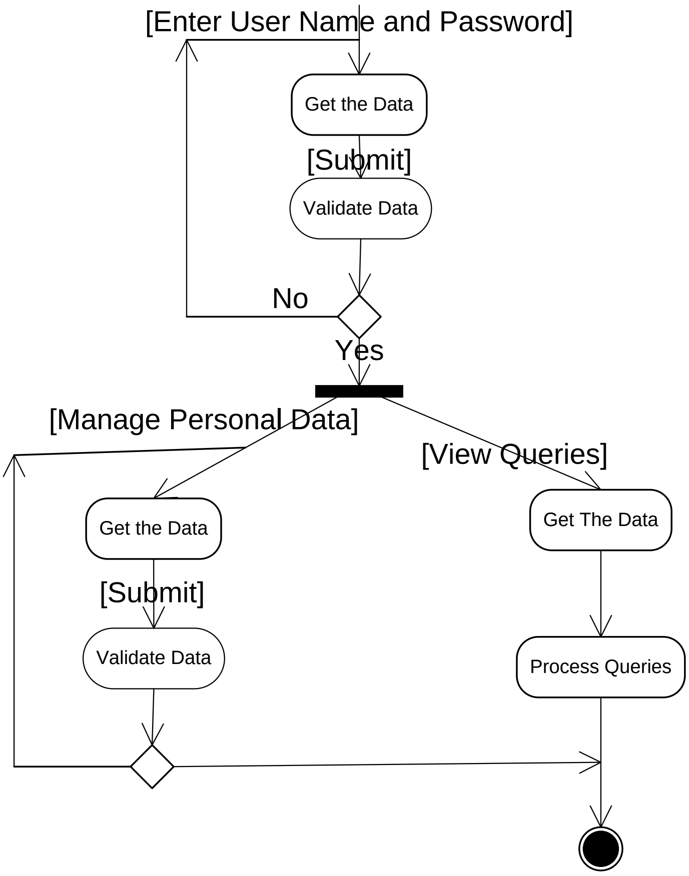
Login Activity Diagram:



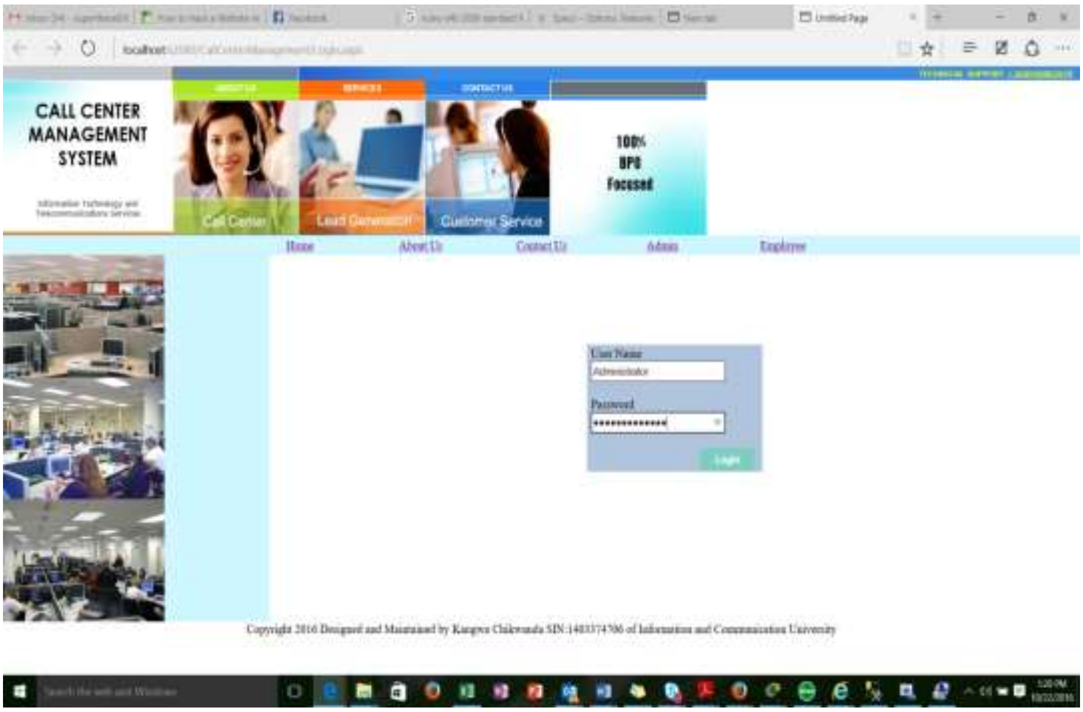
Admin Activity Diagram:



Employee Activity Diagram:



7. OUTPUT SCREENS



User Name
Administrator

Password
•••••••••••••

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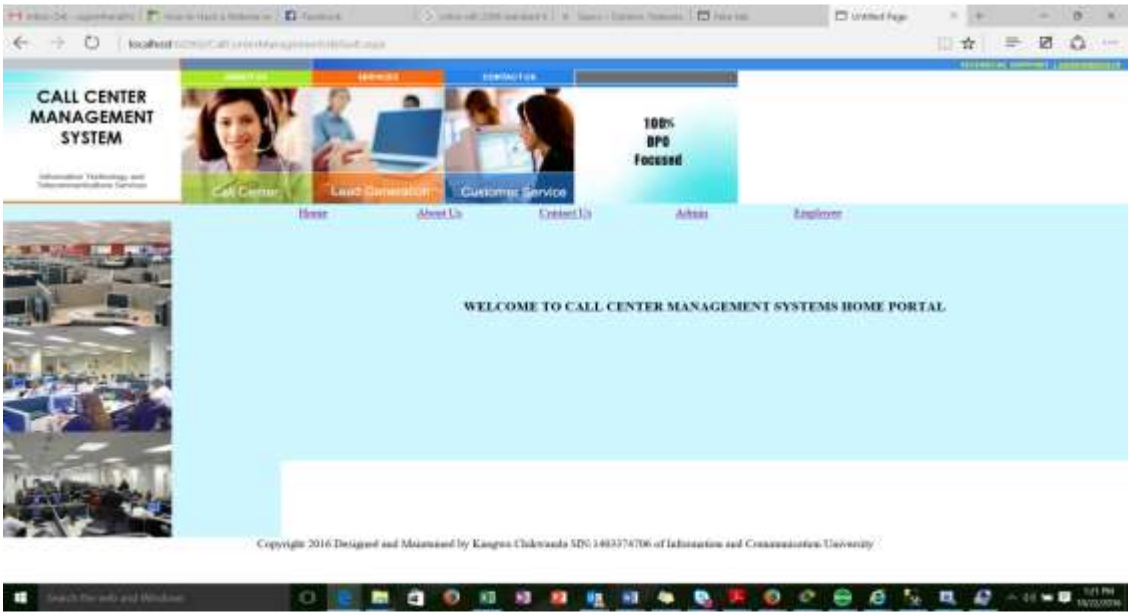

WELCOME TO CALL CENTER MANAGEMENT SYSTEMS HOME PORTAL

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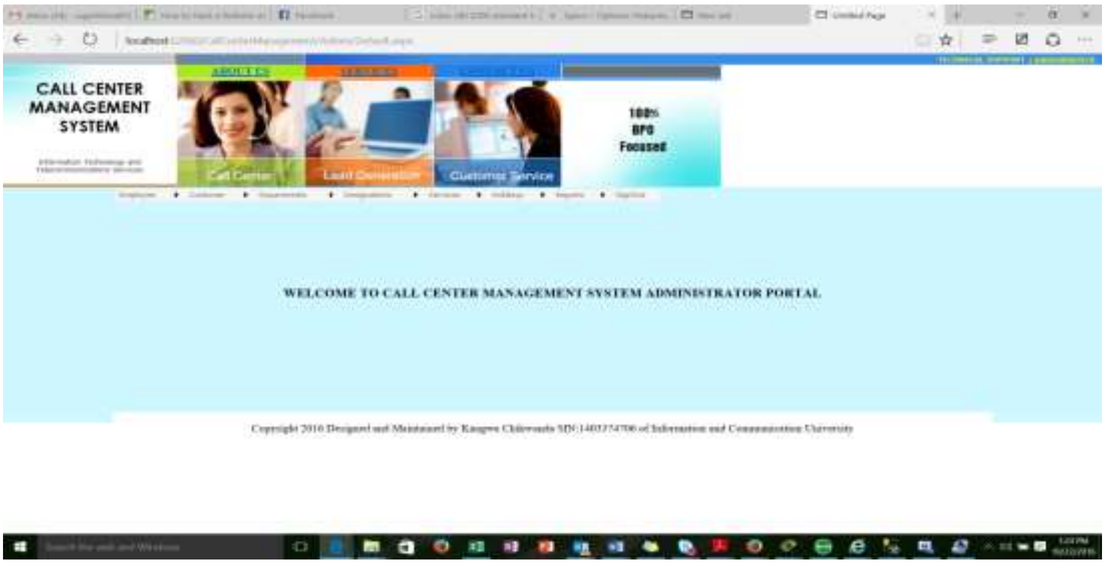

