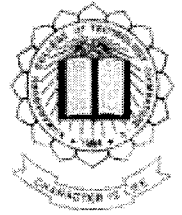P-1902

Environmental, Health and Safety System (EHS)

By

Raja.P

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Of

KUMARAGURU COLLEGE OF TECHNOLOGY

COIMBATORE

A PROJECT REPORT

Submitted to the
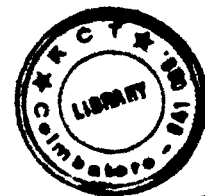
FACULTY OF INFORMATION AND COMMUNICATION ENGINEERING

In partial fulfillment of the requirements

For the award of the degree

Of

MASTER OF COMPUTER APPLICATIONS

July, 2007

Certificate

Kumaraguru College of Technology
COIMBATORE - 641006

Department of Computer Applications

<u>**Bonafide Certificate**</u>

Certified that this project report titled **Environmental, Health and Safety System (EHS)** is the bonafide work of **Mr.P. Raja (71204621026)** who carried out the research under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

Project Guide   Head of the Department

Submitted for the University Examination held on ___02·07·07_____

Internal Examiner   External Examiner

Company Certificate

SYSTEMS

This is to certify that the project work entitled "**Environmental, health and Safety System**" is a bonafide record of work done by **Mr. P. Raja (Reg. No. 71204621026)** as the final semester project in partial fulfillment of the requirement of award of Master of Computer Applications. His effort towards successful completion of the project from January 2007 to June 2007 is appreciable.

Date: 8.6.07

Place: Bangalore

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Abstract

Abstract

The new EHS (Environmental, Health and Safety) System will serve as repository of environmental, health and safety information on Tyco Electronics facilities/buildings. It will be the central source of information on buildings, contacts, permits, ISO, operations, audits, and safety information, among others.

Currently, an application to centralize the information does not exist. Several Microsoft Excel® and Microsoft Access® files are being maintained separately to contain the data. The existence of several files makes it difficult to consolidate data.

The goal of the new EHS system is to centralize information and consolidate reporting. The application can be accessed via the Tyco Electronics Intranet. There will be an initial four to five approximate users.

The EHS takes care of potential threats and provides reliable services to the organisation and user concerned, on demand. The system also helps provide an Administrator role to enable selected users to maintain user group, provide functionality to automatically create/open an email if a building contact is selected.

The system also provides for maintenance of building, contact, audit, and environmental information and provides parameterized reports. User can update their information as and when the changes takes place.

The Environmental, Health and Safety System (EHS) thus provides a comprehensive coverage of the functional requirements with regard to maintain the new system in a web-based environment for building and employees of Tyco Electronics.

Acknowledgement

Acknowledgement

I express my grateful thanks to our beloved principal, **Dr.Joseph V Thanikal**, Kumaraguru College of Technology, Coimbatore, for giving me an opportunity to take up this project.

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I also express my sincere gratitude to my external guide **Mr.P.Maniraj,** for his encouragement and guidance which help me in completing the project.

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Introduction

CHAPTER 1

INTRODUCTION

1.1 SYSTEM OVERVIEW

The project titled "**Environmental, Health and Safety (EHS) System**" serves as repository of environmental, health and safety information on company's facilities/buildings and offers total solution to the various maintenance requirements of the company buildings and employees.

The need for the EHS System felt due to the nature of the work required, which involves lot of updating works of information on buildings, contacts, permits, ISO, operations, audits, and safety information for a company. Moreover the process involved was quite a repetitive one and was prone to numerous errors which could result in inappropriate data being presented to the management.

Centralizing is the key to increase efficiency, performance and reliability in any system and is being rapidly followed in all walks of life. The problem with the traditional approach is that centralizing the information does not exist. Several Microsoft Excel® and Microsoft Access® files are being maintained separately to contain the data. The existence of several files makes it difficult to consolidate data. Centralizing helps eradicate the root cause of the error by completely automizing the system of maintenance.

The EHS integrates all the subsytems involved with result analysis such as Administration, Building audit and contact maintenance, Building environment and SIC codes and report system.

The Administrative subsytem drives the Security tier of the RAS. It separates the various categories of users by assigning them to respective Roles. Each role is

granted certain permissions over the menu and submenu items accordingly, thus depriving users of unauthorized access over restricted information. Each user has his user id and password and is associated with a Role.

The Building audit and contact maintenance involves Add, Edit and Delete the information of audit and contact for the building. Moreover it involves the functionality to automatically create/open an email if a building contact is selected. It takes care of maintenance of all the basic necessities of EHS which aids in its smooth functioning.

Another very important subsystem which powers the EHS System is Building environment and SIC codes. It involves Add, Edit and Delete the information of environment and SIC codes for the company's buildings. This subsystem maintains several environmental information on a building such as FormR, Permit and Certifications separately.

The Report system is the main subsystem which is used to produce the parameterized reports based on adhoc inputs/queries. Reports may be viewed, printed, and/or exported to Excel® or saved as html. Users may select from available criteria to generate reports.

1.2   COMPANY PROFILE

The project entitled "Environmental, Health and Safety System" is developed for Synergy Systems at Bangalore. This company provides business and technology consulting, custom application development and systems integration services. This company was established in December 1992 at #10,1st Floor,5th Main,6th Block, Koramangala, Bangalore - 560 095 and its focus is on building high-quality, rugged applications with seamless data exchange and integration with your company's existing applications and systems. More than 100 employees are employed in this company in all the departments.

There is no franchise for this company and its marketing network is done directly rather than through agencies. The marketing area for the export of the company projects are focused not only in India but also in many foreign countries. The countries that are in contact with this company are Malaysia, Singapore and USA.

The production capacity is up to 10 projects per month and it accepts a minimum order of 3 projects per platform. We specialize in large, scalable database systems that connect seamlessly to back-end applications. We have found the key to any successful engagements has been our emphasis on the smooth flow of intersystem data and operational controls. The company partner with its clients to create technology solutions that solve business problems and enable organizations to gain a competitive advantage.

Synergy Systems has successfully implemented solutions with a diverse clientele Such as Mass Buy, Tyco Electronics, New England Journal of Medicine, Pan-Mass Challenge, Phoenix Color Corporation.

System Study and Analysis

CHAPTER 2

SYSTEM STUDY AND ANALYSIS

2.1 PROBLEM STATEMENT

The employee has to manually make the changes into work sheets and perform various operations related to summarizing those changes and finally submit a copy of the reports generated to the management. The tasks involved in the generation of these reports are repetitive. Often, due to the repetitive nature of the work and the tedious process involved, errors creep into these reports which lead to inconsistent information being submitted to the management. Inconsistent reports lead to less full proof decisions being made to improve the quality of education being provided to students.

Contact maintenance is also a repetitive task and is error prone. Contact person allotted for one building might changes to another building or he/she might allotted to more than one type of contact. This would affect overall contact maintenance.

Building audit, SIC codes and environmental maintenance involves many updating information to the particular building. In this, the information placed for building needs to obtained from the concerned persons and be filed again in paper documents. The information is quite difficult to obtain in case these files are misplaced.

The events happening in the company must be known to the employees in earlier and announcement of those faces many problems.

The company requires a system which could help ease out the problems faced in each of the scenarios mentioned above.

2.2   EXISTING SYSTEM

The changes taken place in the company has to be updated manually and recorded into worksheet manually. The changes are then consolidated to frame various reports which are to be reviewed. If any mistake found, then entire report must be changed.

The contact maintenance is very tedious process and it requires high manual work. For assigning a person as contact, all the employees in that particular building must be searched and based on the search report, the assigning process made. In this, many problems should be faced such as enquiring.

Building audit, SIC codes and environmental maintenance involves many risks. The audit for particular building is done by the concerned person and those details must be given to the data entry operator for storing it. Similarly the SIC code allotted for the building also suffers the same problem. The environmental information such as form R, permit and certifications are entered only by manual. These require a lot of care and concentration. Generating the report for these activities was a risky job.

Employee details are maintained on separate forms. These forms are updated to reflect changes in employee records. Employees add details on contact also. These forms are also updated to reflect promotions and other details. Employee details are quite critical at the time of performance appraisals.

The events to be happening in the company are to be announced to the employees of the company only through notice board. This list is not available to the employees unless when displayed on the notice board.

2.2.1 Drawbacks of the Existing System

The drawbacks of the existing systems can be summarized as below:

- ➤ Time Consuming.
- ➤ Data Redundancy.
- ➤ Data Inconsistency.
- ➤ Lot of paperwork.
- ➤ Historical data retrieval takes a long time.
- ➤ Access and retrieval of relevant information requires considerable overhead.
- ➤ Generation of reports is difficult, since various records are to be verified.

2.3 PROPOSED SYSTEM

The proposed system would automate all of the manual processes described which would help to reduce the overhead and make the whole process simple and efficient. The proposed system will have computerized data entry screens and processes can be caried out based on inputs from those screens. A set of reports would be provided to ease out the end users task of having to consolidate data to be sent across to the management.

2.3.1 Advantages of the Proposed System

The expected benefits of the Proposed System are as follows:

- ➤ Easy to use and Simple.
- ➤ New modules can be added with ease without much modifications to the existing system.

> ➤ Flexible and Scalable.

> ➤ Secure.

> ➤ Data available on demand.

> ➤ Retrieval of historical records will be much simpler.

> ➤ Easier software updates and removal.

> ➤ Automatic multiple client support.

> ➤ Data is centralized. Users will be viewing and maintaining the data from a single application.

