

**DEVELOPMENT OF A COMPUTERIZED GRANT
SYSTEM TO HANDLE RESEARCH GRANT
DETAILS OF NSF**

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02/AS/006

This thesis is submitted in partial fulfillment of the requirements for the degree of

Bachelor of Science
In
Physical Science

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August 2006.

DECLARATION

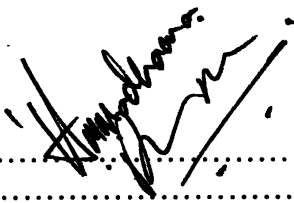
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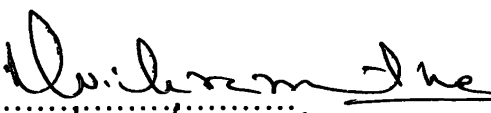
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ACKNOWLEDGEMENT

I express my sincere gratitude to my internal supervisor Mr.H.K.S.Amarakeerthi, Instructor in Computer Science, Department of Physical Sciences, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka who gave me guidance and encouragement to carry out this work successfully.

I would like to dedicate the gratitude from my heart to the External Supervisor Mr.H.M.M.Perera, Coordinator-IT, National Science Foundation, Sri Lanka who guiding me towards of successful completion of this project.

I specially express my gratitude to Dr.M.C.N.Jayasooriya, the Director, National Science Foundation, Sri Lanka who kindly offered me a training placement with required facilities.

ABSTRACT

The National Science Foundation awarding grants for scientific and technological researches in Sri Lanka. These grants are intended to provide the assistance to supplement the financial, physical and manpower resources available for scientific research in the scientist's own institutions. The research grants are handled by the research division, one of the key divisions in the National Science Foundation and all financial matters are recorded by the financial division while National Science library and resource center is maintaining the information related to all research grants.

The aim of this project was to develop a user friendly software system to handle all the information related to the research grants in a computer system.

Initially the feasibility study was carried out to find out the feasible way to implement the system. After that the functional requirements were collected by interviewing the Accountant, Management people and some potential users of the system. Also sampling of existing documentation and forms. Then the database was developed using MS SQL 2000 Server to meet the functional requirements. All User Interfaces in the system were designed using MS Visual Basic (VB6.0). Finally the database and interfaces were connected using ADO Data Control. There After the system subjected to both unit testing and system testing.

The final system was more user friendly and efficient to handle all the information related to the research grants. The system contains eight forms and one database with three tables.

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ABBREVIATION

NSF	– National Science Foundation
SDLC	– Software Development Life Cycle
DDLC	– Database Development Life Cycle
MS SQL	- Microsoft Structure Query Language
SQL	- Structure Query Language
VB 6.0	– Visual Basic 6.0
DFD	- Data Flow Diagram
ERD	– Entity Relationship Diagram
SQA	– Software Quality Assurance
V&V	– Validation and Verification

1. INTRODUCTION

1.1 NSF at a Glance

“Research is the Foundation of the Knowledge” is the theme of National Science Foundation. The objectives of the NSF are

- To initiate, facilitate and support basic and applied scientific research by universities, science and technology institutions and scientists.
- To foster the interchange of scientific information among scientists in Sri Lanka and foreign countries.
- To award scholarships and fellowships for scientific study or scientific work at science and technology institutions.

The main activity of NSF is the awarding of Research Grants. These grants are intended to provide assistance to supplement the financial, physical and manpower resources available for scientific research in the scientist's own institutions. The Objectives of awarding research grants are

- To promote scientific and technological research in Sri Lanka
- To provide training for young scientists.
- To provide an opportunity to obtain postgraduate qualifications
- To promote human resources development in science and technology.

1.1.1 Activities

Some Important activities of the organization are follows

- Awards and monitors research grants in the different fields of science and technology.
- Serves as the national focal point for the collection & dissemination of Science & Technology information through the National Science Library and Resource Center (NSLRC).
- Organize Conferences / Workshops / Seminars / Symposia.
- Administers a fund for overseas visits by local scientists.
- Science & Technology publications.

1.2 Overview of Project

1.2.1 Project Description

National Science Foundation award grants for scientific and technological researches in Sri Lanka and related data are handling by the Financial Department of this Organization manually.

The manual system has set of drawbacks. Mainly it is time consuming and lack of easy references.

Therefore this department requires a user friendly system with necessary operations to store these data in a computer system.

1.2 Objective

The main objective of this project is to develop a user friendly software system to handle all the information related to the research grants. To make this system user friendly a GUI (Graphical User Interface) was added to the system. Typically GUI Interfaces were designed in Visual Basic.

1.2.1 Specific Objectives

- To study the software development Methodologies.
- To study the database development lifecycle.
- To analyze the available methodologies to fit this project.
- To develop the application with minimum resources and within the particular time frame.

2. LITERATURE REVIEW

2.1 Software Development

The software is:

- Instructions (Computer Programs) that executed the desired functions and performance.
- Data structures that enables the program to adequately manipulate information use of the programs.

Therefore software is not only the executable programs but include several other elements that support them in their operation. Also it is not a single task but software is developing by a team.

In general the softwares are developing under two main limitations. Such as cost and time duration. The software should be profitable and it should be delivered at right time to the customer.

2.1.1 Software Products

Software products are software systems delivered to a customer with the documentation which describes how to install and use the system.

From the development perspective software products are fall into two broad classes.

- **Generic Software (Tailer-madeProducts):** These are stand alone and multi user systems which have been developed for a common specific need by a development organization.
- **Bespoke Software (Custom-Built Products):** These are systems which are requested by a particular customer. The software is developed specially for that customer by some contractors.

There is another classification too, that is based on the use of the software.

- **System Software:** It is a software that directly controls the Hardware and facilitates other application software.
E.g. Operating System, Compilers & Interpreters, Utility Software and device drivers.
- **Application Software:** It performs user oriented function in a particular field.
E.g. Real time Software, Embedded software and more

2.1.1.1 Software Product Attributes

These are characteristics displayed by the product once it is installed and make it into use. These are not the services provided by the product.

The characteristics shown in the figure are critical quality attributes which are the essences of well-engineered software.

Product Characteristics	Description
Maintainability	It should be possible to evolve software to meet The changing needs of customers.
Dependability	It include a range of characteristics reliability, Security and safety.
Efficiency	Software should make wasteful use of system resources such as Memory and Processor cycle.
Usability	Software should have an appropriate user interface and adequate documentation.

Table2.1 Essential attributes of good software

Optimizing all of these attributes is difficult as some are exclusive.

2.1.1.2 Problems of Software Development

Software industry suffered from many problems on and off and first it was discovered as a “Software Crisis” in 1968.However despite of introducing new techniques and tools with sound Engineering principles still these problems persist. Therefore software problem is more of a “Chronic Affliction” rather than sudden crisis.

Main features of the software problem include:

- High Software Cost.
- High Maintain Efforts.

2.2 The Software Process

The software process is the set of activities and associated results which produce a software product. There are four fundamental process activities which are common to all software process.

1. **Software Specification:** The functionality of the software and constraints on its operation must be defined.
2. **Software Development:** The software to meet the specification must be produced.
3. **Software Validation:** the software must be validated to ensure that it does what the customer wants.
4. **Software evolution:** The software must evolve to meet changing customer needs.

For the effective control of software process it is essential to have a phased development strategy. It consist number of stages that produce one or more deliverables.

2.2.1 Software Development Process Model

It involves many activities and it consist number of distinct phases. However there are number of ways in which these activities are organized into complete development process. Each of these is called “Software Development Process Model” which shows how the activities are organized and how they are linked. Each model has its own advantages and dis-advantages.

The model will be selected by the developer according to the clarification of customer requirements. However the final software product should fulfill the customer requirements.

In the case of problem solving projects the following models are frequently used for the software development.