WELCOME TO CALL CENTER MANAGEMENT SYSTEM ADMINISTRATOR PORTAL

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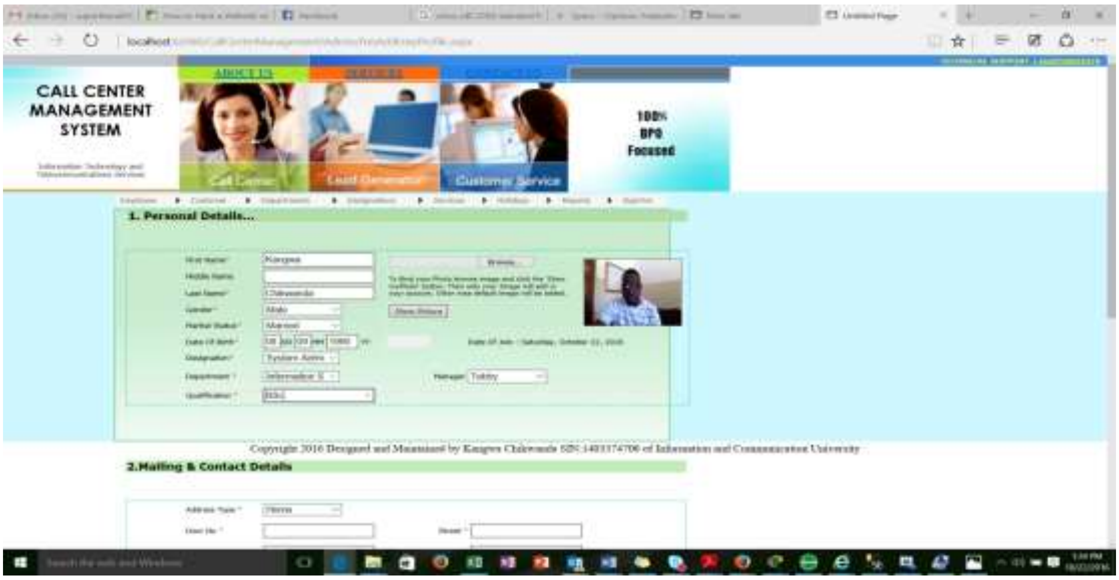

1. Personal Details...

First Name*	Kangwa
Middle Name	
Last Name*	Chikwanda
Gender*	Male
Marital Status*	Married
Date Of Birth*	[illegible]
Designation*	System Admin
Department *	Information S
Qualification *	BSc
Manager	[illegible]

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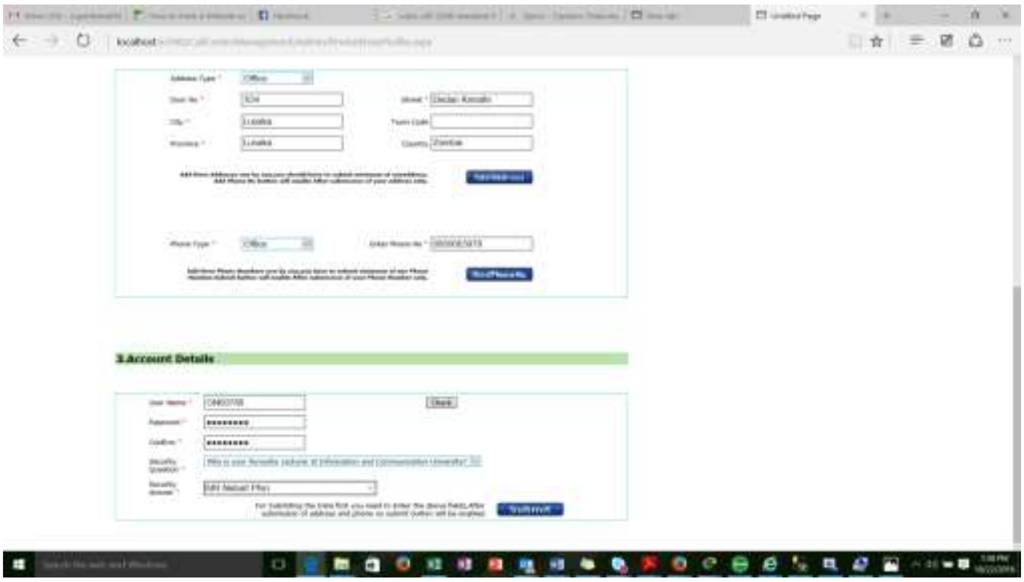
2.Mailing & Contact Details

Address Type *	[illegible]



Address Type * Office

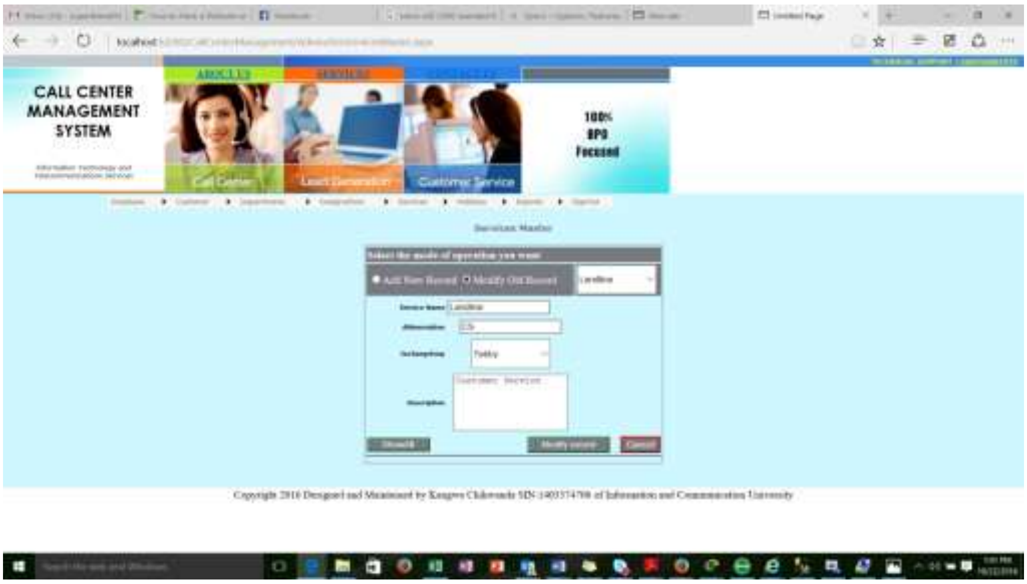
City * Lusaka

Province * Lusaka

Country Zambia

Phone Type * Office

3.Account Details



Services Master

Select the mode of operation you want

● Add New Record ○ Modify Old Record Landline

Service Name Landline

Description Customer Service

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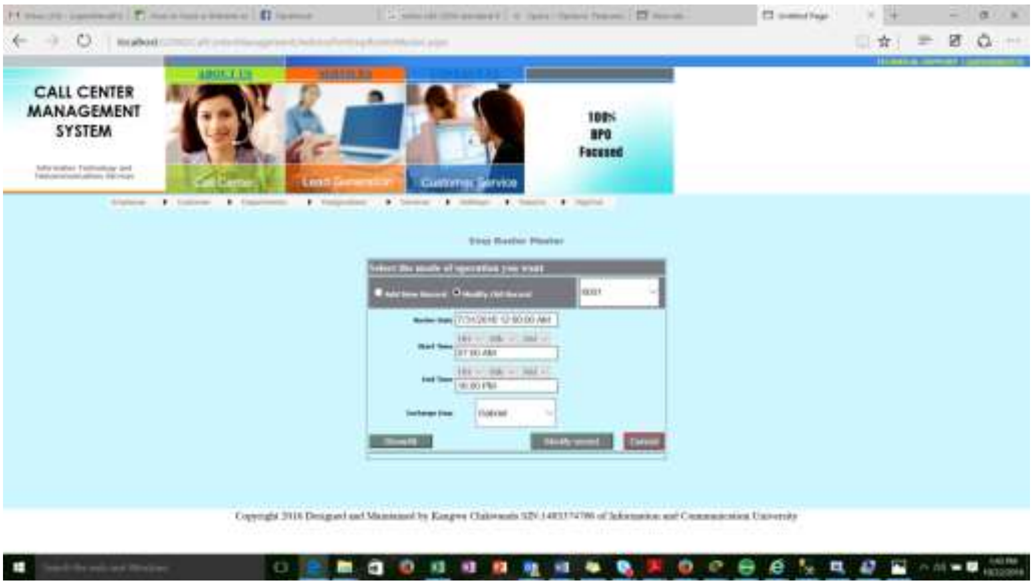