2.4   FEASIBILITY ANALYSIS

Feasibility analysis is the measure of how beneficial or practical the development of EHS System will be to the Organization. Once the problem is explained information is gathered about the system to test whether the system is viable Technically, Financially and Operationally. Thus, feasibility study is carried out in three phases as follows:

2.4.1   Technical Feasibility

Technical Feasibility is the measure of practicality of a specific technical solution and the availability of technical resources and expertise. It centers on the existing computer system (hardware, software, etc.) and to what extent it can support the new addition.

The proposed system is to be developed using ASP.Net and SQL Server which are some of the leading technologies of Microsoft in the market. These resources are very common and used widely in all places. These technologies work on all architectures i.e. on all available platforms. Hence if the company decides to shift on to Linux platform later, the system can be ported across to it. These features of the selected technologies are quite beneficial to the proper functioning of the system in different environments.

2.4.2 Operational Feasibility

Operational Feasibility asks if the system will work when it is developed and installed. It checks for the support of the management, the current business methods, user's involvement and their attitude towards the proposed system, etc.

The proposed system has found encouraging support from the company employees and management as it will be of great use to them. The employees of the organization are also committed to have the system operational as it will save time and reduce their workload. Also since the Company employees can have easy access to building, audit and contact information, maintenance they are very much in favor of implementing the system. The current processes followed in the company would be depicted in the system as it is very effectively.

2.4.3 Economic Feasibility

Economic Feasibility is the measure of the cost-effectiveness of the proposed system. The investment to be made in the proposed system must prove a good investment to the organization by returning benefits equal to or exceeding the costs incurred in developing the system.

The proposed benefits of the system will outweigh the costs to be incurred during system developed since the system does not require procurement of additional hardware facilities except framework it is economically feasible. In addition capability of the system to incorporate future enhancement will improve the performance to suit the future need of the company.

2.5 USERS OF THE SYSTEM

The users of the proposed EHS System have been categorized as below and each of the user categories will have a set of rights which manage their use of the proposed system.

- ➤ Administrators
- ➤ Update Users
- ➤ Inquiry Users

Administrator is authorized to make changes to all data available in the system, add users, remove users and assign permissions to each user through roles. Administrator can be anybody with a proper knowledge of the working of the system. The administrator can change the overall appearance of the system. The administrator has to see to it that only valid data is being entered into the system. He/She is accountable for the consistency and integrity of the data in the system. They also have all maintenance role capabilities.

Update users can access all data available in the system. They would be allowed access to all reports generated by the system and can update his/her details into the system in the maintenance sections. They can insert, update, and delete any data on the EHS Database. They also have all inquiry role capabilities.

Inquiry users fall into the category of users who have the least privileges on the system. They are only entitled to view the reports that restrict him to perform queries in the report section. He/she can also export the report to excel for reference. He has got view level rights only. They can only perform queries on the EHS Database and view all reports on the EHS Database.

Development Environment

CHAPTER 3

DEVELOPMENT ENVIRONMENT

3.1 HARDWARE REQUIREMENTS

The hardware support required for deploying the application:-

Server Configuration

Processor	: Pentium 3 Processor or above
RAM	: Minimum 512 MB
Hard Disk	: 20GB or more

Client Configuration

Processor	: Pentium 3 Processor or above
RAM	: Minimum 128 MB

3.2 SOFTWARE REQUIREMENTS

The software support required for deployment is:-

Operating System	: Microsoft Windows XP
Web Server	: IIS running on Windows XP server
Database	: SQL server
Software for development	: Visual Studio.Net
Tools used	: ASP.Net
Web browser	: IE 5.0

3.3 PROGRAMMING ENVIRONMENT

3.3.1 Microsoft .Net

- Microsoft® .NET is a set of Microsoft software technologies for connecting information, people, systems, and devices.

- .NET is a platform that provides a standardized set of services.

- It's just like Windows, except distributed over the Internet.

- It exports a common interface so that its programs can be run on any system that supports .NET.

3.3.2.1 ASP.Net

- Framework for building Web applications and Web services in any .NET language such as C#, C++, VB.NET, JScript, etc.

- Automatic multiple clients support like DHTML, HTML 3.2, WML, small devices

- Compilation of ASP.NET Web applications into .NET assemblies

  o Cached the first time when called

  o All subsequent calls use the cached version

- Separation of code and content

  o Developers and designers can work independently

3.3.2.2 Advantages of ASP.Net

- Rich page architecture – "Web Forms"

- Rich set of ASP.NET server controls

  o Data validation

  o Data bound grids

- Event-driven execution model

- Great Web-services support

- Easy to deploy

- High reliability and availability

- High performance and scalability

- Scalable handling of state information

3.3.3.1 SQL Server 2000

The database component of Microsoft® SQL Server™ 2000 is a Structured Query Language (SQL)–based, scalable, relational database with integrated Extensible Markup Language (XML) support for Internet applications. Microsoft® SQL Server™ 2000 extends the performance, reliability, quality, and ease-of-use of Microsoft SQL Server version 7.0. Microsoft SQL Server 2000 includes several new features that make it an excellent database platform for large-scale online transactional processing (OLTP), data warehousing, and e-commerce applications.

3.3.3.2 Features of SQL Server 2000

SQL Server 2000 provides statements for a variety of tasks, including:
- Querying data
- Inserting, updating, and deleting rows in a table
- Creating, replacing, altering, and dropping objects
- Controlling access to the database and its objects
- Guaranteeing database consistency and integrity
- Supports stored procedures

System Design and Development

CHAPTER 4

SYSTEM DESIGN AND DEVELOPMENT

4.1   ELEMENTS OF DESIGN

System Design is the most creative and challenging phase in the development of a software system. Design implies to a description of the final system and the process by which it is developed. The first step is to determine what input data is needed for the system and then to design a database that will meet the requirements of the proposed system. The next step is to determine what outputs are needed from the system and the format of the output to be produced.

During the design of the proposed system some areas where attention is required are:

➤ What are the inputs required and the outputs produced?
➤ How should the data be organized?
➤ What will be the processes involved in the system?
➤ How should the screen look?

The steps carried out in the design phase are as follows:

➤ Modular Design
➤ Input Design
➤ Output Design
➤ Database Design

4.1.1 Modular Design

It is always difficult for any System Development team to grasp a system without breaking it into several smaller systems. These smaller systems will be a part of the original system yet they will be independent in the sense that they will incorporate within them the major functionalities of the proposed system.

A software system is always divided into several subsystems which make it easier to develop and perform tests on the whole system. The subsystems are known as the modules and the process of dividing an entire system into subsystems is known as Decomposition.

The modules identified for the proposed EHS system are as below:

- ➢ General Information system
- ➢ Building Contact and Audit system
- ➢ Building environment and SIC codes
- ➢ Report system
- ➢ Administration

4.1.1.1 General information system

- General Details like Building, General information, Building information, manufacturing process shall be maintained as a part of the General Information subsystem.

- Building details like Building No, name, etc should be maintained by the General Information system which aids in developing the appropriate report generation.

- All these details are configured as and when required by either the system administrator or the concerned user.

- Information of one building to another building is easily done if they both have similar information.

4.1.1.2 Building Contact and Audit System

This refers to both Building contact subsystem as well as Building audit subsystem.

4.1.1.2.1 Building Contact Subsystem

- Used to view contact person details for environmental, safety, ISO purposes of specific building.

- A person can be assigned or released from the above responsibilities.

- There is a provision available to assign a person for above three responsibilities.

- The concerned user has to enter details of the contact person scored by the Students in his subject.

4.1.1.2.2 Building Audit Subsystem

- Used to view audit details such as Audit type, Notice date, Audit date, Audit comment, review date and etc. of a specific building.

- The user can ADD the audit details by filling up the inputs. The system displays the 'Audit page' with the inserted information.

- The user can UPDATE the audit details and the system displays the 'Audit page' with edited information.

- The user can REMOVE the audit details and the system displays the 'Audit page' with deleted information.

4.1.1.3 Building Environment and SIC codes

This refers to both building environment subsystem and building SIC codes subsystem.

4.1.1.3.1 Building Environment Subsystem

- Used to view environmental details such as Hazardous waste status, Surrounding area issues, and etc. of a specific building.

- This subsystem is used to add or update environmental information. This provides help to add/update/remove FormR, Certifications, Permit details.

- The system opens separate new window for corresponding FormR, Certifications, Permit information where the user can make add / update / remove the data.

4.1.1.3.2 Building SIC codes Subsystem

- Used to view SIC codes details such as SIC code, description, comments of a specific building.

- This subsystem is used to add or update SIC codes information.

- The system opens new window for corresponding building SIC codes where the user can make add / update / remove the data.

4.1.1.4   Report System

- The system displays 'Search Criteria' page and user selects report types such as Building, building Contact, Environment, Certification, Audit, and etc.

- The system finds records for specific type of report for given inputs and displays related type information.

- The Export button is displayed on the result page. When clicked, the required type report is downloaded as a spreadsheet.

- The 'create Email to these contacts' button is displayed on 'Building Contact' result page. When clicked, system displays 'Email generator' page where the user inputs subject and message and clicks 'Generate Email' button. The system sends emails to the contacts for the specified building.

4.1.1.5   Administration

- The administration module provides security to the system by preventing unauthorized users from accessing the system and wrecking havoc.

- Administrative module allows for creation of menus and submenu items dynamically as desired by the administrator. It gives the default permissions of changing user passwords to all users registered in the system.

- It allows for assigning roles to users by the administrator. Each menu can be assigned a role which in turn shows the particular menu to the users who is assigned the same role. It provides many more features.