- a. The Waterfall Model
- b. Evolutionary Developments
- c. Boehm’s Spiral Model

2.2.1.1 The Waterfall Model

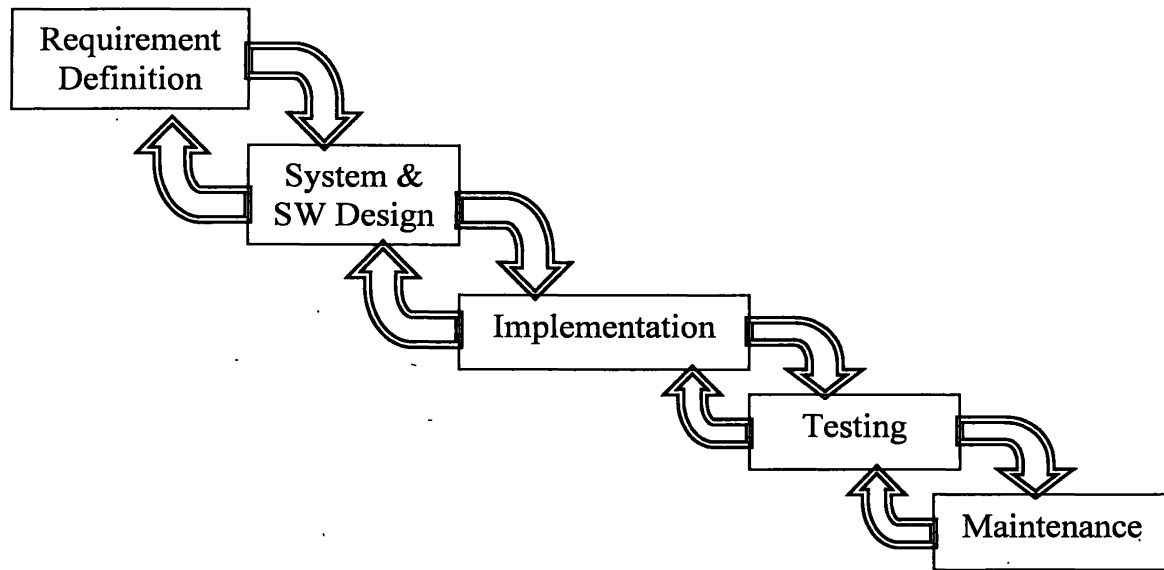


Figure 2.1 the Waterfall Model

Because of the cascade from one phase to another this model is known as waterfall model. This model is more appropriate for large projects also it is applicable where the user requirements are clear, precise and stable.

Advantages of the waterfall model

- Each stage ends by producing some deliverables.
- Better Monitoring and Control of the project
- Easy to assess the project
- Well suited for large systems.

Disadvantages of the waterfall model

- It is difficult to define all requirements at the beginning of a project.
- Has the problems of adapting to change
- Real projects are rarely sequential

2.2.1.2 Evolutionary Development

Rather than having separate specifications, development and validation activities these are carried out concurrently with rapid feedback across these activities. Evolutionary development is based on prototyping.

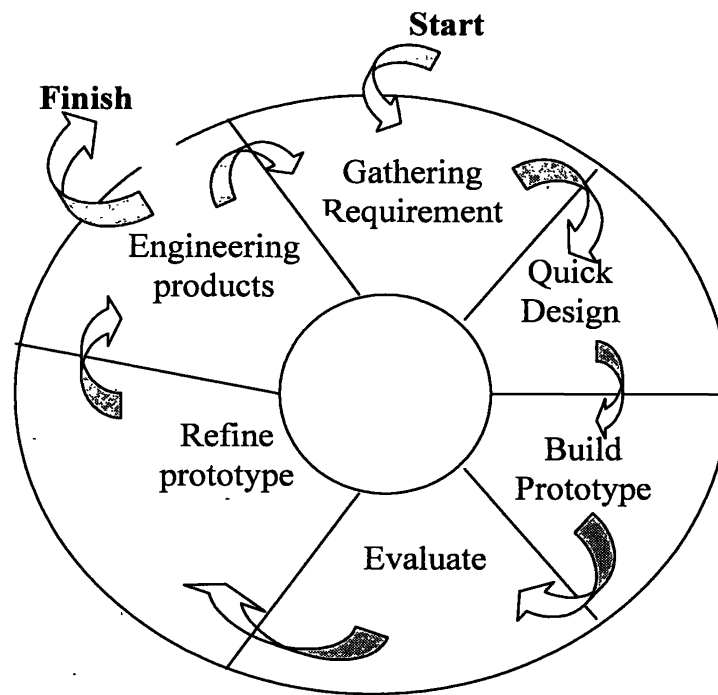


Figure 2.2 Evolutionary Development Model

Advantages of Evolutionary Development Model

- More applicable where user requirements are not precise.
- Use for relatively small projects

Disadvantages of Evolutionary Development Model

- The process is not visible
- System are usually poorly structured
- Needs highly skilled and highly motivated software personnel to use this approach.

2.2.1.3 Boehm's Spiral Model

The most important distinction between the spiral model and the other, software process models is the explicit consideration of risk in the spiral model.

There are no fixed phases in this model. Management must decide how to structure the project into phases. Each loop in the spiral represents a phase.

Advantages of Spiral Model

- It is very flexible.
- Risks are explicitly assessed and resolved throughout the process.
- Project Manager can shut off the process at any time.
- Different techniques can be used in different loops in the spiral.

Disadvantages of Spiral Model

- It is difficult to stick to a particular time frame.
Therefore project can be unnecessarily dragged.

2.3 Software Development Life Cycle (SDLC)

This is also known as System Life Cycle or Problem Solving Cycle.

The problem solving cycle is “a set of steps that start with a set of user requirements which produces system that satisfies these requirements”.

The steps in SDLC are following

1. Concept Formation
2. Requirements Analysis
3. System Design
4. Implementation(Coding)
5. Testing
6. Maintenance

2.3.1 Concept Formation: Concept formation is problem definition and feasibility study.

Problem Definition- This is the stage which will identify the user's basic requirements which enables to define the system scope.

Feasibility Study- An evaluation of whether it is worth while to proceed with project.

Finding Problems to Solve

As a system analyst there are several methods of finding a problem. When finding problems there are several considerations:

1. External Consideration
2. Internal Consideration

These external considerations can be used to identify the differences between how the things are done in the organization and the accepted way of doing things outside.

During the internal observation the activities are performed internally and it used to identifying the missing functions.

There are four main ways of evaluating any proposal.

1. Technical Feasibility- checks whether the organization has the technology and the skills necessary to carry out the project, else how they can obtain the necessary technology and skills.

It should also check whether existing system (manual or even computerized) could be upgraded to use the new system.

2. Operational Feasibility- it covers two aspects

Technical aspects emphasizes whether the right information is given to the right people at the right place on the right time.

Acceptance resolves around the current system and its personnel. This will further emphasize whether the current system operations can be fit into the new system.

3. Economical Feasibility- This evaluation looks at the financial aspect of the project and it also emphasizes whether the investment needed to construct the project will be recovered.
4. Schedule Feasibility- Generally each projects has a deadline. We need to determine if the deadline is optional or mandatory.

2.3.2 Requirements Analysis

Requirements discovery includes those techniques to be used by systems analysts to identify or extract system problems and solution requirements from the user community.

In order to discover the requirements the system analyst must initially analyze the problem. Problem analysis is the activity of identifying the problem, understanding the problem (including causes and effects) and understanding any constraints that may limit the solution.

After analyzing the problems then the requirements must be gathered.

A system requirement (also called a business requirement) is a description of the needs and desires for an information system. A requirement may describe functions, features (attributes) and constraints.

Requirements of a system can be categorized as functional and non-functional requirements.

A **functional requirement** is a function or feature that must be included in an information system to satisfy the business need and be acceptable to the users.

A **non-functional requirement** is a description of the features, characteristics and attributes of the system as well as any constraints that may limit the boundaries of the proposed solution.

There are different types of non functional requirements available. such as

1. Performance
2. Information
3. Economy
4. Control or Security
5. Efficiency
6. Services

Several techniques can be used for gathering requirements. Such as sampling of existing documentation & forms, research and site visit, observation, questionnaires, interviewing and more.

Requirements discovery consists of following activities.

- Problem Discovery and Analysis
- Requirements Discovery
- Requirements Validation
- Requirements Management

The output of this phase is Software Requirement Specification (SRS).

2.3.3 Software and System Design

The system design process partitions the requirements to either hardware or software systems. It establishes overall system architecture. Software design involves representing the software system functions in a form that may be transformed in to one or more executable programs.

Complete system design consist four design elements. They are Data Design, Architectural Design, Interface Design and Component Design. Out of these four interfaces user interface design and Architectural design are deeply concerned.

2.3.3.1 Data Design

The data design part transforms the information model created during the analysis into the data structure that will be required to implement the software. The data objects and relationships defined in the Entity Relationship Diagram (ERD) and detailed data content define the data dictionary and provide the basis for the data design activity.

The primary activity during the data design is to select logical representation of objects (data structures). Objects are identified during the requirements definition and specification phase.

2.3.3.2 Architectural Design

The primary objective of architectural design is to develop a modular program structure representing the control relationships between modules. It can simply say overall design of the system.

2.3.3.2.1 Object Identification

In practice many different sources of knowledge have to be used to discover objects and object classes. Objects and operations are identified from the system description that was the start point of the design. Further information from the application domain knowledge or scenario analyses are used to define and extend the initial objects.

2.3.3.2.2 ER Diagram

After identifying objects of the system a conceptual is developed. Normally an object is described using Entity, Relationships and Attributes.

Entity can be an object or event in which system needs to keep records.

Relationship is a way of formally defining how tables related to each other. Relationships between the tables in a database shows how the columns in one table are linked to columns in another table.

Attribute specifies the properties of entities and relationships.

2.3.3.2.3 Database Design

There are four main types of database organization available.

1. Flat
2. Hierarchical
3. Relational
4. Object-Oriented

Objects are arranged in the tables with number of fields. Usually Normalization procedure is prerequisite in this process. The Normalization process is carried out up to 3NF. Therefore it minimizes repeating data and reducing the complexity of the data of the relation.