Select the mode of operation you want

○ Add New Record ● Modify Old Record

7/31/2016 12:00:00 AM

Start Time 07:00 AM

End Time 16:00 PM

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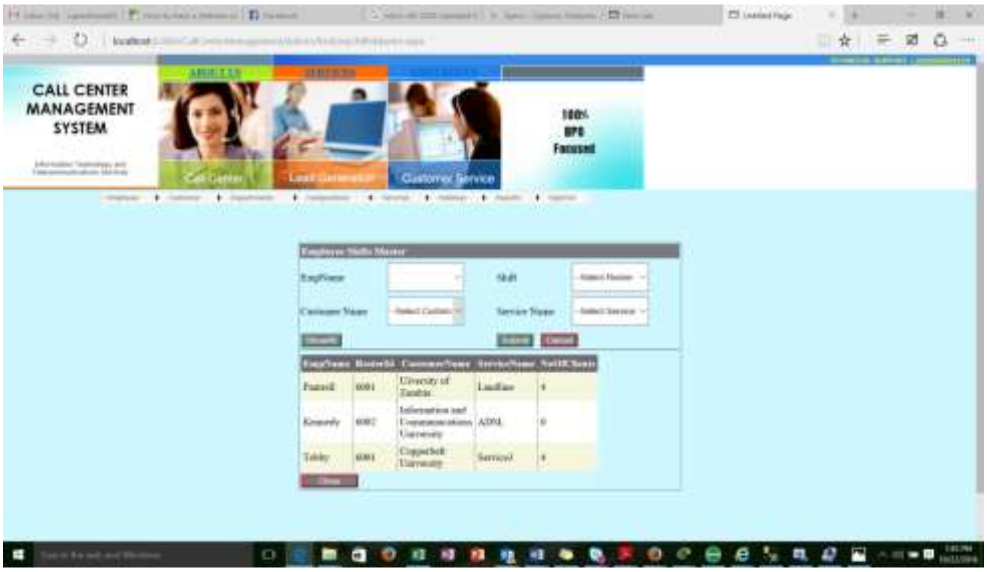
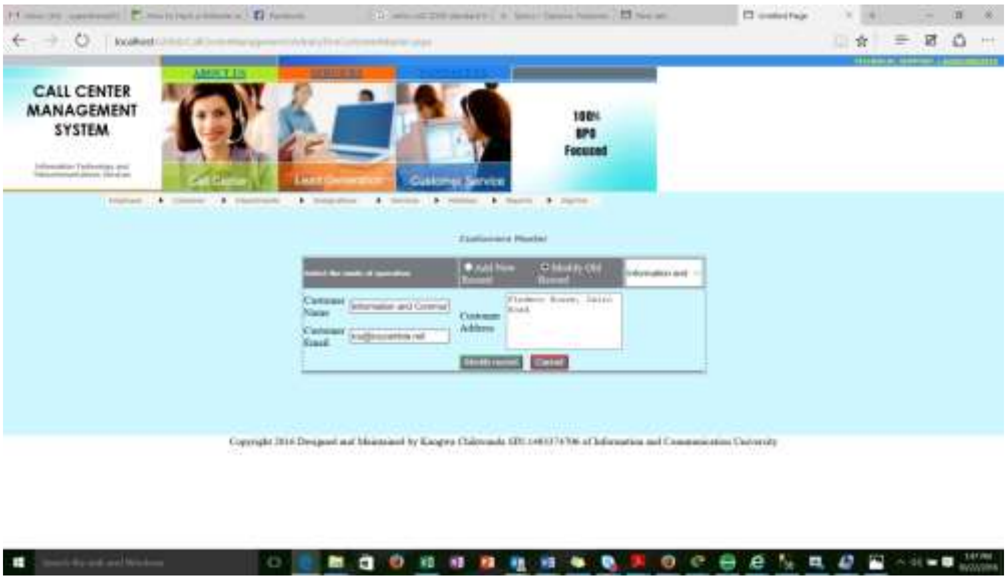


EmpName
Shift -Select Shift-
Customer Name -Select Custom-
Service Name -Select Service-

EmpName	RosterId	CustomerName	ServiceName	NoOfClients
Fumell	0001	University of Zambia	Landline	4
Kennedy	0002	Information and Communications University	ADSL	0
Tebby	0001	Copperbelt University	Serviced	4



Select the mode of operation ● Add New Record ○ Modify Old Record Information and

Customer Name: Information and Communi

Customer Email: ict@zamtel.net

Customer Address: Fledmore Rosary, Great East Road

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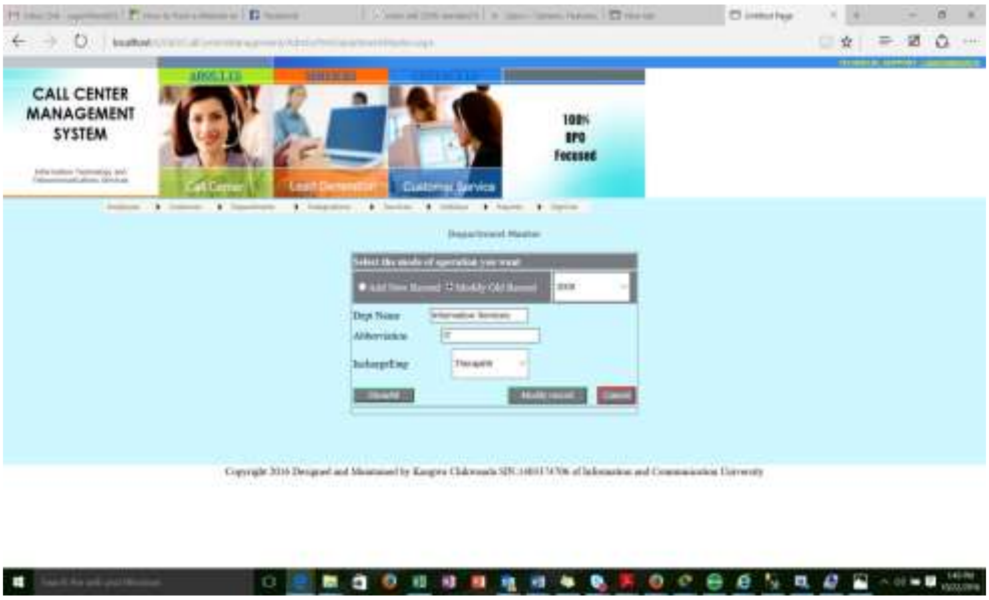

Select the mode of operation you want
● Add New Record ○ Modify Old Record 2008

Dept Name: Information Services

Abbreviation: IT

InchargeEmp: Therapeth

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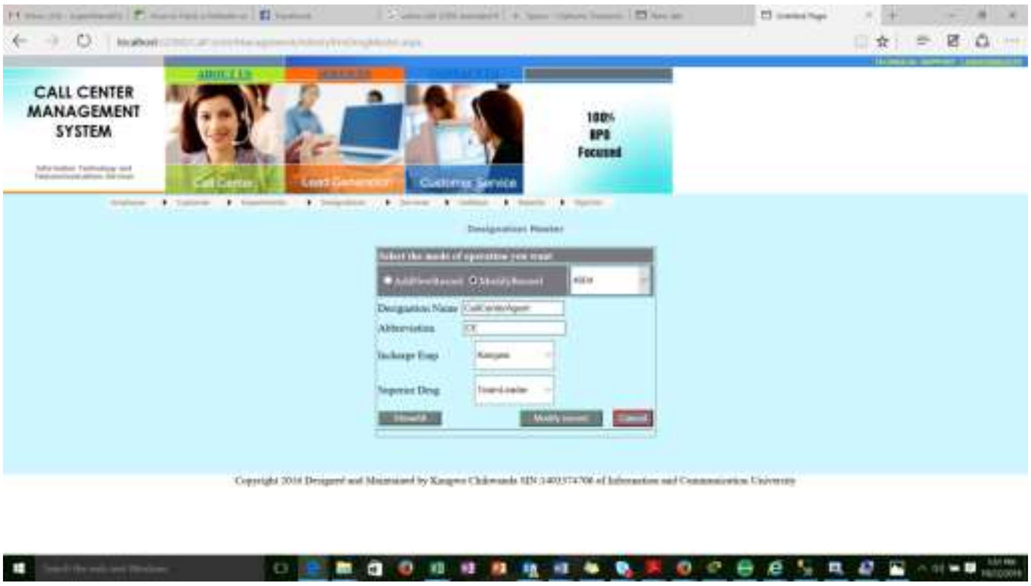