4.1.2 Input Design

The input design is the process of converting the user-oriented inputs into computer-based format. The goal of designing input data is to make sure that the automation is easy, logical and free from errors.

The input design requirements such as user friendliness, consistent format and interactive dialogue which provide users with timely help and correct messages are given high priority.

The input web forms of the *General Information* module are as below:

➢ User Login Form
➢ EHS Building Form
➢ Building Lookup Criteria Form
➢ EHS Building Information Form

- The User Login Form is used by the various users of the system and the system restricts access to the data based on the type of user logged in.

- The EHS Building Form is used to display various building information and a way to enter the Building Lookup Criteria Form.

- The Building Lookup Criteria Form has several text boxes and drop down lists to input criteria details to search building information.

- The EHS Building information Form is same as EHS Building Form with extra links like Contacts, Audit and etc.

The input web forms of the **Building contact and audit** module are as below:

- ➤ EHS Contact Form
- ➤ EHS Contact Search Form
- ➤ EHS ADD Contact Form
- ➤ EHS EDIT Contact Form
- ➤ EHS ADD Audit Form
- ➤ EHS UPDATE Audit Form

- EHS Contact Form is used to view contact person details and a person can be assigned or released from the responsibilities.

- EHS Contact Search Form is used to search the person by giving inputs and assign to specific type of contact.

- EHS ADD Contact Form is used to add the person as the new contact for specified type.

- EHS EDIT Contact Form is used to update the person as the new contact for specific type.

- EHS ADD Audit Form is used to add the audit information in to the database by filling the inputs.

- EHS EDIT Audit Form is used to edit the audit information in to the database by changing the information.

The input web forms of the **Building environment, SIC codes** module are as below:

- EHS Environment Form
- ADD FormR Form
- UPDATE FormR Form
- ADD Certifications Form
- UPDATE Certifications Form
- ADD Permits Form
- UPDATE Permits Form
- ADD SIC Codes Form
- UPDATE SIC Codes Form

- The EHS Environment Form is used to add or update environmental information.

- The ADD FormR Form is used to add FormR information to EHS Database by giving inputs.

- The UPDATE FormR Form is used to update FormR information to EHS Database by changing information.

- The ADD Certifications Form is used to add certification information to EHS Database by giving inputs.

- The UPDATE Certifications Form is used to update certification information to EHS Database by changing information.

- The ADD Permit Form is used to add permit information to EHS Database by giving inputs.

- The UPDATE Permit Form is used to update permit information to EHS Database by changing information.

- The ADD SIC Code Form is used to add SIC code information to EHS Database by giving inputs.

- The UPDATE SIC Code Form is used to update SIC Code information to EHS Database by changing information.

The input web forms of the **Report** module are as below:

➢ Report Search Criteria Form

- The Report Search Criteria Form is used to select report type and input some criteria like building no, name etc.

The input web forms of the **Administration** module are as below:

➢ ADD User Form
➢ REMOVE User Form
➢ EDIT Announcement Form

- The ADD User Form is used to add the new user with his access permission by sending the invite to his email id.

- The REMOVE User Form is used to delete the existing user from the web application.

- The EDIT Announcement Form is used to edit EHS bulletin messages. These messages are edited in a big textbox. Using several buttons the user can format/apply styles to the HTML messages.

4.1.3 Output Design

Reports are generated as output for the users to view and take print-outs. Different reports are generated for different criteria. The reports present in the system are:

- ➢ Building Report
- ➢ Building Contact Report
- ➢ Building Audit Report
- ➢ Environment Report
- ➢ Form R Report
- ➢ Certification Report
- ➢ Permit Report
- ➢ Adhoc Report
- ➢ Building Lookup Result

- The Building Report contains the list of building information and generated based on the adhoc input given. For example, If the country name is given the buildings located in that country are displayed with their basic information.

- The Building Contact Report produces list of contact persons with their email id and telephone number for the specified building.

- The Building Audit Report generates the list of auditing taken place based on the input given. For example, if audit type is given as input the building

name and address with the date and other information for that audit type is displayed.

- The Building Environment Report presents the complete environmental information in the format required by the user.

- The Form R Report produces the list of Form R information in the format required by the user.

- The Certification Report generates the list of certification information in the format required by the user.

- The Permit Report produces the list of permit information in the format required by the user.

- The Adhoc Report generates complete history of the buildings of the particular company in a format required by the college.

- The Building Lookup Result presents the list of buildings based on the input criteria given by the user.

4.1.4 Database Design

A database is a collection of inter-related data stored with minimum redundancy to serve many users quickly and efficiently. The general objective of database design is to make the data access easy, inexpensive and flexible to the user. An elegantly designed database can play a strong foundation for the whole system.

The details about the relevant data for the system are first identified. According to their relationship, tables are designed through the following method.

> The data type for each data item in the table is decided.
> The tables are then normalized.

The tables are normalized so that they can provide better response time, have data integrity, avoid redundancy and be secure.

The tables for the EHS system have been normalized up to the Second Normal Form (2NF).

4.2 TABLE STRUCTURE

Design Conventions Used

1. Every master table name begins with an 'M' and every transaction table name begins with a 'T'.
2. 'T' and 'M' are followed by an Underscore '_'.
3. Appropriate words that describe the table should be used.
4. Words used to describe the table should be separated with an Underscore '_'.
5. No special character other than an underscore is used in formulating a table name.
6. No number should be used anywhere in the table name string.
7. Field names should be of the format TYPE_FIELDNAME.
8. Types are: C- CHAR, V- VARCHAR, N- NUMBER, D- DATE

Table No. 4.2.1	Table Name: M_EHS_USERS
This table deals with users' information. As and when information are entered into this table a row is generated and stored in this table. It indicates the status of the users.	

Sr.	Attribute name	Type	Remarks
1.	N_USERNO	NUMERIC(5)	IDENTITY
2.	N_USERID	NUMERIC(5)	PK
3.	V_PASSWD	VARCHAR(6)	NOT NULL
4.	V_FNAME	VARCHAR(15)	
5.	V_LNAME	VARCHAR(15)	
6.	V_UADDRESS	VARCHAR(30)	NOT NULL
7.	V_UCITY	VARCHAR(20)	NOT NULL
8.	V_USTATE	VARCHAR(20)	NOT NULL
9.	V_UCOUNTRY	VARCHAR(20)	NOT NULL
10.	N_UZIPCODE	NUMERIC(5)	NOT NULL
11.	N_UPPHONE	NUMERIC(10)	NOT NULL
12.	N_USPHONE	NUMERIC(10)	User secondary ph no
13.	N_UPFAX	NUMERIC(10)	NOT NULL
14.	N_USFAX	NUMERIC(10)	User secondary fax no
15.	V_UPEMAIL	VARCHAR(30)	NOT NULL
16.	V_USEMAIL	VARCHAR(30)	User secondary email id
17.	V_HINTQUES	VARCHAR(20)	NOT NULL
18.	V_HINTANS	VARCHAR(20)	NOT NULL
19.	V_ACCESSTYPE	VARCHAR(7)	NOT NULL
20.	V_ACCESSDESC	VARCHAR(30)	NOT NULL
21.	V_APPROVESTATUS	CHAR	Approve(Y/N)
22.	APPROVEDESC	VARCHAR(20)	NOT NULL

Table No. 4.2.2	Table Name: M_EHS_BUILDING		
This table deals with the master record of all basic information of the buildings of the company. It relates to most of the transaction tables. The over all information of the buildings is stored and updated here.			
Sr.	**Attribute name**	**Type**	**Remarks**
1.	N_BUILDINGNO	NUMERIC(5)	IDENTITY
2.	N_BUILDINGID	NUMERIC(5)	PK
3.	V_BUILDINGNAME	VARCHAR(15)	NOT NULL
4.	N_BUILDINGSQFEET	NUMERIC(9)	NOT NULL
5.	N_BUILDINGSTATUSID	NUMERIC(5)	FK(M_BLDG_STATUS)
6.	N_BUILDINGUSEID	NUMERIC(5)	FK(M_BLDG_USE)
7.	N_HAZWASTESTATUSID	NUMERIC(5)	FK(M_HAZWST_STATUS)
8.	N_LEGALTITLEID	NUMERIC(5)	FK(M_BLDG_LEG_TITLE)
9.	N_MANUFACTUREID	NUMERIC(5)	FK(M_MANUFACTURE)
10.	N_USERID	NUMERIC(5)	FK(M_EHS_USERS)
11.	V_ADDRESS1	VARCHAR(20)	NOT NULL
12.	V_ADDRESS2	VARCHAR(20)	
13.	V_ADDRESS3	VARCHAR(20)	
14.	V_CITY	VARCHAR(20)	NOT NULL
15.	V_STATE	VARCHAR(20)	NOT NULL
16.	V_COUNTRY	VARCHAR(20)	NOT NULL
17.	N_ZIPCODE	NUMERIC(5)	NOT NULL
18.	V_RESTRUCTURING	CHAR	Restructuring(Y/N)
19.	V_ENV_COMMENT	VARCHAR(20)	
20.	V_ENV_COMPLIANCE	VARCHAR(20)	NOT NULL

21.	V_PROFITCENTER	VARCHAR(10)	
22.	V_PRODUCTLINE	VARCHAR(15)	
23.	V_PRIORUSERS	VARCHAR(20)	NOT NULL
24.	V_SUR_AREA_ISSUES	VARCHAR(20)	Surrounding area issues
25.	V_REMEDIATION	VARCHAR(20)	
26.	V_PHASE1	VARCHAR(30)	
27.	V_PHASE2	VARCHAR(30)	
28.	V_ALTERNATES	VARCHAR(30)	
29.	V_MONITORWELL	CHAR	Monitoring well(Y/N)

Table No. 4.2.3   Table Name: M_BLDG_CONTACT

This table holds the details of the contact person of the particular building. It also holds the other details of the person's contact types.