2.3.3.2.3.1 Relational Databases

Relational database is most commonly used type of database in the world body. Data are organized as logically independent tables.

A relational database

- Stores data in tables which are in turn composed of rows. Also known as records and columns.
- Enables to retrieve (or query) subset of data from tables.
- Enables to connect relations together for the purpose of retrieving related records stored in different tables.

Relational database has several features, such as

- Natural
- Not so strongly biased towards specific question
- Express relationship by means of shared data rather than explicit pointers.
- Theoretical basis: relational algebra, calculus, closure
- Operations on tables (Join, Project and Select) to form new tables.

2.3.3.2.3.1.1 Key Fields

Primary Key

A primary key is a special type of index which uniquely identifies the records in a relation. So no two records in the same table may have the same value in its primary key field and no record may contain an empty or null value in that field.

Foreign Key

A foreign key is a set of attributes in one relation that a key in another relation. Foreign keys are essential links between relations. They are used to tie data in one relation to another relation.

2.3.3.2.3.1.2 Database Normalization

Normalization is a design technique that is widely used as a guide in designing relational databases. Normalization is essentially a two step process that puts data into tabular form by removing repeating groups and then removes duplicated data from the relational tables. Normalization theory is based on the concepts of **normal forms**. A relational table is said to be a particular normal form if it is satisfied certain set of constraints. There are currently five normal forms that have been defined.

The goal of normalization is to create a set of relational tables that are free of redundant data and that can be consistently and correctly modified. This means that all tables in a relational database should be in the third normal form (3NF). A relational table is in 3NF if and only if all non-key columns are

- (a) mutually independent and
- (b) fully dependent upon the primary key.

A fully normalized database stores each piece of information in the database in its own tables and further identifies each piece of information uniquely by its own primary key.

First Normal Form

It can simply explain as each value in the database table is atomic (represented only once). Duplicates are not allowed.

Second Normal Form

It fulfills the requirements of 1NF and each instance or row in the database table must be uniquely identifiable. That is we remove the partial dependencies from the table and put it into another table.

Third Normal Form

Here the dependencies between non-key attributes are removed and put them into a separate table. This form is already in 2NF also.

2.3.3.2 Interface Design

We should design both internal and external interfaces. Users are interacting with the system by using user interface. But the user interface is a part of the interface design.

2.3.3.2.1 User Interface Design Principle

User interface designers must take into account the physical and mental capabilities of the people who use the software. Following are the principles of these user interfaces.

- User familiarity
- Consistency
- Minimal surprise
- Recoverability
- User guidance
- User deliverability

2.3.3.2.2 User Interaction

The designers of a user interface are faced with two key issues.

How information from the user can be provided to the computer system and how information from the system can be presented to the user. The former is the user interaction and the latter is information presentation.

Different interaction styles like Direct Manipulation, Menu Selection, Form Fill-in, Command Language, Natural Language and Graphical User Interface (GUI) can be used. Each style has its own advantages and disadvantages.

2.3.3.2.3 Accessing Database

Once have a database we need a way to access it from within Visual Basic. There are several ways to do this.

1. Write code and use DAO (Data Access Object), RDO (Remote Database Object) or ADO(ActiveX Data Object) which allow to access data such as records, tables and queries through code.
2. Use the data controls that come with VB.
3. Can Access using the Visual Basic Data from Designer.

2.3.3.2.3.1 The Data Control Object

Data Controls are used to access the database from visual basic, also it provides basic data browsing functionality, enabling application to navigate through a record set and add and update records.

2.3.3.2.3.2 Data Access Object (DAO)

DAO is used to connect to desktop database such as Microsoft Access. DAO jet engine has set of routines and talks to a set of translation routines which convert the request into a format that the target database can understand.

2.3.3.2.3.3 Remote Data Object (RDO)

RDO is used for client/server database. All data work will be against remote database servers over the network connection.

2.3.3.2.3.4 ActiveX Data Object (ADO)

This let you get access to all kinds of data including desktop, client/server and non relational data sources. That meant it allow to seamlessly access multiple database through a single, consistent interface.

2.3.4 Coding

The choice of appropriate programming languages and development tools is important task in system implementation. There are several important features that should be followed when writing a program.

- Use meaningful identifiers
- Use comments to increase the readability
- Avoid tricks in implementation
- Use consistent pattern throughout the program

2.3.5 Testing

2.3.5.1 Software Verification and Validation

Verification

- Are we building right product?
- Process-oriented

Validation

- Are we building product right?
- Product-oriented.

2.3.5.2 Limitation of the Testing

1. Testing all possible inputs is impractical.
2. Testing all possible outputs is impractical.
3. Testing can not guarantee the correctness of software. It can be effectively used to find errors.

2.3.5.3 White box Testing (Program-based testing)

Here we assume that the program is available.

- Derives test cases from the program
- Controls and observes the internal structure of the program

2.3.5.4 Black box Testing (Functional Testing)

Assume that the program is not available or the testers do not want to look at the details of the program.

- Derived test cases (test data) from the requirements of the program
- Controls and observes the program only through external interfaces.

2.3.6 Software Maintenance

Software maintenance is a general process of changing a system after it has been delivered. The changes may be simple changes to correct coding errors, more extensive changes to change design errors or significant enhancements to the system.

There are mainly three types of software maintenance available. Such as

- Maintenance to repair software faults
- Maintenance to adopt the software to a different operating environment
- Maintenance to add to or modify the system functionality.

2.4 Overview of Visual Basic

Visual Basic is a front end programming language developed by Microsoft Corporation in later 1993. It is a member of MS Visual Studio which contains other products such as Visual C++, Visual FoxPro and more.

Visual Basic is an events driven programming language. These are main divergence from the old BASIC. In BASIC, programming is done in a text-only environment and the program is executed sequentially. In Visual Basic, programming is done in a graphical environment. Because users may click on a certain object randomly, so each object has to be programmed independently to be able to response to those actions (events). Therefore a Visual Basic program is made up of many sub programs, each has its own program codes, and each can be executed independently and at the same time each can be linked together in one-way or another (Sheffield Hallam University, 2004).

Advantages of Visual Basic

1. It is easy to learn
2. Excellent for business
3. It is very easy to use
4. It can integrated with internet

Editions of Visual Basic

Visual Basic 6 mainly is available in three editions, each designed to meet specific development requirements.

1. Learning Edition
2. Professional Edition
3. Enterprise Edition

Integrated Development Environment (IDE)

1. Menu Bar
2. Tool Box Window
3. Form Window
4. Properties Window
5. Project Explorer Window
6. Standard Toolbar
7. Code Edit Window
8. Form Layout Window
9. Object Browser
10. Context Menus
11. Immediate, Local and watch window