Designation Master

Select the mode of operation you want

● AddNewRecord ○ ModifyRecord

Designation Name: CallCenterAgent

Abbreviation: CE

Incharge Emp: Kangwe

Superior Desg: TeamLeader

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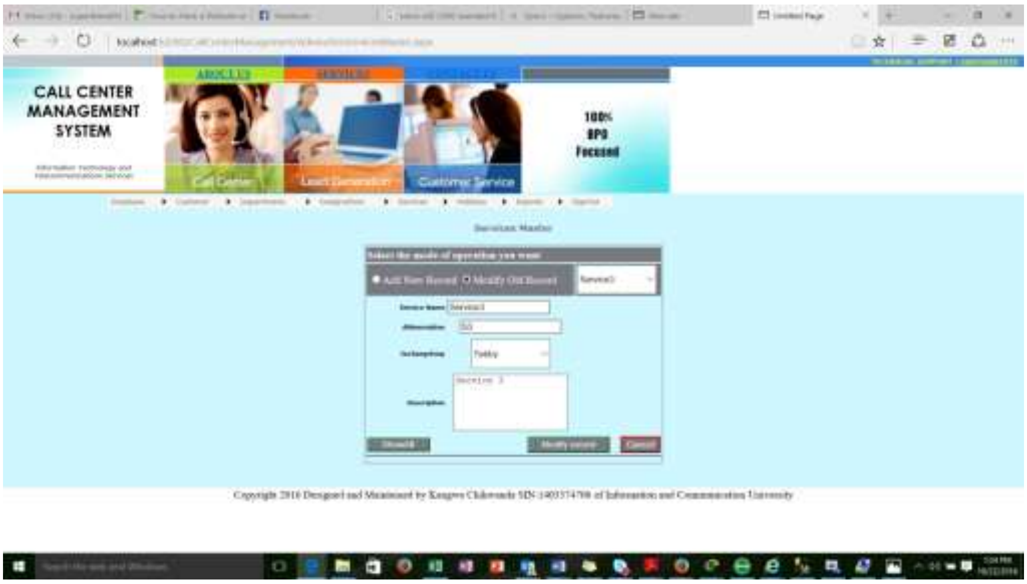

Services Master

Select the mode of operation you want

● Add New Record ○ Modify Old Record — Service3

Service Name: Service3

Abbreviation: S3

Incharge Emp: Tobby

Description: Service 3

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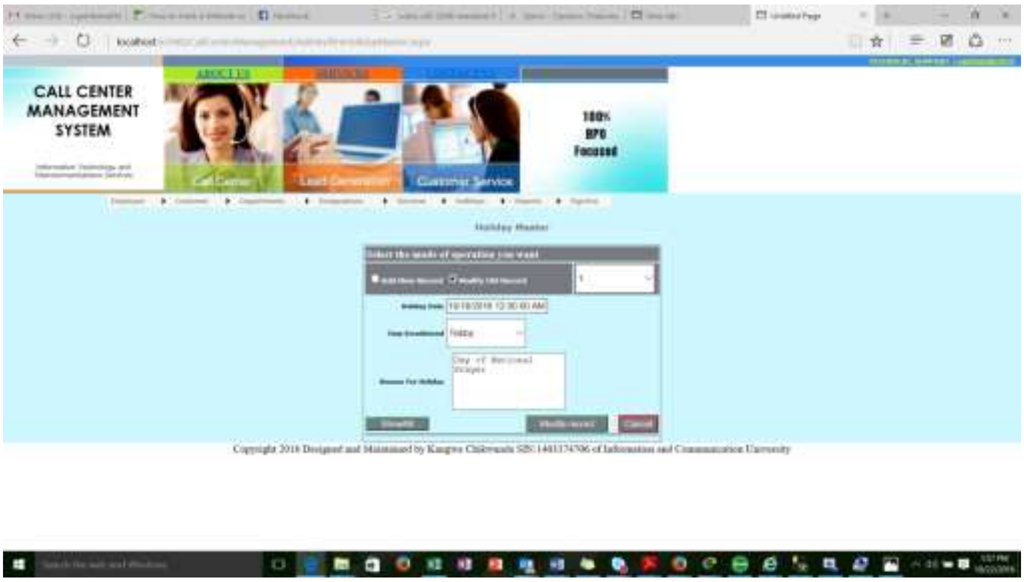

Holiday Master

Select the mode of operation you want

● Add New Record ○ Modify Old Record — 1

Holiday Date: 10/18/2016 12:00:00 AM

Emp Enrollment: Tobby

Reason For Holiday: Day of National Prayer

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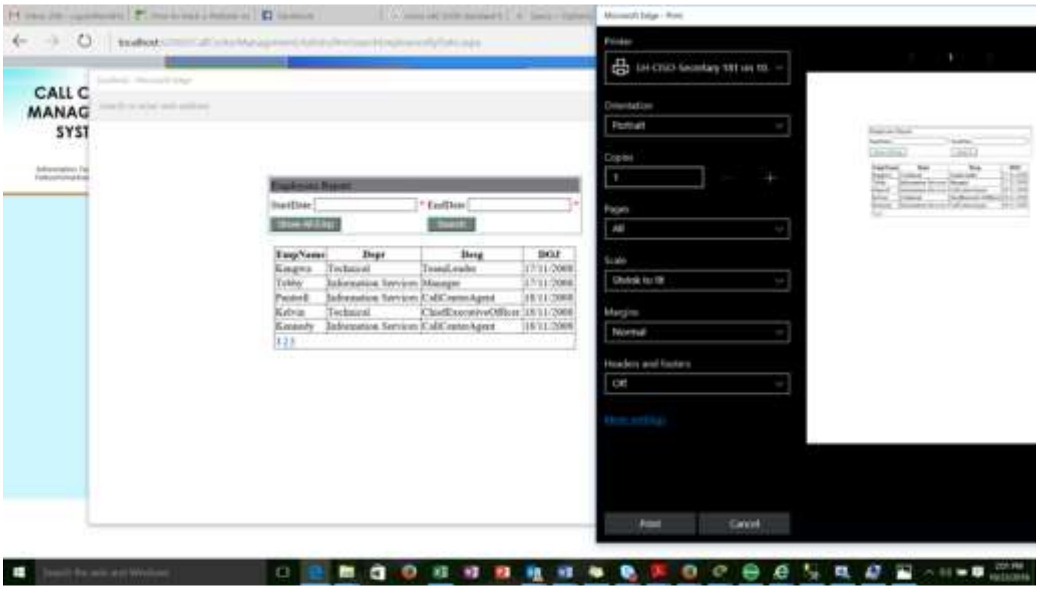


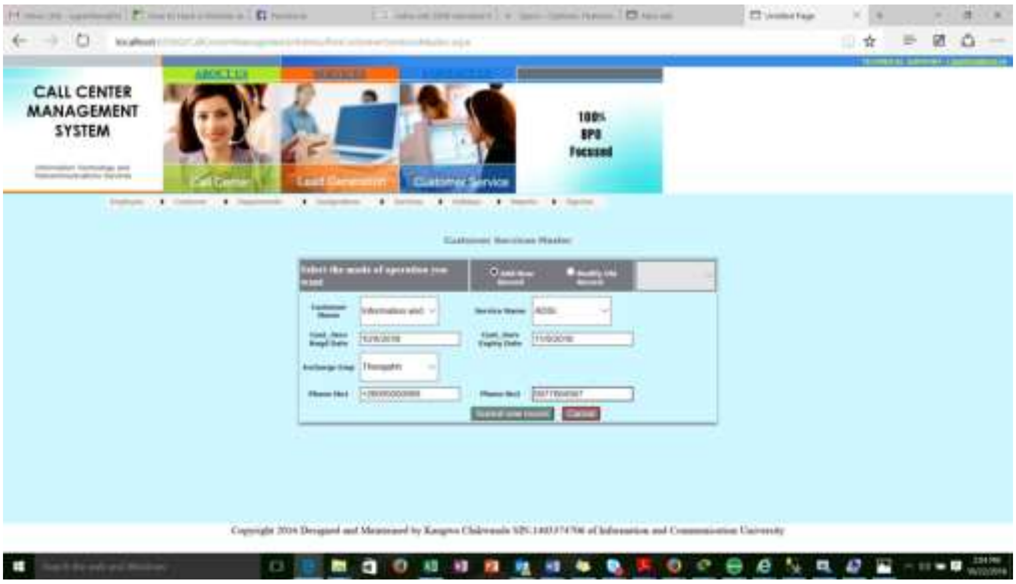
CALL C
MANAG
SYST

Employees Report

StartDate: * EndDate: *

Show All Emp Search

EmpName	Dept	Desg	DOJ
Kangwa	Technical	TeamLeader	17/11/2008
Tobby	Information Services	Manager	17/11/2008
Pasiendi	Information Services	CallCentreAgent	18/11/2008
Kelvin	Technical	ChiefExecutiveOfficer	18/11/2008
Kennedy	Information Services	CallCentreAgent	18/11/2008
1 2 3			