Sr.	Attribute name	Type	Remarks
1.	N_CONTACTID	NUMERIC(5)	PK
2.	N_USERID	NUMERIC(5)	FK(EHS_USER)
3.	N_BUILDINGID	NUMERIC(5)	FK(EHS_BUILDING)

Table No. 4.2.4   Table Name: T_CONTACT_TYPE

Contact types for corresponding contact ids are stored in this table.

Sr.	Attribute name	Type	Remarks
1.	N_USERID	NUMERIC(5)	FK(EHS_USER)
2.	N_CONTACTID	NUMERIC(5)	FK(BLDG_CONTACT)
3.	V_CONTACTTYPE	VARCHAR(15)	NOT NULL

Table No. 4.2.5   Table Name: M_AUDIT_TYPE

This table stores the audit types for the corresponding audit id. New type of audit can be inserted and updating can be made.

Sr.	Attribute name	Type	Remarks
1.	N_AUDITID	NUMERIC(5)	PK
2.	N_USERID	NUMERIC(5)	FK(EHS_USER)
3.	V_AUDITTYPE	VARCHAR(15)	NOT NULL

Table No. 4.2.6   **Table Name: M_VERIFY_TYPE**

This table stores the audit verify types for the corresponding audit id. New type of audit verification can be inserted and updations can be done.

Sr.	Attribute name	Type	Remarks
1.	N_USERID	NUMERIC(5)	FK(EHS_USER)
2.	N_VERIFYID	NUMERIC(5)	PK
3.	V_VERIFYTYPE	VARCHAR(15)	NOT NULL

Table No. 4.2.7   **Table Name: T_BLDG_AUDIT**

This table involves all the required information of the audit and its verified types for the particular building. The information like audit date, audit comment, review date, follow up date and comment etc are attributed in this table.

Sr.	Attribute name	Type	Remarks
1.	N_AUDITID	NUMERIC(5)	FK(M_AUDIT_TYPE)
2.	N_VERIFYID	NUMERIC(5)	FK(M_VERIFY_TYPE)
3.	D_NOTICEDATE	DATETIME(8)	NOT NULL
4.	D_AUDITDATE	DATETIME(8)	NOT NULL
5.	V_AUDITCOMMENT	VARCHAR(25)	
6.	D_FODLLOWUP_DT	DATETIME(8)	NOT NULL
7.	V_FOLLOWUP_CMT	VARCHAR(25)	

8.	D_REVIEWDATE	DATETIME(8)	NOT NULL
9.	V_REVIEWEDBY	VARCHAR(15)	NOT NULL

Table No. 4.2.8   **Table Name: M_BLDG_FORMR**

As its name suggests the table holds record of the formR information in yearly basis.

Sr.	Attribute name	Type	Remarks
1.	N_USERID	NUMERIC(5)	FK(M_EHS_USER)
2.	N_BUILDINGID	NUMERIC(5)	FK(M_EHS_BUILDING)
3.	N_FORMRID	NUMERIC(5)	PK
4.	N_REPORTYEAR	NUMERIC(5)	NOT NULL
5.	V_FORMRDESC	VARCHAR(25)	NOT NULL

Table No. 4.2.9   **Table Name: T_BLDG_PERMIT**

This table stores the record of permit information with the issue date and expiry date.

Sr.	Attribute name	Type	Remarks
1.	N_BUILDINGID	NUMERIC(5)	FK(M_EHS_BUILDING)
2.	N_PERMITID	NUMERIC(5)	FK(M_PERMIT_TYPE)
3.	D_ISSUEDATE	DATETIME(8)	NOT NULL
4.	D_EXPIRYDATE	DATETIME(8)	NOT NULL
5.	V_PERMITCOMMENT	VARCHAR(25)	

Table No. 4.2.10   **Table Name: M_PERMIT_TYPE**

This master table holds the permit types for permit ids which can be inserted and updated. This involves the transaction table named T_BLDG_PERMIT.

Sr.	Attribute name	Type	Remarks
1.	N_USERID	NUMERIC(5)	FK(M_EHS_USER)

2.	N_PERMITID	NUMERIC(5)	PK
3.	V_PERMITTYPE	VARCHAR(15)	NOT NULL

Table No. 4.2.11   **Table Name: T_BLDG_CERT**

This table involves all the required information of the certification for the particular table in record wise and based on the two master tables M_CERT_TYPE and M_CERTFRQ_TYPE.

Sr.	Attribute name	Type	Remarks
1.	N_BUILDINGID	NUMERIC(5)	FK(M_EHS_BUILDING)
2.	N_CERTID	NUMERIC(5)	FK(M_CERT_TYPE)
3.	D_CERTDATE	DATETIME(8)	NOT NULL
4.	V_CERTREGISTRAR	VARCHAR(15)	NOT NULL
5.	D_TARGETDATE	DATETIME(8)	NOT NULL
6.	N_CERTFREQID	NUMERIC(5)	FK(M_CERTFRQ_TYPE)
7.	V_INTEG9000	CHAR	9000 certified(Y/N)
8.	N_COSTREGPERSON	NUMERIC(5)	Cost to register person
9.	N_COSTREGCOST	NUMERIC(5)	Cost to register cost
10.	N_COSTMAINPERSON	NUMERIC(5)	Cost to maintain person
11.	N_COSTMAINCOST	NUMERIC(5)	Cost to maintain cost
12.	V_REASON	VARCHAR(25)	NOT NULL
13.	V_ALTERNATE	VARCHAR(25)	Alternative reasons

Table No. 4.2.12   **Table Name: M_CERT_TYPE**

This table as its name suggests have the certification types for certification ids which are constant.

Sr.	Attribute name	Type	Remarks
1.	N_USERID	NUMERIC(5)	FK(M_EHS_USER)

Table No. 4.2.16	Table Name: M_MANUFACTURE		
This table involves the constant manufacture id and its type. EHS_BUILDING is updated based on this table.
Sr.	**Attribute name**	**Type**	**Remarks**
1.	N_USERID	NUMERIC(5)	FK(M_EHS_USER)
2.	N_MANUFACTUREID	NUMERIC(5)	PK
3.	V_MANUFACTURETYPE	VARCHAR(15)	NOT NULL

Table No. 4.2.17	Table Name: M_BLDG_USE		
This table involves the constant building use id and its type. Based on this table only the other master table EHS_BUILDING is updated.
Sr.	**Attribute name**	**Type**	**Remarks**
1.	N_USERID	NUMERIC(5)	FK(M_EHS_USER)
2.	N_USEID	NUMERIC(5)	PK
3.	V_USEDESC	VARCHAR(25)	NOT NULL

Table No. 4.2.18	Table Name: M_BLDG_STATUS		
This table involves the constant building status id and its type. The other master table EHS_BUILDING is updated based on this table only.
Sr.	**Attribute name**	**Type**	**Remarks**
1.	N_USERID	NUMERIC(5)	FK(M_EHS_USER)
2.	N_BUILDINGSTATUSID	NUMERIC(5)	PK
3.	V_BLDG_STAT_DESC	VARCHAR(25)	NOT NULL

Table No. 4.2.19	Table Name: M_ HAZWST_STATUS		
This table involves the constant hazardous waste status id and its type. Based on this table only the other master table EHS_BUILDING is updated.
Sr.	**Attribute name**	**Type**	**Remarks**
1.	N_USERID	NUMERIC(5)	FK(M_EHS_USER)

| 2. | N_HAZWST_STAT_ID | NUMERIC(5) | PK |
| 3. | V_HAZWST_STAT_DESC | VARCHAR(25) | NOT NULL |

Table No. 4.2.20	Table Name: M_BLDG_LEG_TITLE		
This table involves the constant building legal title id and its type. EHS_BUILDING is updated based on this table only.			
Sr.	Attribute name	Type	Remarks
1.	N_USERID	NUMERIC(5)	FK(M_EHS_USER)
2.	N_LEGALTITLEID	NUMERIC(5)	PK
3.	V_LEGALTITLE_DESC	VARCHAR(25)	NOT NULL

4.3   DATA FLOW DIAGRAMS

Data flow diagrams are graphical representation depicting information regarding the flow of control and the transformation of data from input to output. The DFD may be used to represent the system or software at any level of abstraction. In fact, DFD can be partitioned into levels. A Level 0 DFD called Context Level Diagram represents the entire software system as a single bubble with its interactions. The Context diagram shows the overall system with the users who will be interacting with it.
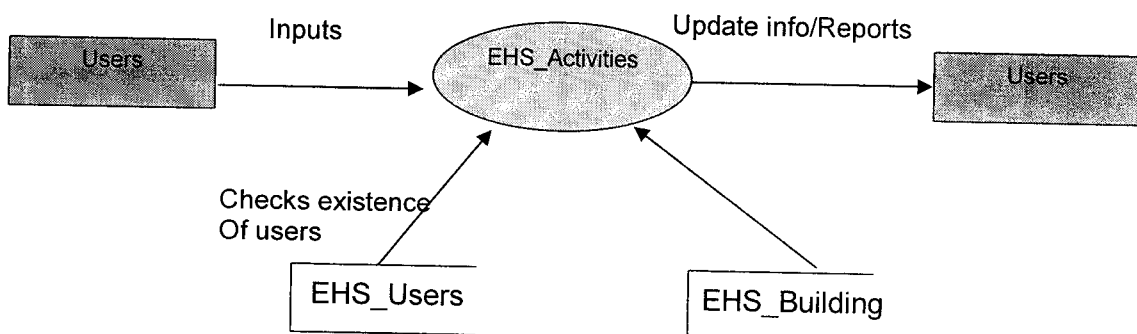
Figure 4.3.1 Context Diagram