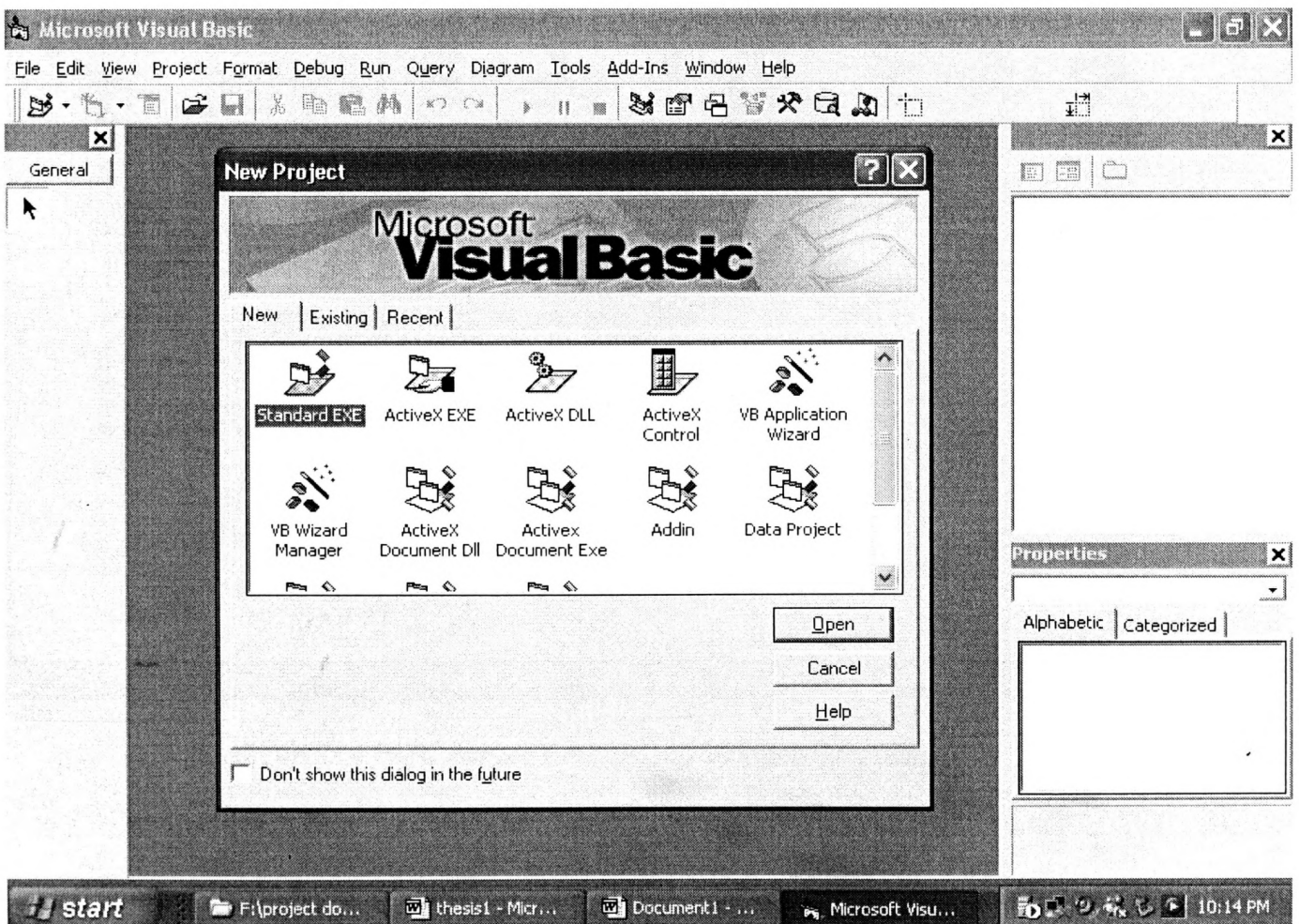


Figure 2.3 The Visual Basic Start-up Dialog Box

2.5 Overview of MS SQL 2000 Server

Microsoft SQL Server is used as a back end environment and used to create computer databases for the Microsoft Windows family of server operating systems. It provides an environment used to generate databases that can be accessed from workstations, the web, or other media such as a personal digital assistant (PDA). Microsoft SQL Server is probably the most accessible and the most documented enterprise database environment right now.

To start MS SQL Server, on the taskbar, click Start -> Programs -> Microsoft SQL Server -> Enterprise Manager.

Now following dialog screen appears

Then right-click on Databases and click New Database...

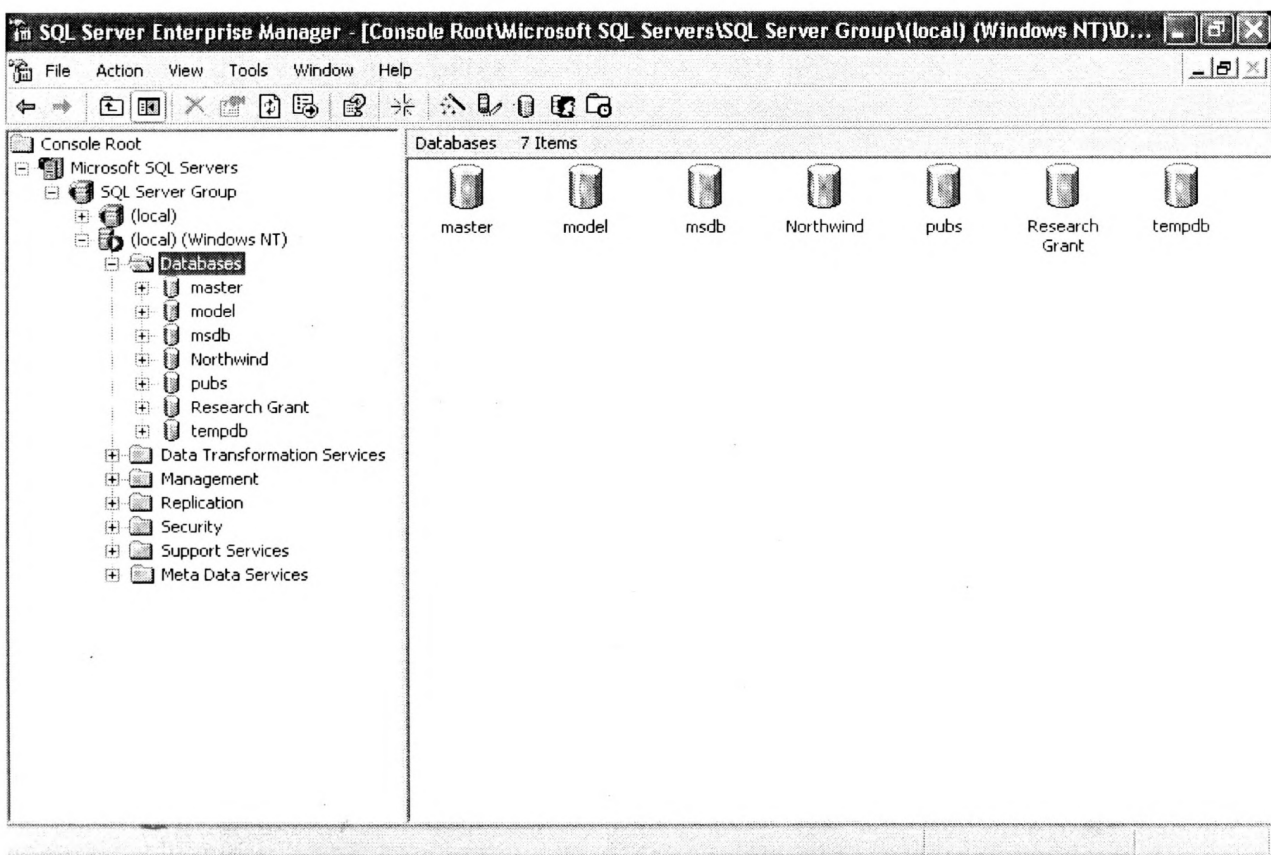


Figure 2.4 SQL Server Enterprise Manager Interface

In the Name text box, type the Database name and click OK. Then the new database has been created. Expand that database and right click on tables.

Select New Tables and then enter the field Name, their size and assign Null values if possible. Give the table name at last.

The amount of space that a database is using is referred to as its size. If we use the Database Properties dialog box of the SQL Server Enterprise Manager, if we specify the name in the general property page and click OK, the interpreter automatically specifies that the database would primarily use 1MB.

This is enough for a starting database. Of course, we can either change this default or later on can increase it when necessary. If we want to specify a size different from the default, if we are using the Database Properties to create database, in the Data Files property page and under the Initial Size column, change the size as we wish.

2.6 Connectivity

The first and most important part of this process is to make sure we have the correct components loaded into VB6 application. Open the Project menu and select components. Select the Microsoft ADO data control 6.0. Next Click the Apply and OK buttons.

Instantiate the classes we added by double clicking on them or dragging them onto the form. The ActiveX Data Control or ADO is labeled as ADODC on the toolbar.

After created an ADODC object, right click on it to bring up the menu shown below. When the menu pops-up select the ADODC properties to continue on with the configuration process.

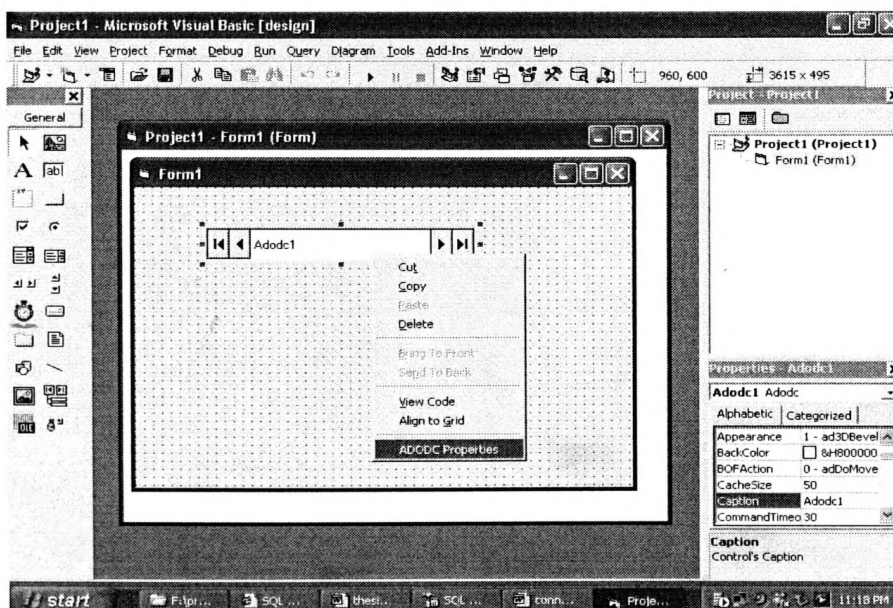


Figure2.5 The ADO Data Control Screen

Using the menu below, we will build a connection to a database. Select the Use Connection String radio button and then click on Build button. Select the appropriate connection technique and click on Next button. Then select the database name and click OK button.