CALL CENTER MANAGEMENT SYSTEM

Customer Services Master

Select the mode of operation you want ○ Add New Record ● Modify the Record

Customer Name	Information and	Service Name	ADSL
Cust. Serv Regd Date	10/8/2016	Cust. Serv Expiry Date	11/9/2016
Exchange Grp	Thorngate		
Phone No1	+260000000000	Phone No2	0977004567

Submit new record Cancel

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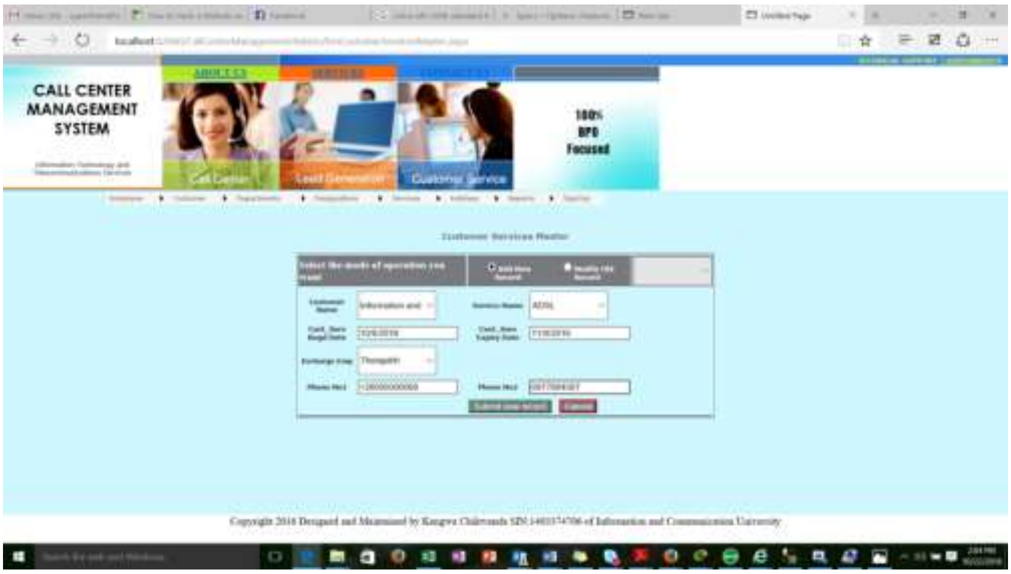

CALL CENTER MANAGEMENT SYSTEM

Customer Services Master

Select the mode of operation you want ○ Add New Record ● Modify the Record

Customer Name	Information and	Service Name	ADSL
Cust. Serv Regd Date	10/8/2016	Cust. Serv Expiry Date	11/9/2016
Exchange Grp	Thorngate		
Phone No1	+260000000000	Phone No2	0977004567

Submit new record Cancel

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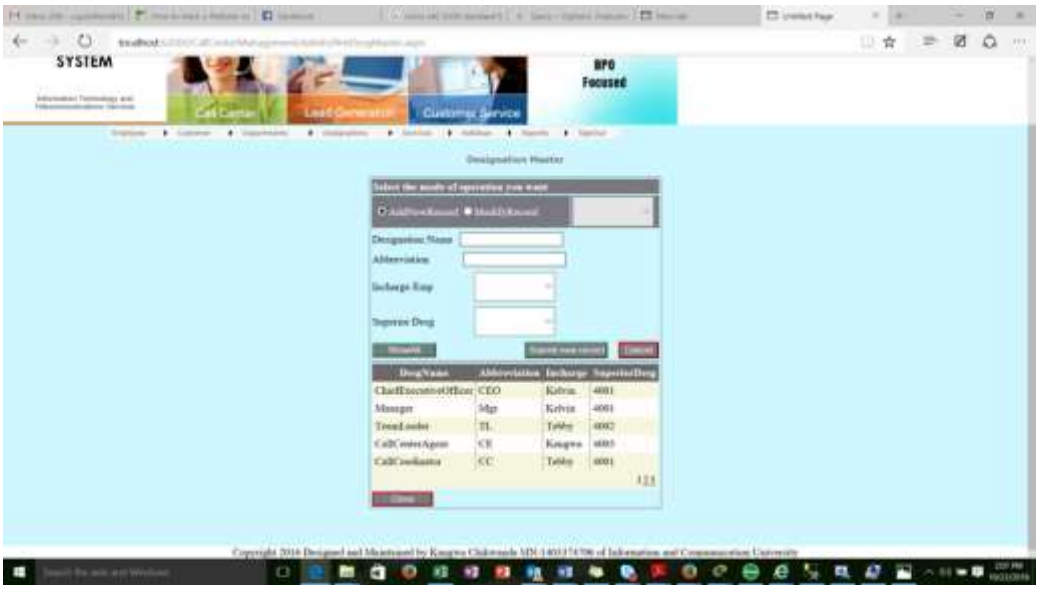

Designation Master

Select the mode of operation you want

○ AddNewRecord ● ModifyRecord

Designation Name

Abbreviation

Incharge Emp

Superior Desg

DesgName	Abbreviation	Incharge	SuperiorDesg
ChiefExecutiveOfficer	CEO	Kelvin	4001
Manager	Mgr	Kelvin	4001
TeamLeader	TL	Tebby	4002
CallCenterAgent	CE	Kangwa	4003
CallCoodinator	CC	Tebby	4001

1 2 3

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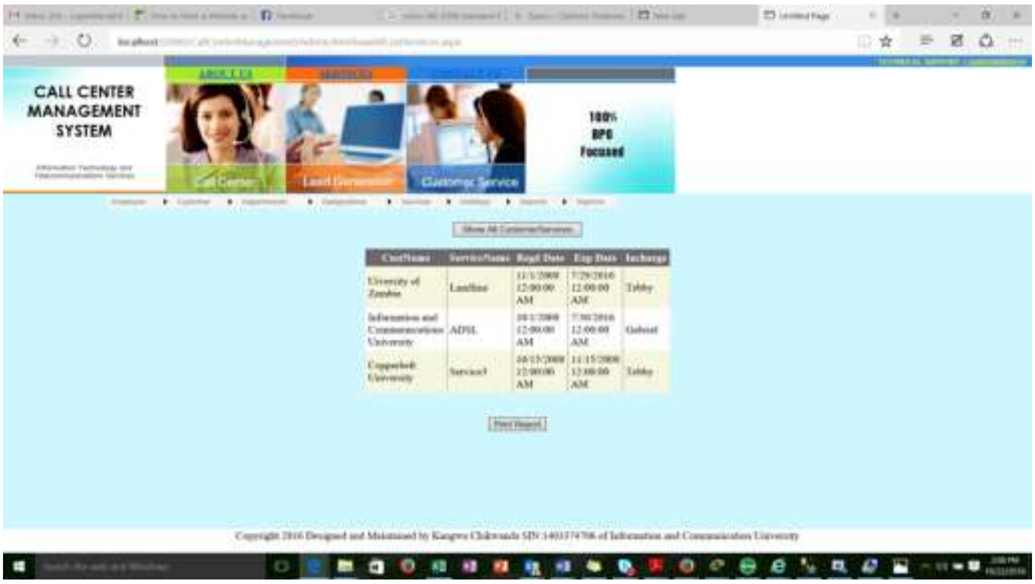

CustName	ServiceName	Regd Date	Exp Date	Incharge
University of Zambia	Landline	11/1/2008 12:00:00 AM	7/29/2016 12:00:00 AM	Tebby
Information and Communications University	ADSL	10/1/2008 12:00:00 AM	7/30/2016 12:00:00 AM	Gabriel
Copperbelt University	Service3	10/15/2008 12:00:00 AM	11/15/2008 12:00:00 AM	Tebby