The Level 1 DFD will explain the major modules in the whole system, i.e., how the data flow between each of these modules. The flow from once a user logins to entering measurement criteria, entering data, conducting reviews, audits etc., is shown in level 1 of the data flow diagram. The interaction of each process with the corresponding tables is also shown.
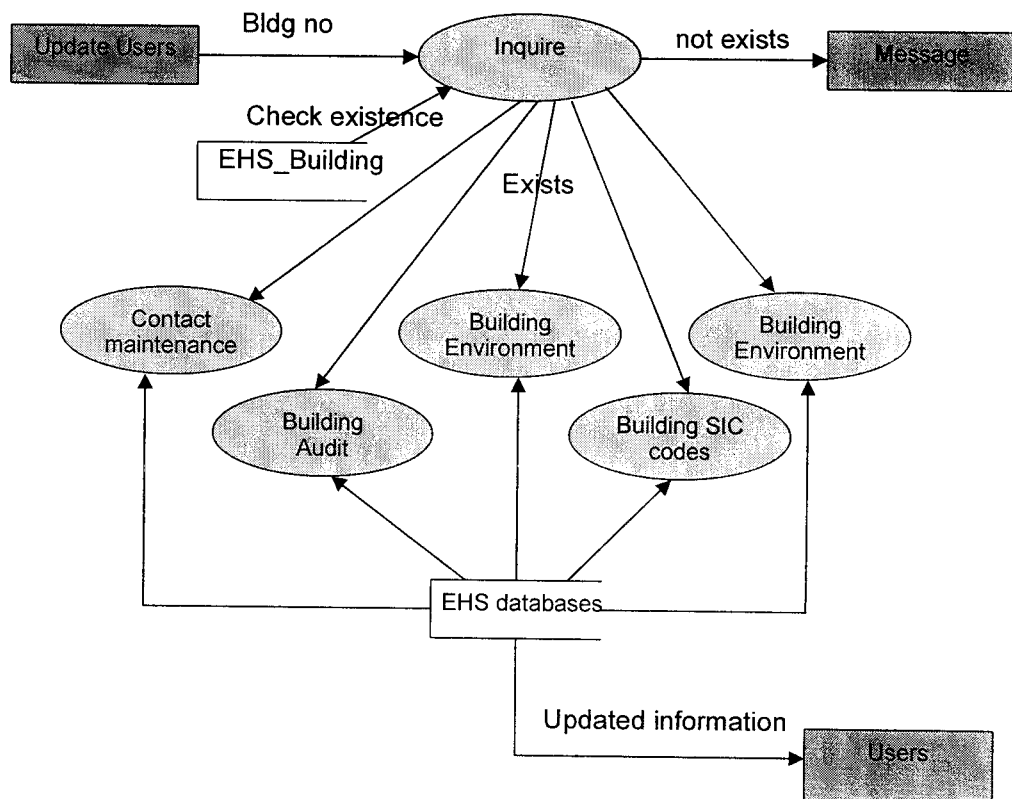
Figure 4.3.2 Level 1 Diagram