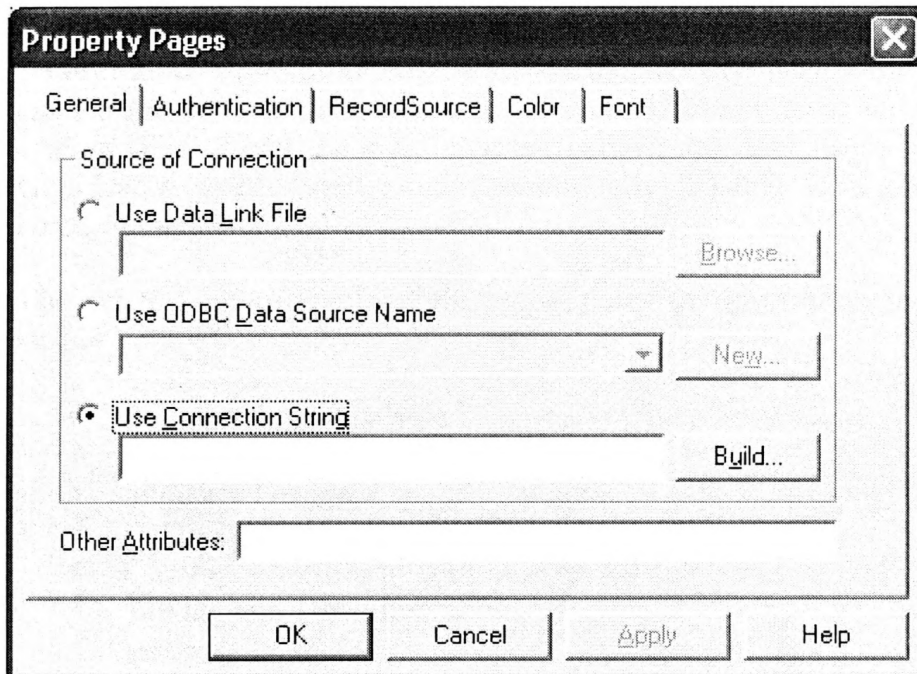


Figure 2.6 Connection String Dialog Box

This connection string appears in the property window. It can easily copy and paste to the module of the system. Then this connection string is visible all forms in that particular form.

3. METHODOLOGY

Initially the requirements were gathered from relevant people and they were analyzed according to their importance. The collected requirements were clear and precise, not changed frequently and the proposed system will be used for long time. Therefore the Iterative waterfall model was used for this system development.

After the user requirements were analyzed, the feasibility study was carried out to find out whether the system development is feasible or not. During this study it was clearly understood that this system was technically, operationally and economically feasible to implement in a computer system.

The entire system development process was going through the following stages.

- Requirements Analysis
- Data Design
- Interface Design
- Database Design
- Coding
- Testing and Documentation

3.1 Requirements Analysis

This stage was conducted with the participation of the users those who are directly benefited and involved with this particular system. Further requirements were collected by referring their existing documents such as forms, and reports. Also the following people were interviewed in order to further clarification of the requirements.

1. Accountant
2. Administration Officer
3. Data Entry Operator

After this the requirements were analyzed.

3.2 Data Design

After requirements analysis completed the description of the entire system was written in normal English Language. Then the entities, relationships and their attributes were identified. Thereafter Entity Relationship Diagram (ERD) drawn for the complete system. Appendix I show the ER Diagram for the system

3.3 Interface Design

All users were interacted with the software by the user interfaces. these user interfaces were designed using Visual Basic 6.0 Enterprise Edition. Because using Visual Basic environment can easily design attractive and user friendly interfaces.

The following basic elements comprised the interfaces.

- Forms
- Reports
- Data Control and Data Grid
- Other Screens: Login Dialogue Box and Menus

3.3.1 Forms

Form designing was played a significant role here in this particular system. Because forms were designed as the gateway points to access main areas of the system. Attractive forms designing attract the user to interact with the system.

Following controls were used during form designing.

- Text Boxes
- Labels
- Frames
- Command Buttons
- Picture Boxes
- Combo Boxes
- List Boxes

The following figure depicts the hierarchy of the entire forms in the system.

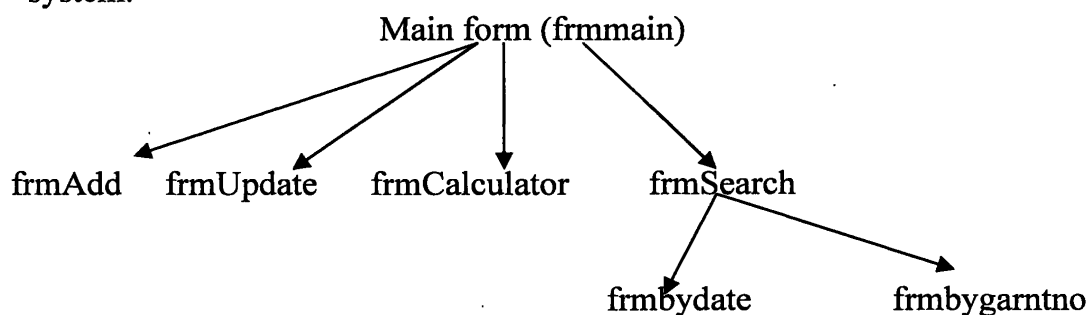


Figure3.1 Forms hierarchy of the system

Appendix II illustrates all these forms.

Other Screens

A login dialogue box was designed to authenticate the access to the system. Also menu was incorporated with the forms for easy navigation of the user group.

3.4 Database Design

The relevant ER Diagram was drawn and then it was converted into the tables. Then the tables were normalized up to 3NF.

The Microsoft SQL 2000 server environment was used to create this database which was designed to contain the following tables.

1. Voucher
2. Grantee
3. Grant Details

Appendix III illustrates the tables.

3.5 Coding

Visual Basic was used as the programming language. This ensured the establishment of the database connection through a basic module with the built-in support provided for MS Jet database engine (ADO). Validation rules and security features were also implemented in this phase itself.

E.g. Following codes were generated to the module of the system that is common for all forms

```
Public cn As ADODB.Connection  
Public rs As ADODB.Recordset  
Public conn As String
```

```
Public Sub openCon()  
On Error GoTo eh:
```

```
conn = "Provider=MSDASQL.1;Persist Security Info=False;Data  
Source=RESEARCH;Initial Catalog=Research Grant"  
Set cn = New ADODB.Connection  
With cn  
    .ConnectionString = conn  
    .CursorLocation = adUseClient  
    .Open  
End With
```

```

Set rs = New ADODB.Recordset
rs.Open "Voucher", "Grant Details", "Grantee", cn,
adOpenDynamic, adLockOptimistic, adCmdTable

```

```

Exit Sub

```

```

eh:
If Err.Number = -2147217865 Then
    MsgBox "Database Table does not exist", vbCritical, "Research
Grant Load Error"
ElseIf Err.Number = -2147467259 Then
    MsgBox "SQL Server is not Started" & vbCrLf & _
        "check Control Panel Services Settings", vbCritical, "Please try
after some time"
Else
    MsgBox Err.Source & " reports " & Err.Description, , "Error "
    & Err.Number
End If

```

```

End Sub

```

Tool bar, Status bar and Menu bar were incorporated with the main screen of the system. Following codes were generated to the Main Form.

For the Main Form

```

Private Sub mnuAboutNSF_Click()
frmaboutsnsf.Show
End Sub

```

```

Private Sub mnuAboutSystem_Click()
frmaboutsystm.Show
End Sub

```

```

Private Sub mnuBydate_Click()
frmSearch.Show
End Sub

```

```

Private Sub mnuExit_Click()
End
End Sub

```

```

Private Sub mnunew_Click()
frmAddNewGrants.Show
End Sub

```

```

Private Sub mnuUpdate_Click()
frmUpdate.Show

```

End Sub

```
Private Sub Toolbar1_ButtonClick(ByVal Button As  
MSComctlLib.Button)  
If Button.Index = 1 Then  
    frmAddNewGrants.Show  
ElseIf Button.Index = 2 Then  
    frmUpdate.Show  
ElseIf Button.Index = 3 Then  
    frmSearch.Show  
ElseIf Button.Index = 4 Then  
    frmCalculator.Show  
ElseIf Button.Index = 5 Then  
    frmaboutsistem.Show  
ElseIf Button.Index = 6 Then  
    End  
  
End If  
End Sub
```

The following codes were generated to add new grants details to the database.