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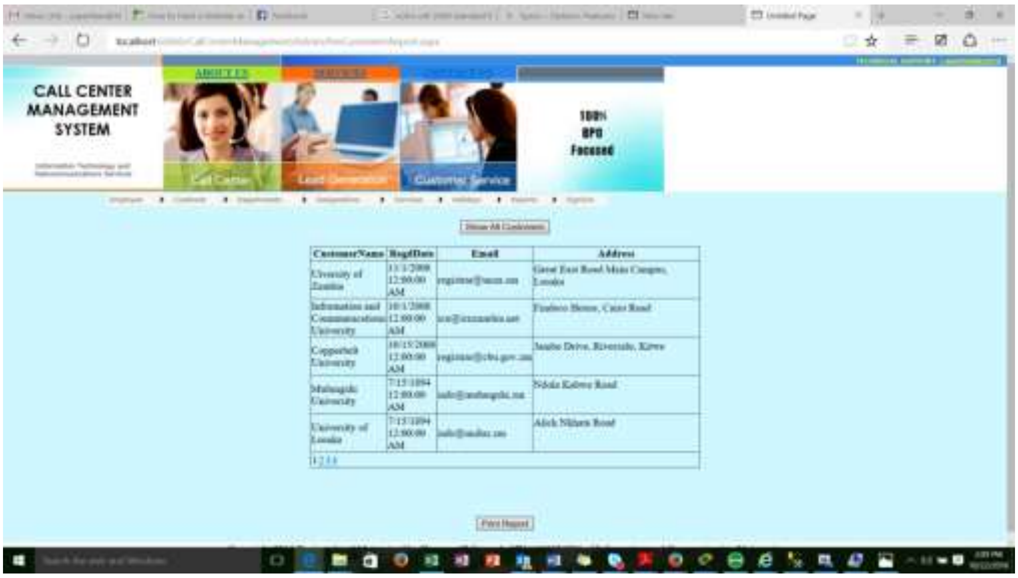
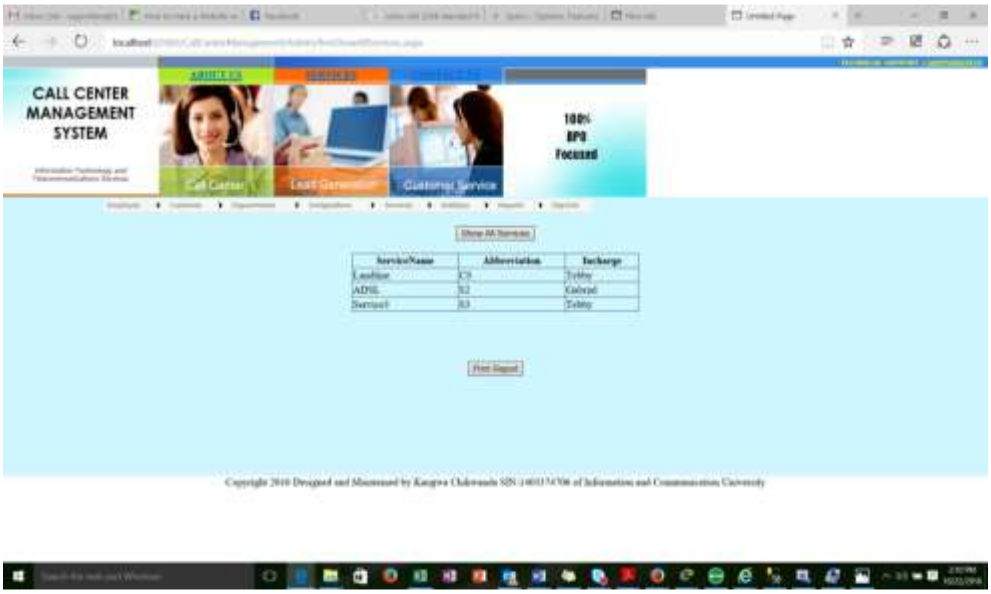


CustomerName	RegdDate	Email	Address
Uiversity of Zambia	11/1/2008 12:00:00 AM	registrar@unza.zm	Great East Road Main Campus, Lusaka
Information and Communications University	10/1/2008 12:00:00 AM	icu@iczambia.net	Findeco House, Cairo Road
Copperbelt University	10/15/2008 12:00:00 AM	registrar@cbu.gov.zm	Jambo Drive, Riverside, Kitwe
Mulungushi University	7/15/1994 12:00:00 AM	info@mulungushi.zm	Ndola Kabwe Road
University of Lusaka	7/15/1994 12:00:00 AM	info@unilus.zm	Alick Nkhata Road

1 2 3 4



ServiceName	Abbreviation	Incharge
Landline	S1	Tobby
ADSL	S2	Gabriel
Serviced	S3	Tobby

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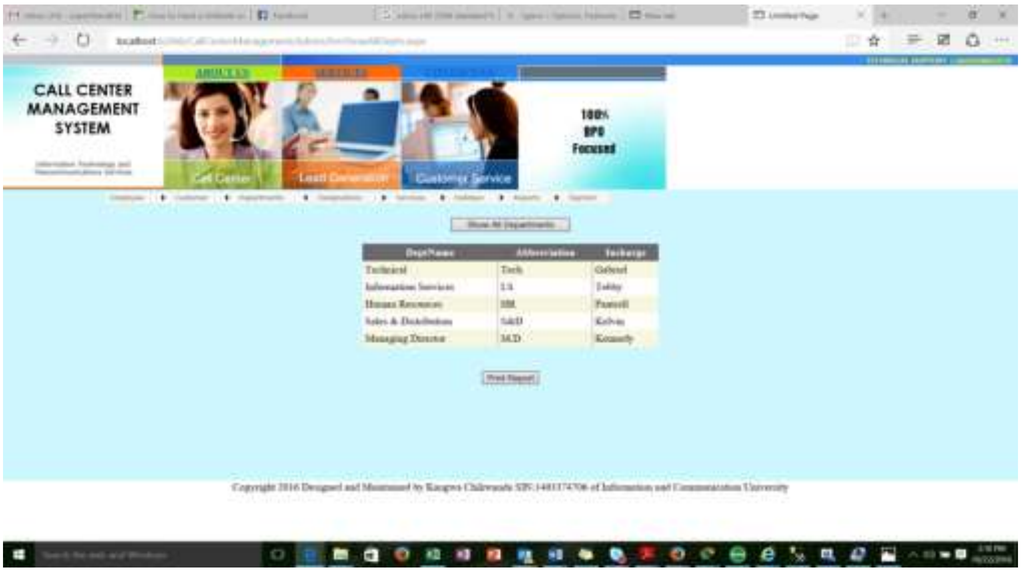

DeptName	Abbreviation	Incharge
Technical	Tech	Gabriel
Information Services	I.S	Tobby
Human Resources	HR	Pamell
Sales & Distribution	S&D	Kelvin
Managing Director	M.D	Kennedy

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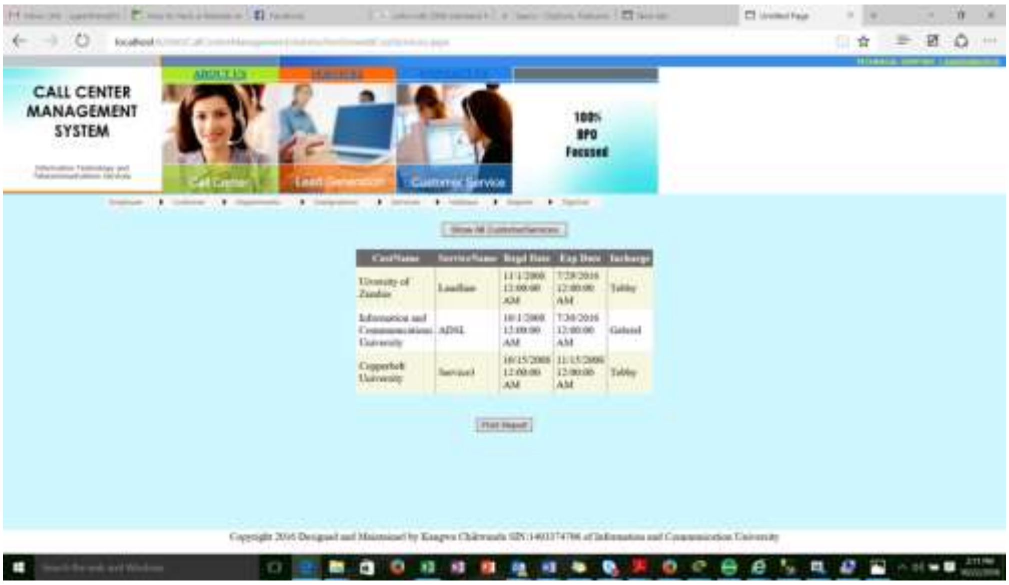

CustName	ServiceName	Regd Date	Exp Date	Incharge
University of Zambia	Landline	11/1/2008 12:00:00 AM	7/28/2016 12:00:00 AM	Tobby
Information and Communications University	ADSL	10/1/2008 12:00:00 AM	7/30/2016 12:00:00 AM	Gabriel
Copperbelt University	Serviced	10/15/2008 12:00:00 AM	11/15/2006 12:00:00 AM	Tobby