The level 2 of data flow diagram shows the detailed processing in these modules. The setup module has been depicted in the Level 2 of the DFD starting from Perspective processing to entering of strategic initiatives.
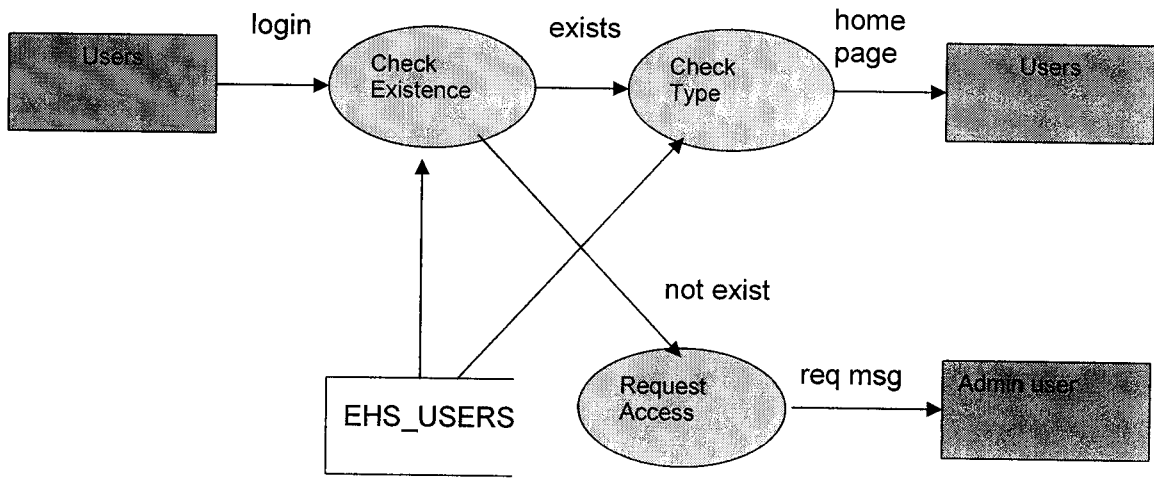
Figure 4.3.3 Level 2 Verification of users
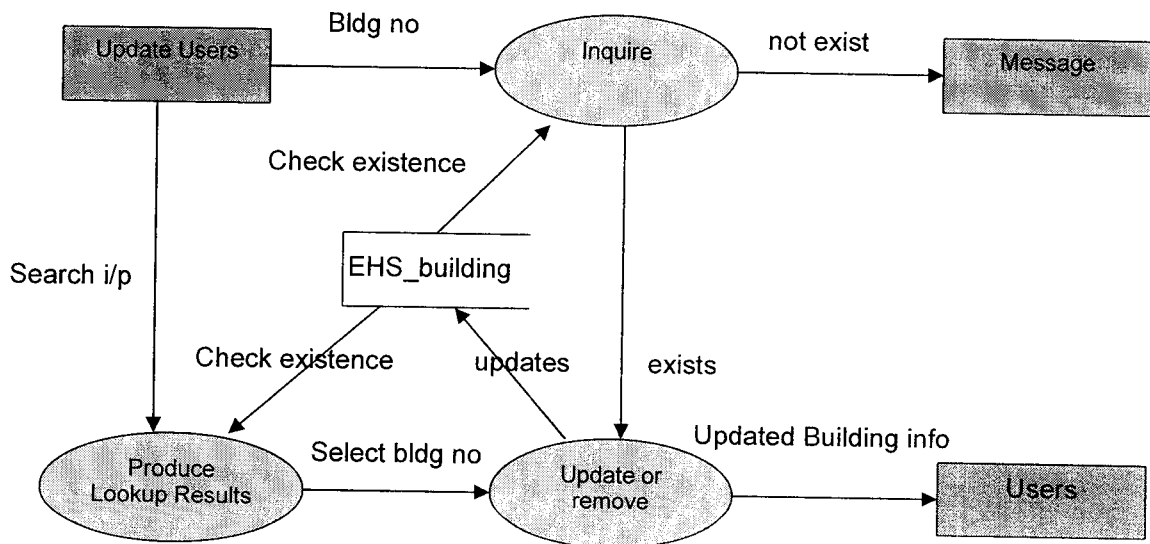
Figure 4.3.4 Level 2 Existence of building
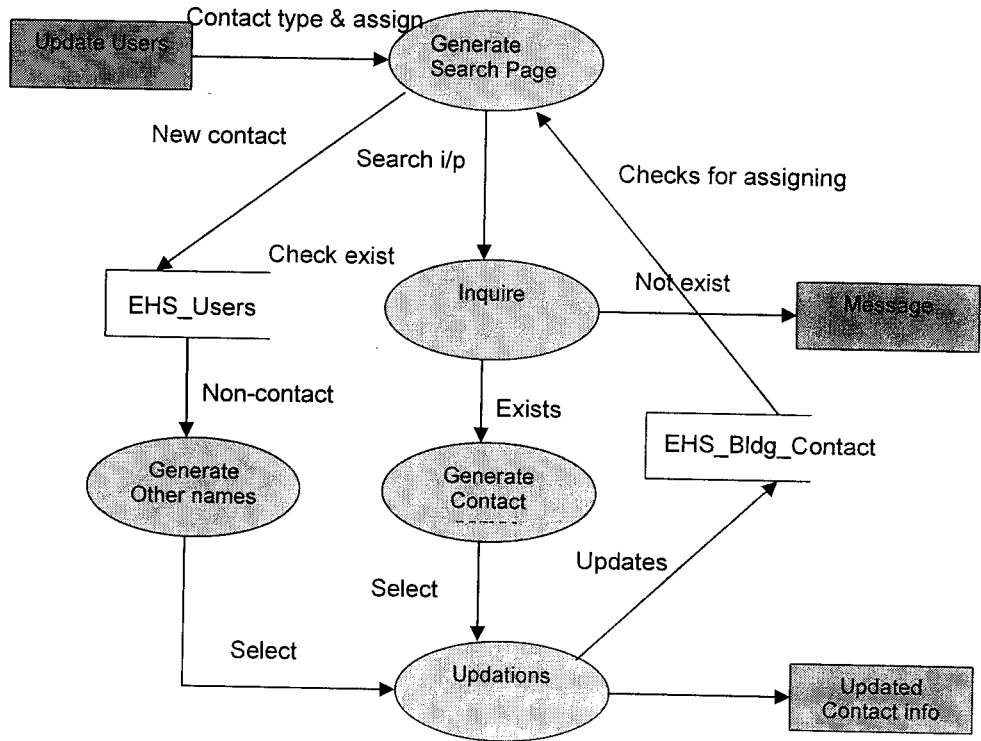
Figure 4.3.5 Level 2 Contact maintenance
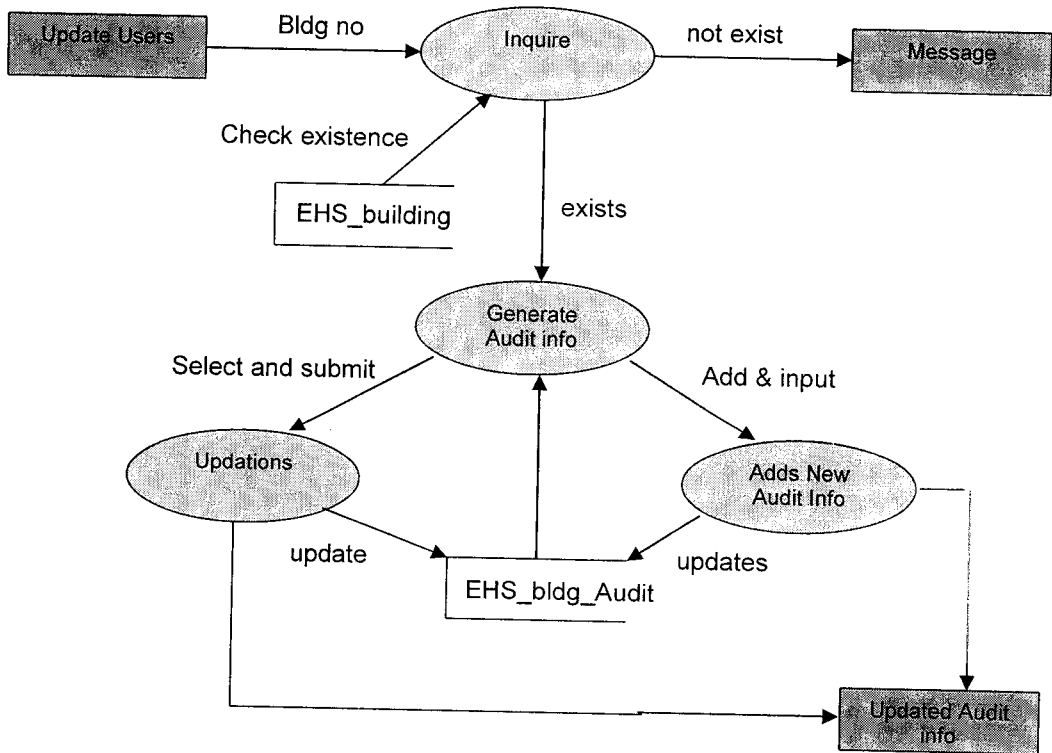
Figure 4.3.6 Level 2 Building Audit
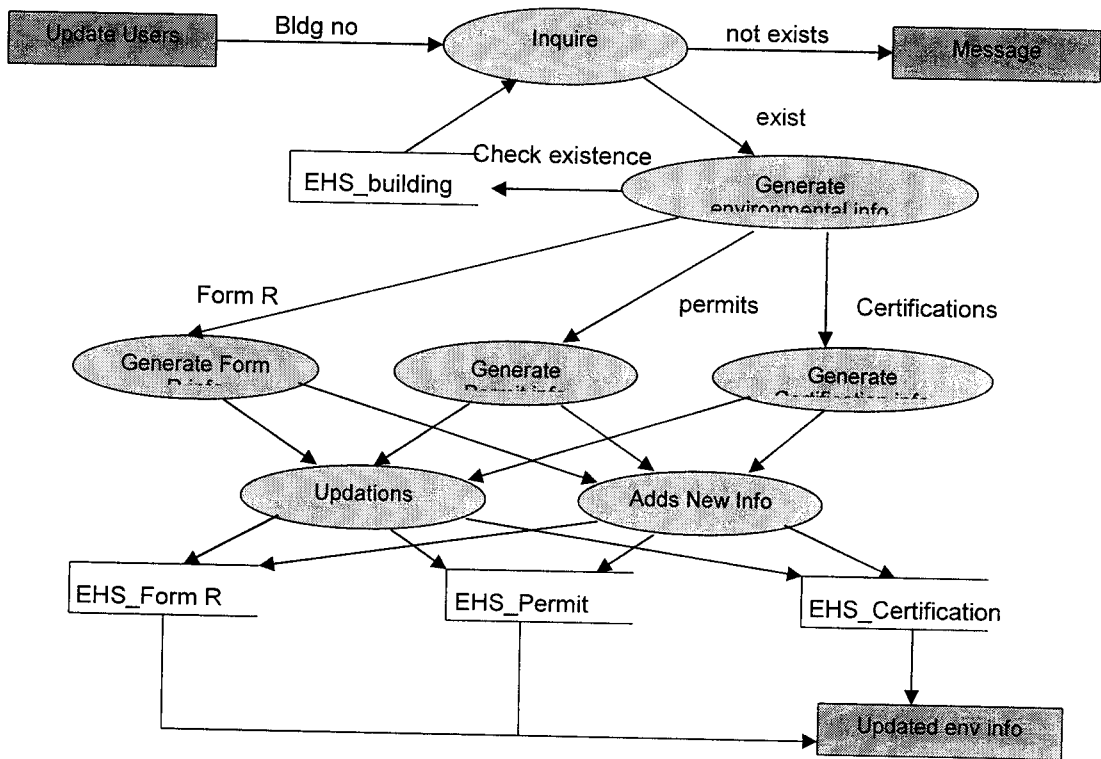
Figure 4.3.7 Level 2 Building Environment
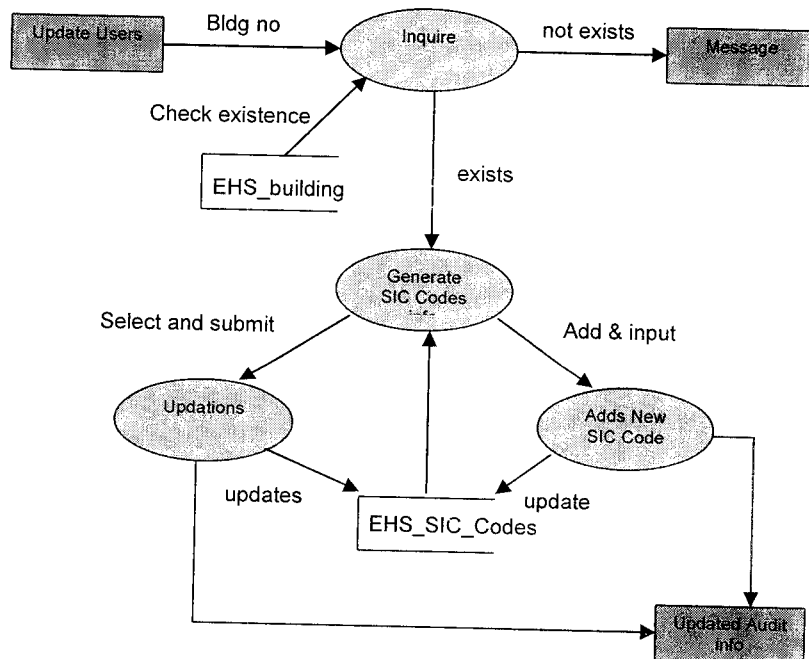
Figure 4.3.8 Level 2 Building SIC Codes
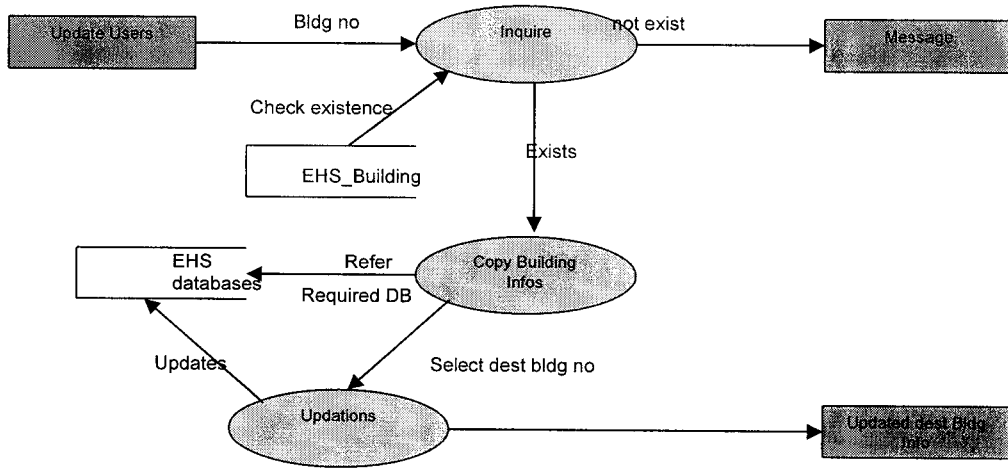
Figure 4.3.9 Level 2 Copy building Information
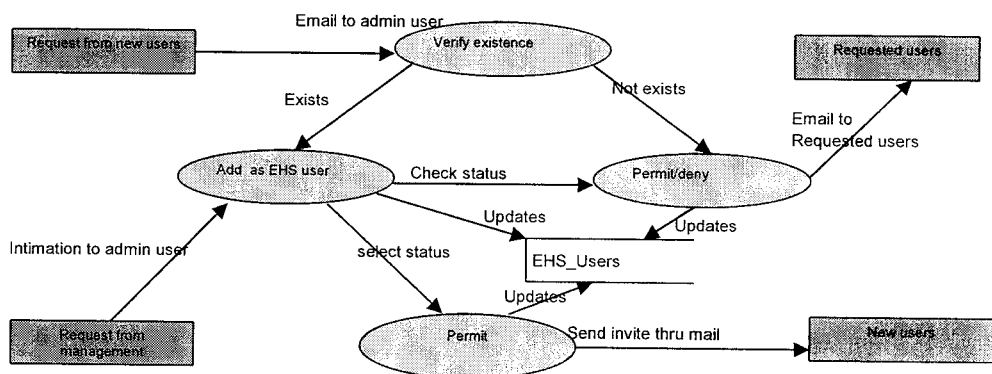
Figure 4.3.10 Level 2 Add/remove user

4.4   USE CASE DIAGRAMS

Use case diagrams give a picture of the different scenarios wherein users interact with the different components of the system. It gives a general idea on the requirements to be addressed by the system and the sequence of operations happening.