frmAddNewGrants

```
Option Explicit  
Dim rs As ADODB.Recordset  
Private Sub cmdClear_Click()  
    txtGrantNo.Text = ""  
    txtGrantee.Text = ""  
    txtInstitute.Text = ""  
    txtTotalAllocation.Text = ""  
    txtDate.Text = ""  
    txtThisInstall.Text = ""  
    txtPersonRS.Text = ""  
    txtPersonTA.Text = ""  
    txtPersonO.Text = ""  
    txtEquip.Text = ""  
    txtConSum.Text = ""  
    txtTraSub.Text = ""  
    txtMisc.Text = ""  
    txtChqNo.Text = ""  
    txtVouNo.Text = ""  
    txtGrantNo.SetFocus  
End Sub
```



```

Private Sub cmdsave_Click()
On Error GoTo err:
Dim rs As New Recordset

rs.Open "select * from Grantee,Voucher,Grant_Details where
GrantNo =" & txtGrantNo.Text & "'", ADOCon, adOpenStatic,
adLockReadOnly
If rs.RecordCount <> 0 Then
MsgBox ""
Else
ADOCon.BeginTrans

ADOCon.Execute "insert into Grantee values('' &
txtGrantNo.Text & "','" & txtInstitute.Text & "','" & txtGrantee.Text
& "','" & txtTotalAllocation.Text & "')"
ADOCon.Execute "insert into Grant_Details values('' &
txtGrantNo.Text & "','" & txtThisInstall.Text & "','" &
txtpersonRS.Text & "','" & txtpersonTA.Text & "','" & txtpersonO.Text
& "','" & txtEquip.Text & "','" & txtConSum.Text & "','" &
txtTraSub.Text & "','" & txtMisc.Text & "','" & Format(txtDate.Text,
"mm/dd/yyyy") & "','" & "')"
ADOCon.Execute "insert into Voucher values ('' & txtVouNo.Text
& "','" & txtChqNo.Text & "','" & Format(txtDate.Text,
"mm/dd/yyyy") & "','" & txtGrantNo.Text & "')"
MsgBox "Data saved Successfully", vbInformation
ADOCon.CommitTrans
End If
rs.Close
Exit Sub

'ADOCon.Execute "update grantee set institute=''' & txtinstitute.Text
& ''' where grantno=''' & txtGrantNo.Text & '''
'adocon.Execute "delete from grantee where grantno=''' &
txtGrantNo.Text & '''
err:
MsgBox "" & err.Description & ""
ADOCon.RollbackTrans
End Sub

```

3.6 Testing

After completing the implementation part the system was tested. This tested allowed to detect errors or bugs in the system and to be fixed. Two basic test approaches were used in this process.

3.6.1 Unit Testing

After designed each form of the system that was subjected for unit testing. Otherwise individual modules of the developed system were tested for consistency.

3.6.2 System Testing

All the modules of the system were integrated and act as a single unit. Then this single unit was tested for its consistency.

3.6.3 Acceptance Testing

The overall acceptability and compatibility of the new system was tested. Finally they accepted the system.

4.RESULTS AND DISCUSSION

4.1 Results

The outcome of this software is a user friendly information system to handle information related to the Research Grants of the National Science Foundation. This system meets all the user requirements such as user can add new grants details to the database, the user can update existing grants data and he can find the relevant data of particular grant in the database.

4.1.1 Components of the Final System

Ultimately validated and approved system contains following components.

1. Interfaces:08 forms
2. Database: one with three tables

4.2 Discussion

The system was checked continuously for its consistency with the original goals. The results of testing, verification and validation procedures revealed that it matches with the original user requirements.

Also the other features of this system were up to the expected standards and hence the overall acceptability for the entire system was in satisfaction level.

The database of this system was designed by using MS SQL 2000 server. MS SQL 2000 database system has lots of operations and it has a good security mechanism. Therefore it is efficient enough to maintain all such records.

5. CONCLUSION AND RECOMMENDATION

The objective of developing a user friendly system has been achieved in the view of the stakeholders. The project work can be regarded as up to the customer expectation and satisfaction.

However, continuous monitoring must be done in order to check whether the system meets its goals in the long run.

The following can be suggested for the further work

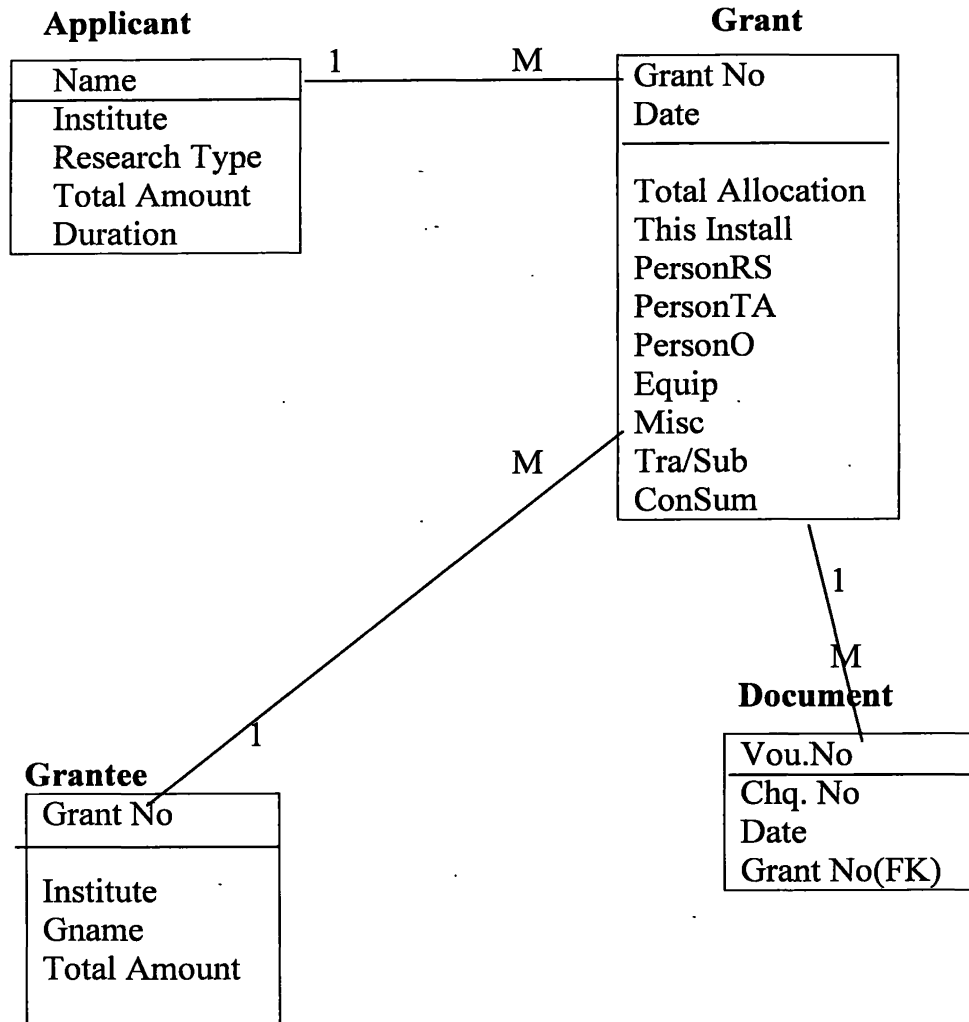
1. Development of the web based on-line accessibility to the system.
2. Adding a report generating tool such as Crystal Report to the system for the purpose of getting enhanced report.

REFERENCES

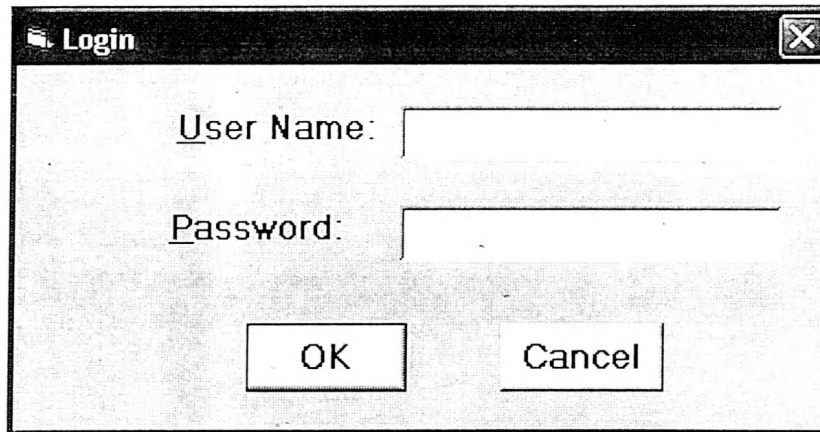
1. Sommerville I (1996) Software Engineering, 5th Edition, Addison-Wesley Inc., 742 p.
2. Pressman, R.S. (2001) Software Engineering- A practitioner's Approach McGraw-Hill Companies, New York, 860 p.
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5. University of Colombo School of Computing-Teaching Material (2006) Software Engineering.(Form:www.bit.lk)