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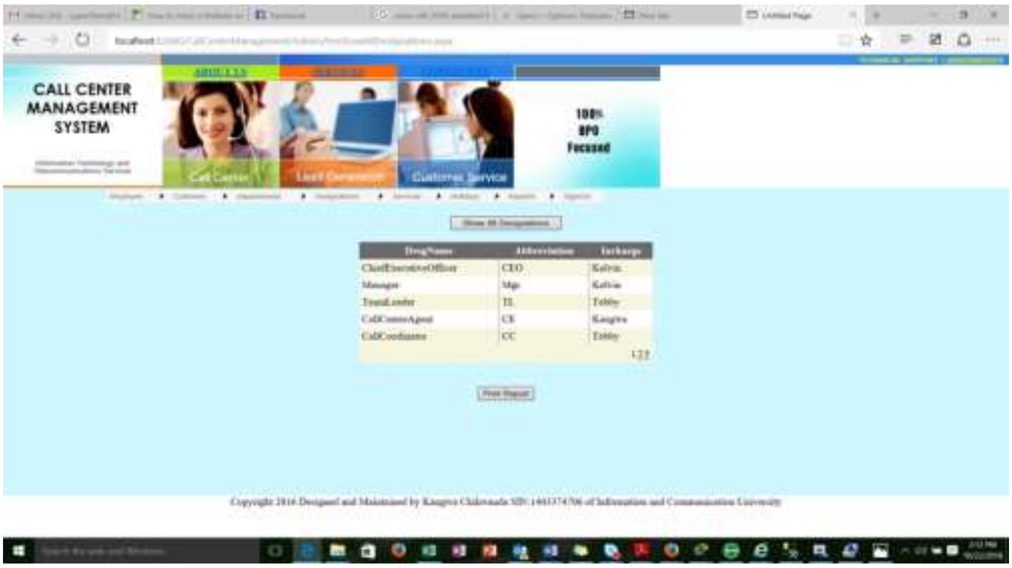

DesgName	Abbreviation	Incharge
ChiefExecutiveOfficer	CEO	Kelvin
Manager	Mgr	Kelvin
TeamLeader	TL	Tobby
CallCenterAgent	CE	Kangwa
CallCoordinator	CC	Tobby

1 2 3

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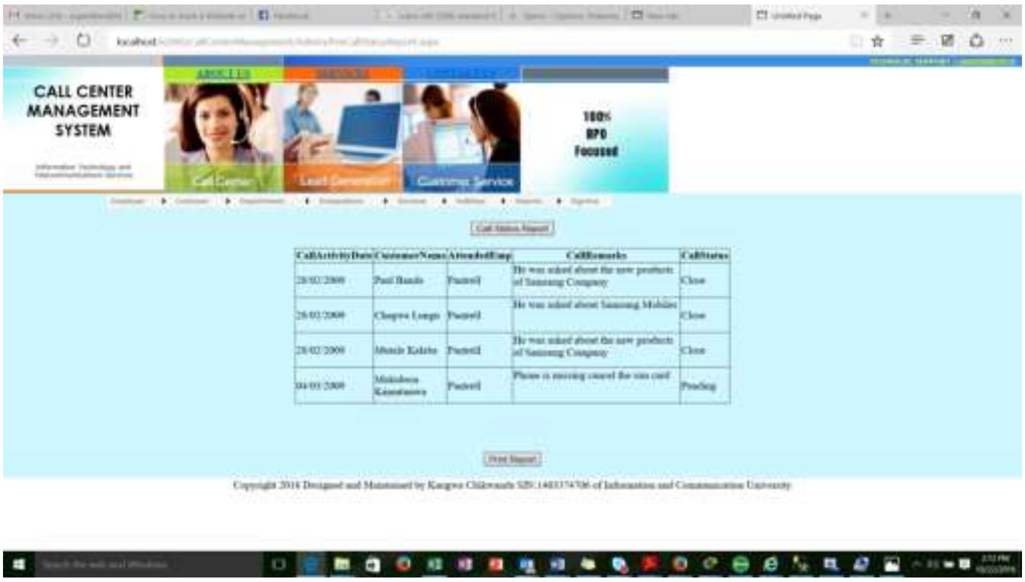

CallActivityDate	CustomerName	AttendedEmp	CallRemarks	CallStatus
28/02/2009	Paul Banda	Fastwell	He was asked about the new products of Samsung Company	Close
28/02/2009	Chopwa Lungu	Fastwell	He was asked about Samsung Mobiles	Close
28/02/2009	Mwale Kalaba	Fastwell	He was asked about the new products of Samsung Company	Close
04/03/2009	Mukuboma Kasamwa	Fastwell	Phone is missing cancel the sim card	Pending

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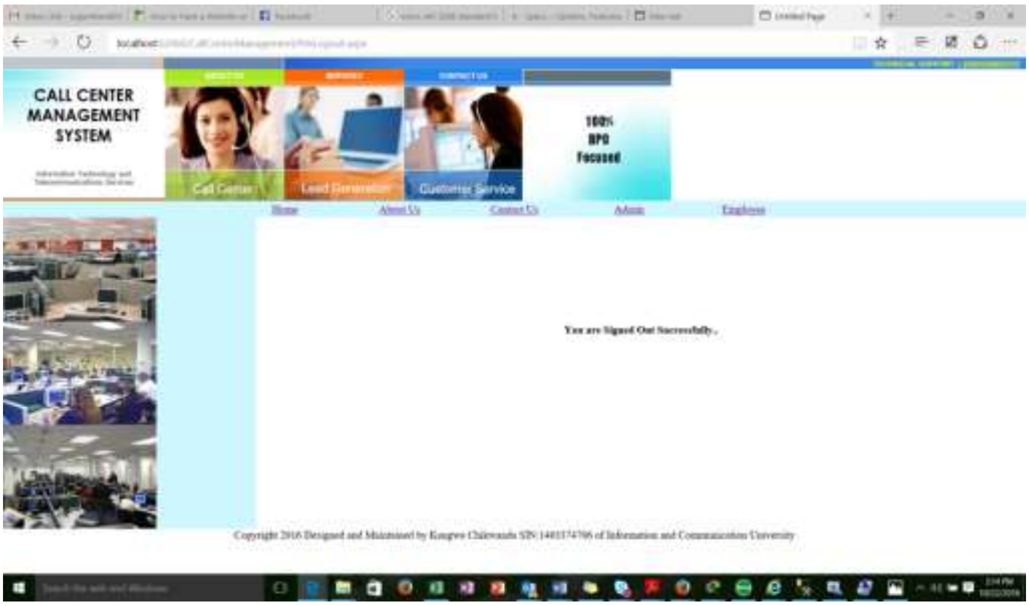

You are Signed Out Successfully..

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8. SYSTEM TESTING AND IMPLEMENTATION

8.1 INTRODUCTION:

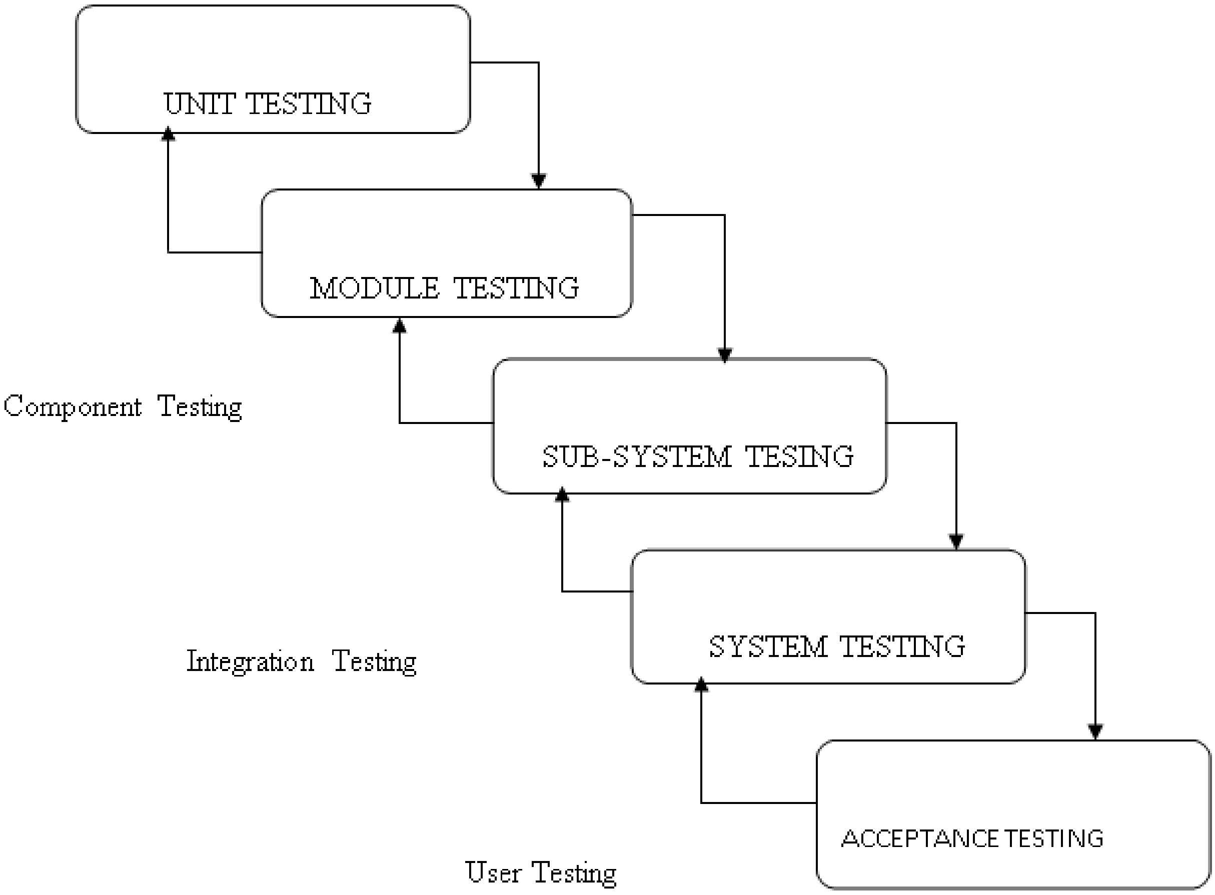
Software testing is a critical element of software quality assurance and represents the ultimate review of specification, design and coding. In fact, testing is the one step in the software engineering process that could be viewed as destructive rather than constructive.