The diagram below gives the overall context of the EHS. The users of the system are depicted below.
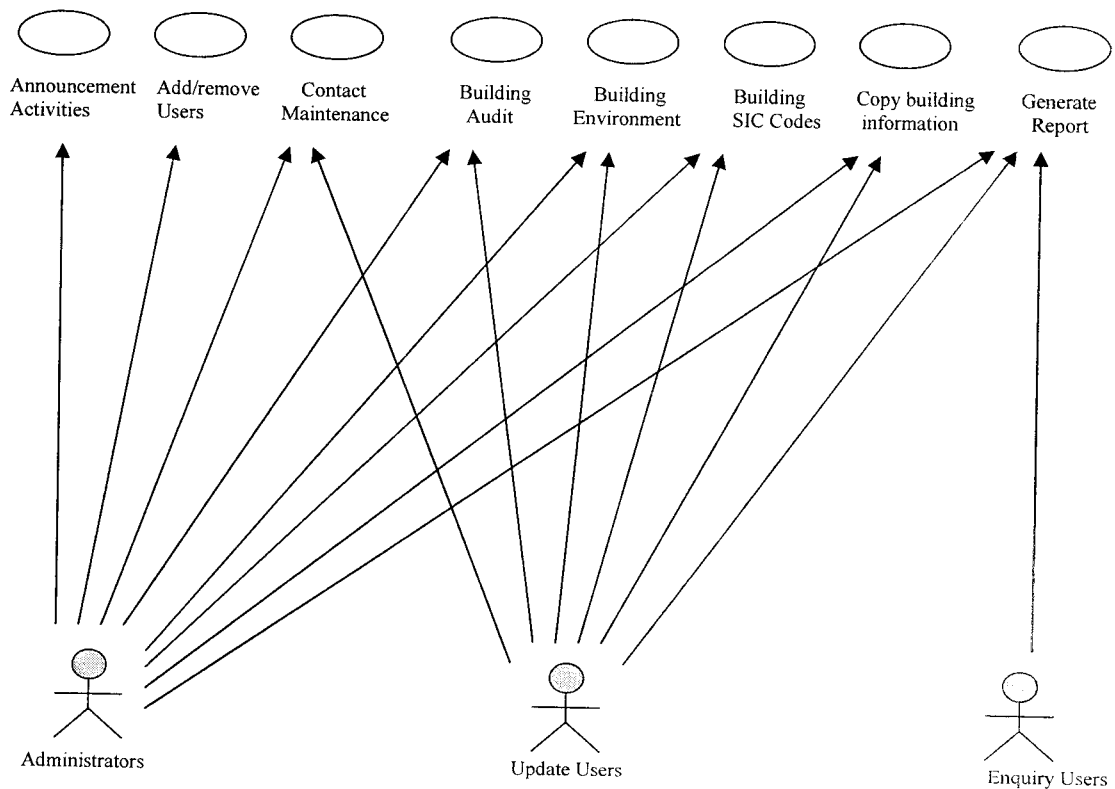
Fig 4.4.1 Context of the EHS

The interaction of the user with the sub processes involved in the contact maintenance process is shown below.
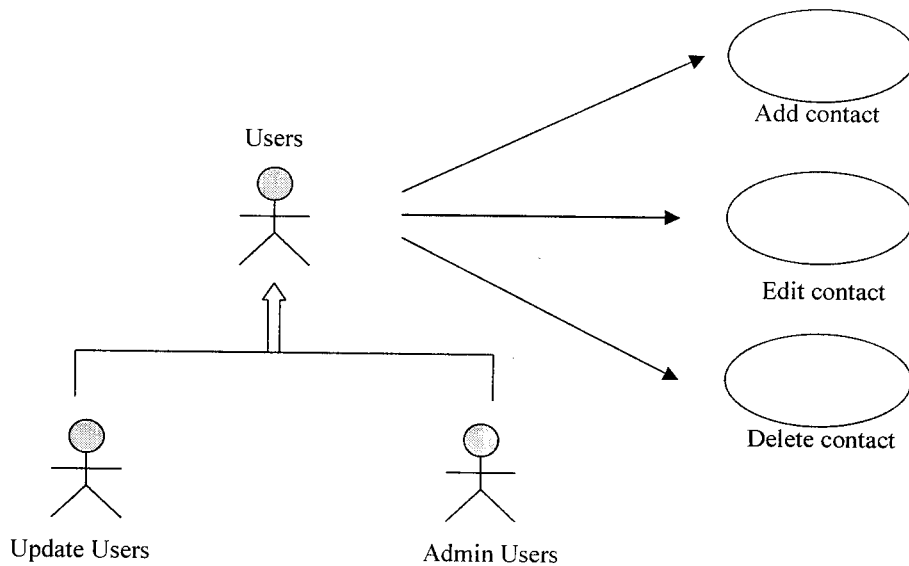
Fig 4.4.2 Contact maintenance use case

The interaction of the user with the sub processes involved in the audit maintenance process is shown below.
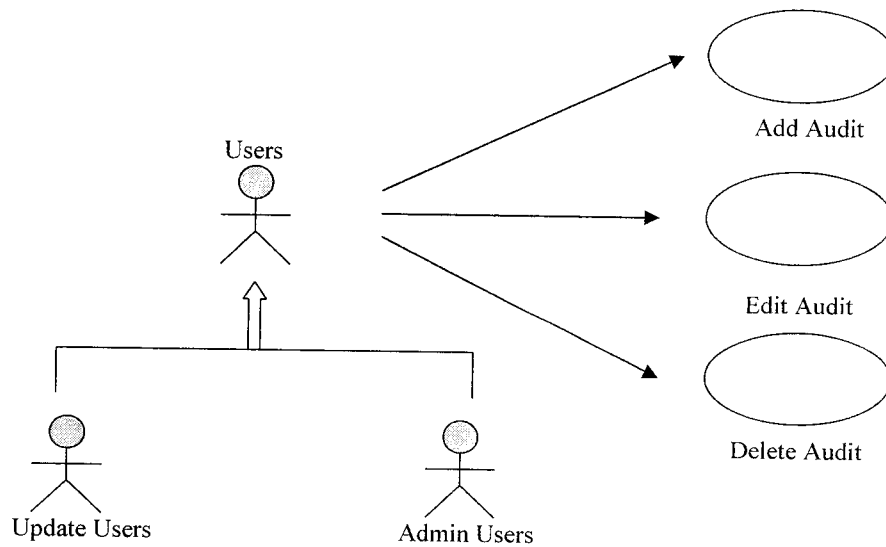
Fig 4.4.3 Audit maintenance use case

The interaction of the user with the sub processes involved in the environmental system is shown below.
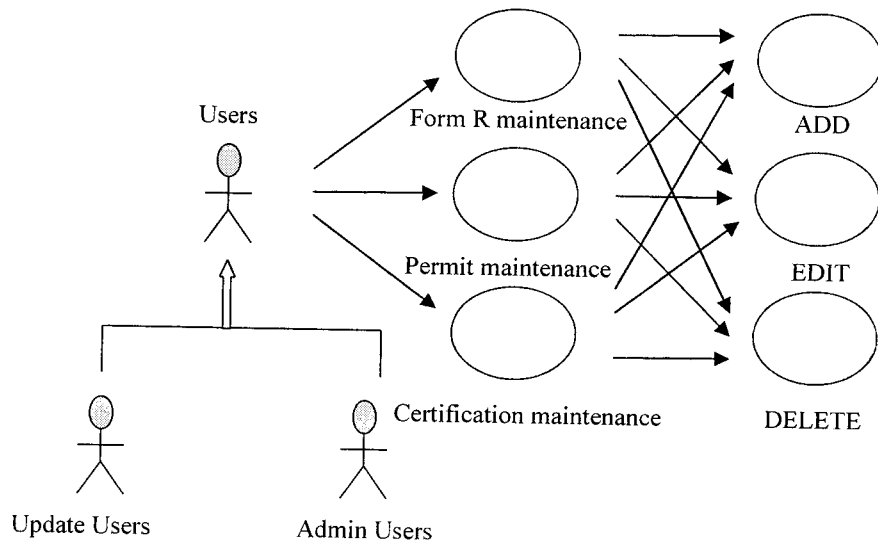
Fig 4.4.4 Environment system use case

Implementation

CHAPTER 5

IMPLEMENTATION

System Implementation is the part of the software engineering life cycle, where, the design artifacts are converted to a working application. Coding is done in this stage using an apt framework and programming language, which would solve the specific problem the best way. Once the design is coded into a working application, it has to be verified, validated and tested in detail. The tested product if successful is deployed in the user environment.