APPENDIX I

ER Diagram

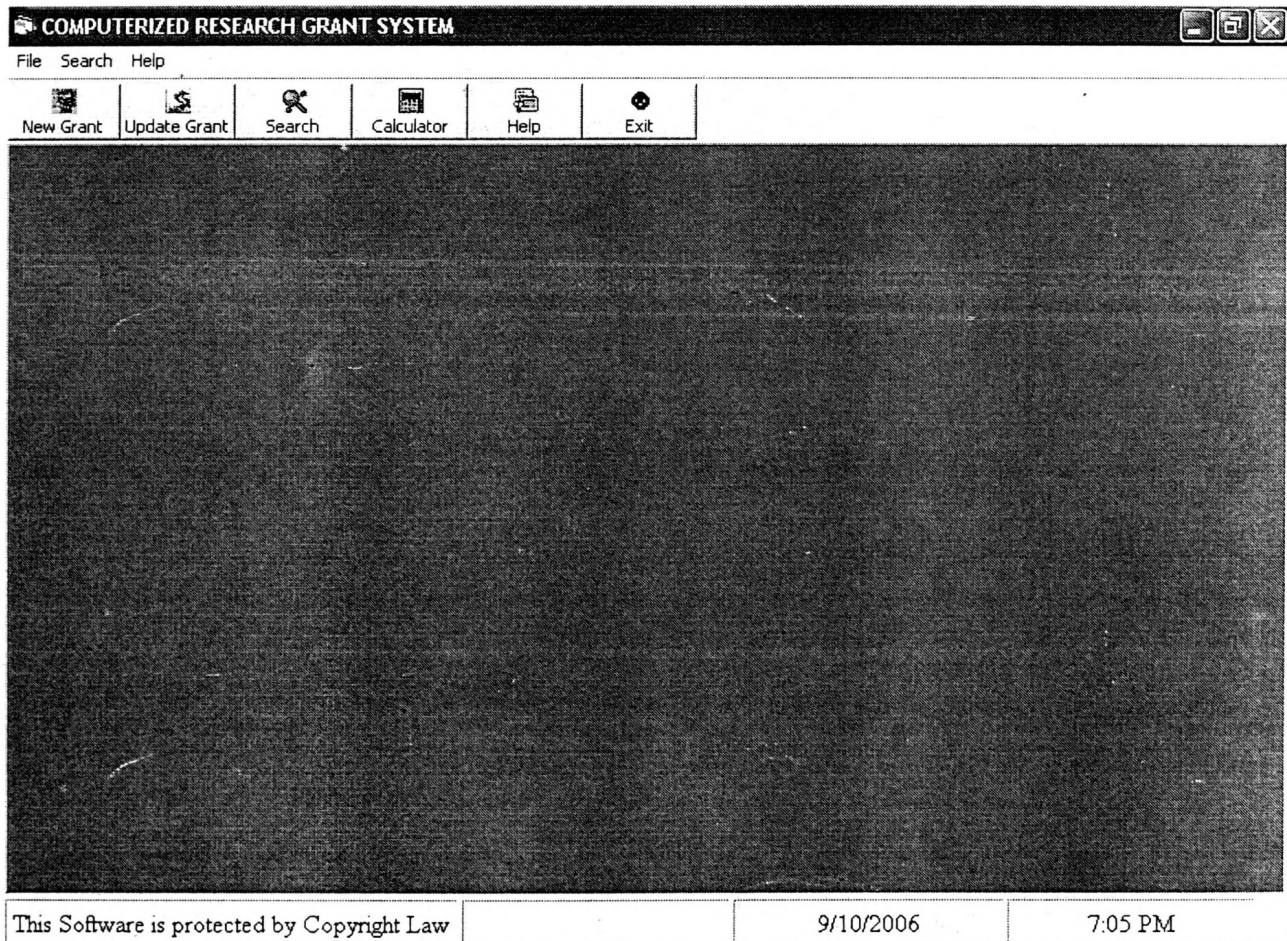


APPENDIX II



A small dialog box titled "Login" with a close button (X) in the top right corner. It contains two text input fields: "User Name:" and "Password:". Below the fields are two buttons: "OK" and "Cancel".

Login Form



The main window of the "COMPUTERIZED RESEARCH GRANT SYSTEM". The title bar includes the text "COMPUTERIZED RESEARCH GRANT SYSTEM" and standard window controls. Below the title bar is a menu bar with "File", "Search", and "Help". A toolbar contains icons for "New Grant", "Update Grant", "Search", "Calculator", "Help", and "Exit". The main area is a large, dark, textured rectangle. At the bottom, a status bar contains the text "This Software is protected by Copyright Law", a date field showing "9/10/2006", and a time field showing "7:05 PM".

Main Form of the System

COMPUTERIZED RESEARCH GRANT SYSTEM

File Search Help

New Grant Update Grant Search Calculator Help Exit

ADD NEW GRANTS

GRANT NO:	<input type="text"/>	PERSON(O):	<input type="text"/>
GRANTEE:	<input type="text"/>	EQUIP:	<input type="text"/>
INSTITUTE:	<input type="text"/>	CONSUM:	<input type="text"/>
TOTAL ALLOCATION:	<input type="text"/>	TRA/SUB:	<input type="text"/>
DATE:	<input type="text"/>	MISC:	<input type="text"/>
THIS INSTALL:	<input type="text"/>	VOU NO:	<input type="text"/>
PERSON(RS):	<input type="text"/>	CHQ NO:	<input type="text"/>
PERSON(TA):	<input type="text"/>		

SAVE CLEAR

This Software is protected by Copyright Law 9/10/2006 7:14 PM

Form for Add New Grants Details

COMPUTERIZED RESEARCH GRANT SYSTEM

File Search Help

New Grant Update Grant Search Calculator Help Exit

Update Existing Grant

GRANT NO: PERSON(TA) :

DATE: PERSON(O) :

THIS INSTALL: EQUIP. :

VR.NO.: CONSUM :

CHQ.NO/DATE: TRA/SUB :

PERSON(RS.): MISC. :

SAVE CLEAR VIEW DELETE

TOTAL ALLOCATION : UPTO NOW :

This Software is protected by Copyright Law 9/10/2006 9:17 PM

Form of Update Existing Grants

COMPUTERIZED RESEARCH GRANT SYSTEM

File Search Help

New Grant Update Grant Search Calculator Help Exit

Serching By Date

DATE:

GRANT NO:

GRANTEE:

INSTITUTE:

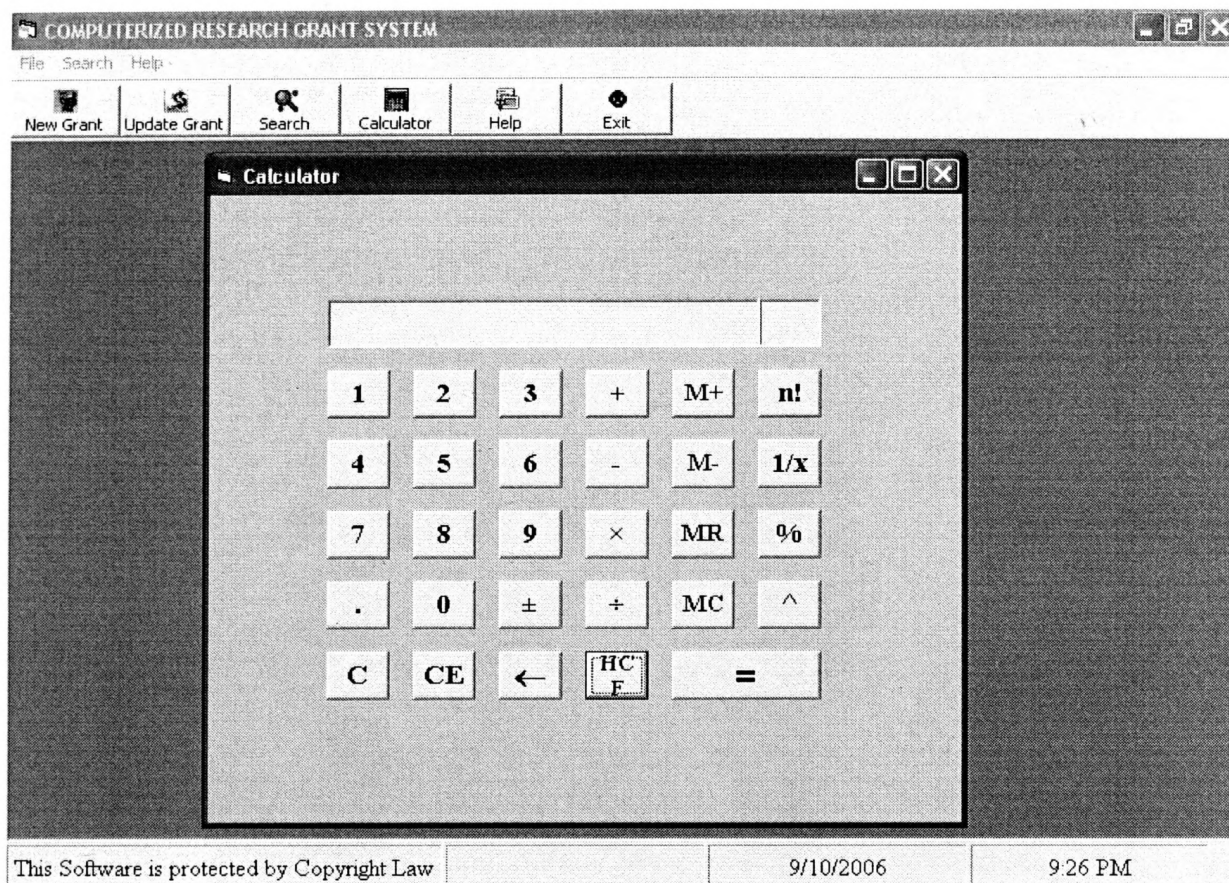
TOTAL AMOUNT:

UP TO NOW:

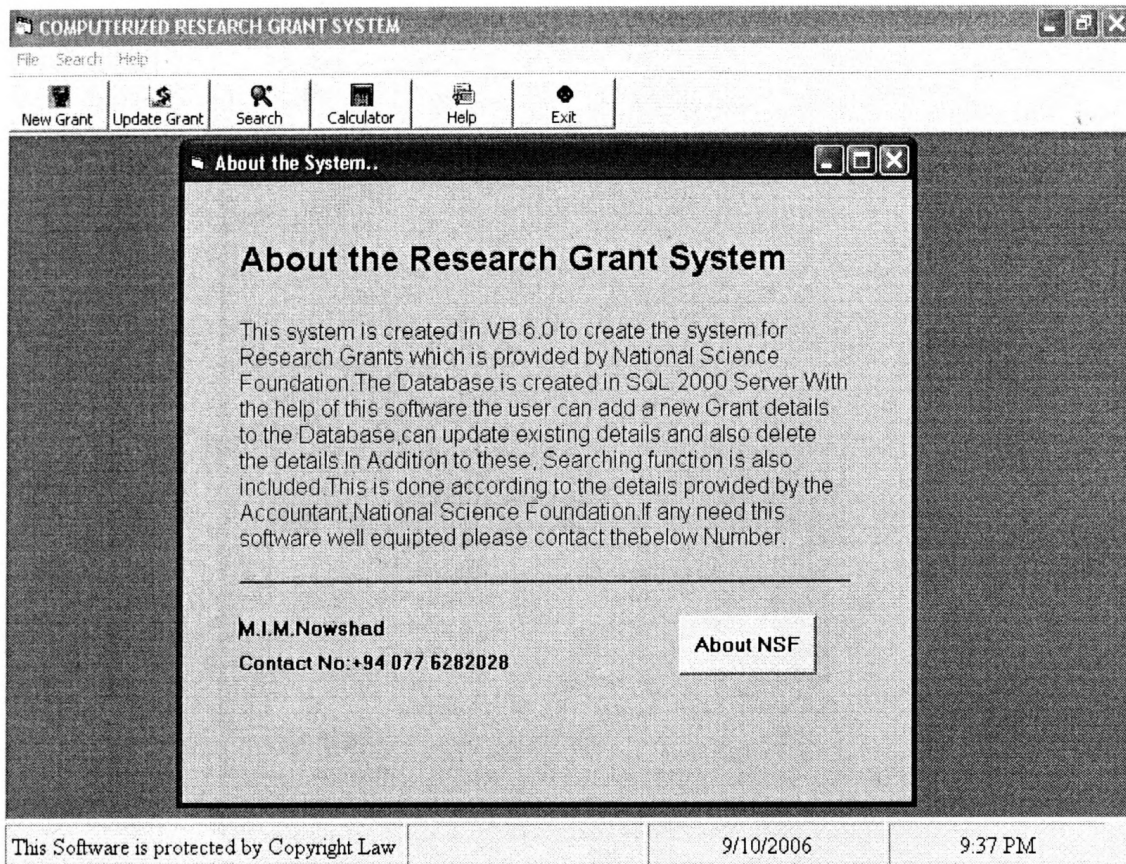
O.K

This Software is protected by Copyright Law 9/10/2006 9:22 PM

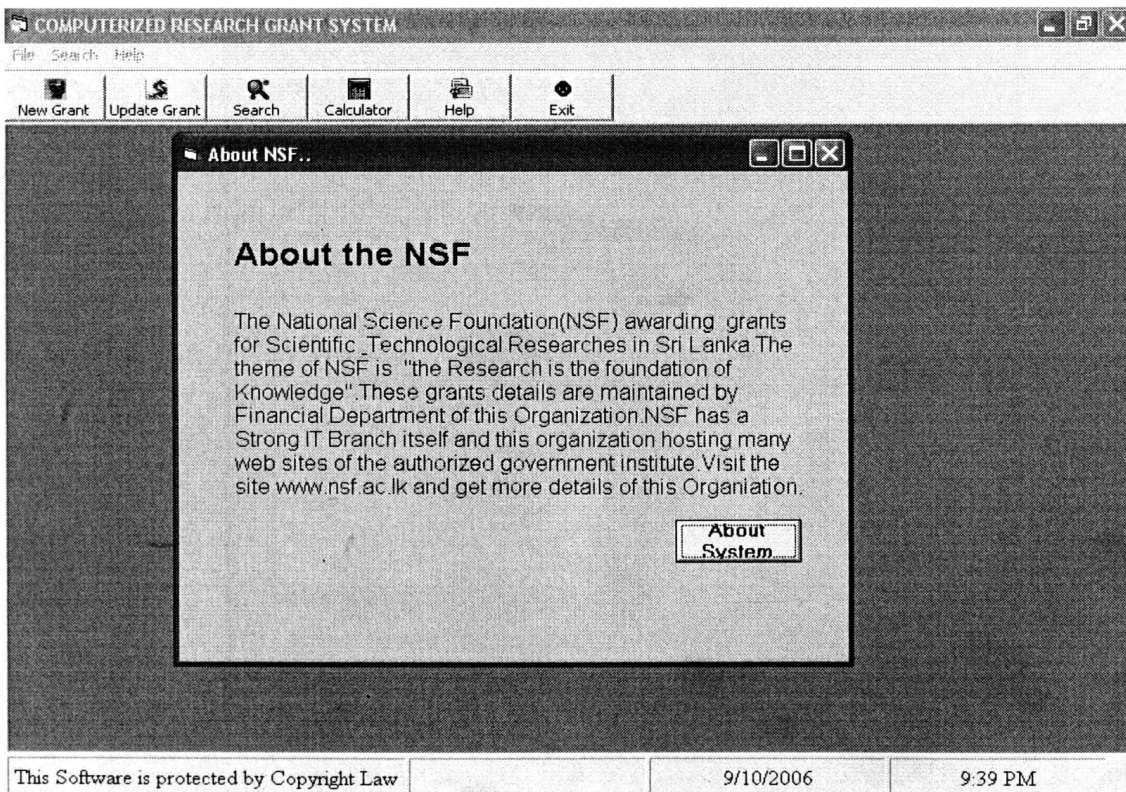
Form of Searching Details



Calculator Form



Help Form (About System)



Help Form (About NSF)

APPENDIX III

Table Properties - Grant_Details

General

Name: Grant_Details Permissions...

Owner: dbo
 Create date: 9/11/2006 9:20:21 PM
 Filegroup: PRIMARY
 Rows: 0

Columns:

Key	ID	Name	Data Type	Size(...)	Nulls	Default
		PersonTA	money	8	<input checked="" type="checkbox"/>	
		PersonRS	money	8	<input checked="" type="checkbox"/>	
		PersonO	money	8	<input checked="" type="checkbox"/>	
		Equip	money	8	<input checked="" type="checkbox"/>	
		ConSum	money	8	<input checked="" type="checkbox"/>	
		Misc	money	8	<input checked="" type="checkbox"/>	
		TraSub	money	8	<input checked="" type="checkbox"/>	

OK Cancel Apply Help

Grant_Details Table

Table Properties - Grantee

General

Name: Grantee Permissions...

Owner: dbo
 Create date: 9/11/2006 9:15:17 PM
 Filegroup: PRIMARY
 Rows: 0

Columns:


Key	ID	Name	Data Type	Size(...)	Nulls	Default
		GrantNo	varchar	30	<input type="checkbox"/>	
		Grantee	varchar	25	<input checked="" type="checkbox"/>	
		Institute	varchar	50	<input checked="" type="checkbox"/>	
		TotalAllocation	money	8	<input type="checkbox"/>	

OK Cancel Apply Help

Grantee Table

Table Properties - Voucher [X]

General

 Name: Voucher Permissions...


Owner: dbo

Create date: 9/11/2006 9:13:07 PM

Filegroup: PRIMARY

Rows: 0

Columns:

Key	ID	Name	Data Type	Size(...)	Nulls	Default
		VouNo	varchar	10	<input type="checkbox"/>	
		ChqNo	numeric	9(18,0)	<input type="checkbox"/>	
		Date	datetime	8	<input type="checkbox"/>	
		GrantNo	varchar	30	<input checked="" type="checkbox"/>	

< [Progress Bar] >

OK Cancel Apply Help

Voucher Table

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