A strategy for software testing integrates software test case design methods into a well-planned series of steps that result in the successful construction of software. Testing is the set of activities that can be planned in advance and conducted systematically. The underlying motivation of program testing is to affirm software quality with methods that can economically and effectively apply to both strategic to both large and small-scale systems.

8.2 STRATEGIC APPROACH TO SOFTWARE TESTING:

The software engineering process can be viewed as a spiral. Initially system engineering defines the role of software and leads to software requirement analysis where the information domain, functions, behavior, performance, constraints and validation criteria for software are established. Moving inward along the spiral, we come to design and finally to coding. To develop computer software, we spiral in along streamlines that decrease the level of abstraction on each turn.

A strategy for software testing may also be viewed in the context of the spiral. Unit testing begins at the vertex of the spiral and concentrates on each unit of the software as implemented in source code. Testing progress by moving outward along the spiral to integration testing, where the focus is on the design and the construction of the software architecture. Talking another turn on outward on the spiral we encounter validation testing where requirements established as part of software requirements analysis are validated against the software that has been constructed. Finally, we arrive at system testing, where the software and other system elements are tested as a whole.



8.3. UNIT TESTING:

Unit testing focuses verification effort on the smallest unit of software design, the module. The unit testing, we have is white box oriented and some modules the steps are conducted in parallel.

1. WHITE BOX TESTING:

This type of testing ensures that

- All independent paths have been exercised at least once
- All logical decisions have been exercised on their true and false sides
- All loops are executed at their boundaries and within their operational bounds
- All internal data structures have been exercised to assure their validity.

To follow the concept of white box testing we have tested each form, we have created independently to verify that Data flow is correct, All conditions are exercised to check their validity, All loops are executed on their boundaries.

2. BASIC PATH TESTING:

Established technique of flow graph with Cyclomatic complexity was used to derive test cases for all the functions. The main steps in deriving test cases were:

Use the design of the code and draw correspondent flow graph.

Determine the Cyclomatic complexity of resultant flow graph, using formula:

$V(G)=E-N+2$ or

$V(G)=P+1$ or

$V(G)=$Number Of Regions

Where $V(G)$ is Cyclomatic complexity,

E is the number of edges,

N is the number of flow graph nodes,

P is the number of predicate nodes.

Determine the basis of set of linearly independent paths.

3. CONDITIONAL TESTING:

In this part of the testing each of the conditions were tested to both true and false aspects. And all the resulting paths were tested. So that each path that may be generate on particular condition is traced to uncover any possible errors.

4. DATA FLOW TESTING:

This type of testing selects the path of the program according to the location of definition and use of variables. This kind of testing was used only when some local variable was declared. The *definition-use chain* method was used in this type of testing. These were particularly useful in nested statements.

5. LOOP TESTING:

In this type of testing all the loops are tested to all the limits possible. The following exercise was adopted for all loops:

All the loops were tested at their limits, just above them and just below them.

All the loops were skipped at least once.

For nested loops test the inner most loop first and then work outwards.

For concatenated loops the values of dependent loops were set with the help of connected loop.

Unstructured loops were resolved into nested loops or concatenated loops and tested as above.

Each unit has been separately tested by the development team itself and all the input have been validated.

9. SYSTEM SECURITY

9.1 INTRODUCTION:

The protection of computer based resources that includes hardware, software, data, procedures and people against unauthorized use or natural

Disaster is known as System Security.

System Security can be divided into four related issues:

- Security
- Integrity
- Privacy
- Confidentiality

SYSTEM SECURITY refers to the technical innovations and procedures applied to the hardware and operation systems to protect against deliberate or accidental damage from a defined threat.

DATA SECURITY is the protection of data from loss, disclosure, modification and destruction.

SYSTEM INTEGRITY refers to the power functioning of hardware and programs, appropriate physical security and safety against external threats such as eavesdropping and wiretapping.

PRIVACY defines the rights of the user or organizations to determine what information they are willing to share with or accept from others and how the organization can be protected against unwelcome, unfair or excessive dissemination of information about it.

CONFIDENTIALITY is a special status given to sensitive information in a database to minimize the possible invasion of privacy. It is an attribute of information that characterizes its need for protection.

9.2 SECURITY SOFTWARE:

System security refers to various validations on data in form of checks and controls to avoid the system from failing. It is always important to ensure that only valid data is entered and only valid operations are performed on the system. The system employees two types of checks and controls:

CLIENT SIDE VALIDATION:

Various client side validations are used to ensure on the client side that only valid data is entered. Client side validation saves server time and load to handle invalid data. Some checks imposed are:

- VBScript in used to ensure those required fields are filled with suitable data only. Maximum lengths of the fields of the forms are appropriately defined.
- Forms cannot be submitted without filling up the mandatory data so that manual mistakes of submitting empty fields that are mandatory can be sorted out at the client side to save the server time and load.
- Tab-indexes are set according to the need and taking into account the ease of user while working with the system.

SERVER SIDE VALIDATION:

Some checks cannot be applied at client side. Server side checks are necessary to save the system from failing and intimating the user that some invalid operation has been performed or the performed operation is restricted. Some of the server side checks imposed is:

- Server side constraint has been imposed to check for the validity of primary key and foreign key. A primary key value cannot be duplicated. Any attempt to duplicate the primary value results into a message intimating the user about those values through the forms using foreign key can be updated only of the existing foreign key values.

- User is intimating through appropriate messages about the successful operations or exceptions occurring at server side.

- Various Access Control Mechanisms have been built so that one user may not agitate upon another. Access permissions to various types of users are controlled according to the organizational structure. Only permitted users can log on to the system and can have access according to their category. User- name, passwords and permissions are controlled o the server side.

- Using server side validation, constraints on several restricted operations are imposed.

10. CONCLUSIONS

It has been a great pleasure for me to work on this exciting and challenging project. This project proved good for me as it provided practical knowledge of not only programming in ASP.NET and C#.Net web based application and no some extent Windows Application and SQL Server, but also about all handling procedure related with **"Call Center Management System".** It also provides knowledge about the latest technology used in developing web enabled application and client server technology that will be great demand in future. This will provide better opportunities and guidance in future in developing projects independently.

BENEFITS:

The project is identified by the merits of the system offered to the user. The merits of this project are as follows: -

- It's a web-enabled project.

- This project offers user to enter the data through simple and interactive forms. This is very helpful for the client to enter the desired information through so much simplicity.

- The user is mainly more concerned about the validity of the data, whatever he is entering. There are checks on every stages of any new creation, data entry or updating so that the user cannot enter the invalid data, which can create problems at later date.

- Sometimes the user finds in the later stages of using project that he needs to update some of the information that he entered earlier. There are options for him by which he can update the records. Moreover, there is restriction for his that he cannot change the primary data field. This keeps the validity of the data to longer extent.

- User is provided the option of monitoring the records he entered earlier. He can see the desired records with the variety of options provided by him.

- From every part of the project the user is provided with the links through framing so that he can go from one option of the project to other as per the requirement. This is bound to be simple and very friendly as per the user is concerned. That is, we can say that the project is user friendly which is one of the primary concerns of any good project.

- Data storage and retrieval will become faster and easier to maintain because data is stored in a systematic manner and in a single database.

- Decision making process would be greatly enhanced because of faster processing of information since data collection from information available on computer takes much less time than manual system.

- Allocating of sample results becomes much faster because at a time the user can see the records of last years.

- Easier and faster data transfer through latest technology associated with the computer and communication.

- Through these features it will increase the efficiency, accuracy and transparency,

LIMITATIONS:

➢ The size of the database increases day-by-day, increasing the load on the database back up and data maintenance activity.

➢ Training for simple computer operations is necessary for the users working on the system.

11. IMPROVEMENTS TO THE SYSTEM

➢ This System being web-based and an undertaking of Cyber Security Division, needs to be thoroughly tested to find out any security gaps.

➢ A console for the data center may be made available to allow the personnel to monitor on the sites which were cleared for hosting during a particular period.

➢ Moreover, it is just a beginning; further the system may be utilized in various other types of auditing operation viz. Network auditing or similar process/workflow based applications...

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