5.1 SYSTEM VERIFICATION

System Verification answers the question "Am I building the product right?" It includes the review of interim work steps and interim deliverables during a project to ensure they are acceptable. Verification also determines if the system is consistent, adheres to standards, uses reliable techniques and prudent practices, and performs the selected functions in the correct manner. In data access, it verifies whether the right data is being accessed, in terms of the right place and in the right way.

For e.g., the drop downs gather data from the database, so each dropdowns should be verified whether they are bound to the correct database field. It is done during development of the key artifacts. Verification is a demonstration of consistency, completeness, and correctness of the software at each stage and between each stage of the development life cycle. In EHS, verification is done during the development itself. Each database bindings are verified after binding to test whether the control is bound to the right data field.

5.2   SYSTEM VALIDATION

Validation answers the question "Am I building the right product?" This checks whether the developer is moving towards the right product, whether the development is moving towards the actual intended product that was agreed upon in the beginning. Validation also determines if the system complies with the requirements and performs functions for which it is intended and meets the organization's goals and user needs. It is traditional and is performed at the end of the project. In data access, it checks whether we are accessing the right data, in terms of data required to satisfy the requirement.

Validation is performed after a work product is produced against established criteria ensuring that the product integrates correctly into the environment. It determines the correctness of the final software product by a development project with respect to the user needs and requirements.

Functional validation is done in the EHS System to check whether each of the functions is done correctly as expected in every page. Each control in a Screen is designed to do some function. These functions are checked against the requirements stated for them. **For e.g.** clicking 'Save' button should take the corresponding action of saving the details into the database. Clicking the Edit icon should allow one to edit the contents that are being currently displayed. This level of validation can continue to all the controls in the system. This checking is usually done after the system is developed so that all activities that are affected can be checked.

Field level validation is done in EHS to check whether each of the fields either accepts the data as expected and do the client side validation of data entered. **For e.g.** a field level validation on a text box would check against the type of data entered and follow rules such as length of entry etc. The data type validation checks are conducted after the form is submitted. It takes place in the Action Form class of the

struts framework. If the validation check fails then the processing stops and the control returns back to the original form that was submitted.

The validation is done in a step by step process. First the screen is loaded with the controls. When the user moves between controls on the screen, the validation events for the control that lost the focus are fired and appropriate error messages (if any) are displayed. If the user generates a form save request, the entire form is evaluated for any validation controls that are not valid. If even one control is not valid, the form will not be submitted.

5.3 TESTING

Testing is a critical element of software quality and assurance and represents the ultimate review of specification design and coding. It is a vital activity that has to be enforced in the development of any system. This could be done in parallel during all the phases of system development. The feedback received from these tests can be used for further enhancement of the system under consideration. The testing phase conducts test using the Software Requirement Specification as a reference and with the goal to see whether the system satisfies the specified requirements.

Standard procedures have been followed in testing EHS. Test cases are generated for each screen. These test cases will cover every possibility which could result in both positive and negative results. These test plans are maintained for any further testing done on the system. The test plan stores information such as, the test script/input, expected output, actual output, comments and the name of the tester. This plan will be followed for all types of testing done in the system.

The main types of tests carried out on EHS are:

> Unit Test
> Integration Test
> System Test

5.3.1 Unit Testing

Module or Unit Testing is the process of testing all the program units that make up a system. Unit testing focuses on an individual module thus allowing one to uncover all the errors made logically and while coding in the module.

In EHS each page is tested separately as a unit. Initially the flow of control and data through that page is checked. When considering a module as a unit, the flow of data and control through the whole module is tested. The result is stored in the test plan. In a page, each control is further tested in unit testing. The process is done in all the pages of the system. Once the errors are rectified, the testing procedure is repeated with same test cases to ensure this hasn't produced new errors. Hence this is a continuous process.

Test cases were generated to test the control flow of each unit or module. Almost all cases needed for testing control flows have been generated.

Test Cases for the Login Screen:-

Sr.No	Test Case	Expected Result	Observed Result	Status
1	User id : ROOT, Password: XYZ	Invalid Login	Invalid Login	Pass
2	User id : ROOT, Password: server	Login successful	Login Successful	Pass
3	User id : XYZ , Password: abc	Invalid Login	Invalid Login	Pass
4	User id : 12401, Password: 712401	Login Successful	Login Successful	Pass

5.3.2 Integration Testing

Integration testing tests the process of integrating the various modules to form the completed system. Integration starts with a set of units each individually tested in isolation and ends when the entire application has been built. Integration testing verifies that the combined units function together correctly. It facilitates in finding problem that occur at interface or communication between the individual parts.

EHS followed top-down integration testing. Modules were linked to the main menu in a sequence as required in the real time operating mode of the system. Menu items were created as and when required for the integration. For e.g. The User names are tested first, then the contact maintenance is tested based on the user. The user selected should be properly reflected on the contact maintenance screen and should be added on to the database with the configured information. This indicates proper flow of information in the contact maintenance module. The same procedure is followed in other modules in the same level at first. Then the upper level is taken into action. The flow of data through the whole module in the upper level is taken and executed. A change of data made in one screen should have reflected in all other screens.

This process is continued from the page level to module level, finally to the system level. In the final stage, the whole system is taken together and tested for integration. A change in one place should be reflected through out the system. Regression testing is done after each change made into the software. This tests if the change has affected any part of EHS negatively after the change was made. The whole set of test cases need to be run again to do the regression testing.

5.3.3 System Testing

System testing is actually a serious of different tests, whose primary purpose is to fully exercise the computer-based system. This helps in verifying that all the system elements have been properly integrated and perform the allocated functions. It verifies the entire product after having integrated all software and hardware components, and validates it according to the original project requirement. The system testing takes into consideration the hardware, and the software. That is, EHS should be able to be run on the specified hardware for variety of cases. The EHS is tested against recovery from errors.

5.3.3.1 Security Testing

Security testing is important in system testing. The system in no way shall be accessible to unauthorized users. Testing is done to ensure that a user with respective rights can only view the various forms and reports presented by EHS. If users try to perform something beyond his assigned rights corresponding messages should be displayed. The EHS in such cases redirects the user back to the previous page in such a case.

Another security issue involves the sensitive data in the system. The system is highly secure with authentication fixed at various levels of the hierarchy.

One more level of security is concerned with user rights. Each user is applied rights module wise. The menus can be configured to roles. Users can also be configured to roles. Menu items are assigned to users dynamically based on the roles assigned to menu items as well as users. A match is done before displaying the menu to the user.

5.3.3.2 Stress Testing

Stress Testing executes a system in a manner that demands resources in abnormal quantity, frequency or volume. EHS was stress tested in the company by having user's simultaneous access to various modules in the system.

Conclusion

CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENT

6.1 CONCLUSION

The EHS enables the organisation to get rid of a very tedious and time consuming process which has been followed for over decades. By automating the entire building information, contact maintenance, audit and environment information and report generation process the employees/users are spared of a cumbersome and repetitive task. It also eliminates the possibility of any error in manual entry of the building information or in the maintenance procedure.

When fully deployed, the EHS will transform the entire maintenance of the organisation and serve as repository of environmental, health and safety information on facilities/buildings , log and record based exercise into computerized professionally operated process. It makes the entire procedure faster, error free, simple, efficient and more performance enhancing one. EHS provides a uniform interface for conducting queries and generating reports on demand.

It enhances the scope of the entire project by integrating with the GIS, building maintenance and Administration modules. GIS provides the basic details and information like building name, status, use, legal title, region, manufacturing process, contact, audit and environment details to the EHS. These information should be maintained upto date with periodic updates. The security feature of the system allows only administrator to make updates to important and sensitive data. It prevents unauthorized access to important data.

Thus the EHS increases the efficiency, performance of the organization employees by enabling them to spend more time on concentrating on their other activities. The reports provided to the management are error free and leads to improved decision making. Since reports are parameterized, it provides ability to select field ranges. Building information will be updated on a daily basis. Reports may be viewed, printed, and/or exported to Excel® or saved as html.

6.2 FUTURE ENHANCEMENT

The following features listed below if introduced could benefit the users of the system.

➤ All the other systems like the Staff Management System and other systems available in the organization can be integrated to form a bigger system which can be accessed at any time by anyone in the company through the intranet.

➤ The system is developed with the back end SQL Server but it can be develpoed with XML so that it can be used for interchanging the structured data between web applications and stores data in form of plain text which can be understood by any type of device.

Appendices

Building Information Maintenance

Building Lookup Results

Environment maintenance

Building SIC codes maintenance

Reports

Search criteria

Building Report

Reference

REFERENCE

1. Programming Microsoft ASP.Net 2.0 authored by Dino Esposito

2. ASP.Net Programmers reference Book Jason authored by Bell,Mike Clark,Andy Elmhorst,Matt Gibbs,Bruce Lee,Matt Milner,Jan Narkiewicz,Adil Rehan

3. ASP.NET in a Nutshell, Second Edition authorized by O'Reilly Media

4. SQL SERVER 2000 (help) from the software profiler

5. System analysis and design authorized by Elias M.Award