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INTELLIGENT TUTORING SYSTEM USING NATURAL LANGUAGE DIALOGUES

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ABSTRACT

Intelligent tutoring system, ITS is a system that provides individualized tutoring or instruction. The intelligent systems, agents or tutoring systems act as virtual tutors and learning companions that help learners in learning. The notion of intelligent machines for teaching purposes can be traced back to 1926 when Sidney L. Pressey built a machine with multiple choice questions and answers. This machine delivered questions and provided immediate feedback to the user.

With rapid technology changes, the Malaysian educational system is challenged with providing increased educational opportunities to every student. Many educational institutions are answering this challenge by developing distance teaching programs.

The development of this project, An Intelligent Tutoring System Using Natural Language Dialogues, is one of many attempts to use technology in modern teachings to create a more effective learning and teaching environment.

Artificial Intelligence is applied here in this system to enhance its capabilities and at the same time to make the system smarter in interacting with the user of this system. The main objective in developing this system is to produce a smart and intelligent system which could help students enhance their academic performance. This system is also developed to provide a self control learning environment where users can progress at their own rates and own capabilities. The development of this project focusses on the secondary school students and teachers. All the academic information will be based on the Malaysian education system or the Kurrikulum Bersepadu Sekolah Menengah (KBSM) system for chemistry. Among the features of this system are :-Login/ Access

Module, Latest notes on form five chemistry subject, exercises/tutorials, natural language dialogue box and an interactive user interface.

This project, is a dialogue based natural language application that uses the keyboard to interact with the system which will generate answers to each query by the user of the system. This system will be developed using Microsoft Visual Basic 6.0 with other available softwares.

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CHAPTER ONE

Introduction

1.0 INTRODUCTION

Multimedia and Artificial Intelligence (AI) are now fast becoming a standard feature in the education sector. The growth of Multimedia Super Corridor (MSC) project, indicates that the government is placing great importance on the use of AI in education. This strong emphasis on AI has resulted in promulgation of new educational model between academic and training institutions. Players in the education sector now have to resort to more innovative mode of instructions via various technology approaches.

In the modern age of AI, Electronic learning and teaching that occurs could help the learning and tutoring process follow the growth of the mentioned technology. AI is a great platform in helping the learning and teaching process and at the same time allows teachers and tutors present their ideas in a form where it can be accessed anytime after schooling hours.

The growth in e-learning indicates the need to widen access to learning throughout the life span and to make education flexibly available at the time and place of the students choosing.

What is an Intelligent Tutoring System?

An Intelligent Tutoring System, ITS is a system that provides individualized tutoring or instruction. Intelligent Tutoring Systems (ITSs) aim to provide students with individualised, dedicated tutoring based partly upon an analysis of the procedures followed by the user and AI techniques which may provide some assistance on how the user should progress. The goal of ITS is to provide the benefits of one-on-one instruction automatically and cost effectively. Like training simulations, ITS enables users to practice their skills by carrying out tasks within highly interactive learning

environments. However, ITS goes beyond training simulations by answering user questions and providing individualized guidance. Unlike other computer-based training technologies, ITS systems assess each learner's actions within these interactive environments and develop a model of their knowledge, skills, and expertise. Based on the learner model, ITSs tailor instructional strategies, in terms of both the content and style, and provide explanations, hints, examples, demonstrations, and practice problems as needed.

Each ITS consists of three components:

- knowledge of the domain
- knowledge of the learner
- knowledge of teacher strategies

The domain refers to the topic or curriculum being taught. The learner refers to the student or the user of the ITS. The teacher strategies refers to the methods of instruction and how the material shall be presented.

This project, An Intelligent Tutoring System Using Natural Language Dialogues aims to provide a better learning environment to students or users of this system at an affordable rate and also to provide a self control learning environment where students can progress at their own rates and own capabilities. The system to be developed will enhance the quality of learning such as improving performance, and understanding. In this respect, this system will be serving as a pedagogical expert where it would monitor the student's performance and provide feedback to students. Artificial Intelligence is used in this system to enhance its capabilities and at the same time make the system smarter in interacting with the user of the system.

The goal of the natural language in the system is to design and build a computer system that will analyze, understand and generate languages that humans use naturally so that eventually you can address your computer as though you were addressing another person.

1.1 PROJECT OVERVIEW

This system, An Intelligent Tutoring System Using Natural Language Dialogues, is a dialogue based natural language application that uses the keyboard to interact with the system which will generate answers to each query by the user of the system. This is roughly how the natural language system works :-

- The system has a database of particular words called the keywords. For each keyword, the system stores an integer. Once the user of this system inputs a sentence, the system will find a keyword from the sentence and try to match the keyword with the ones in the database. If there is more than one keyword then the system picks the keyword with the highest integer value. The system then uses the output specification that is associated with this keyword to generate the next sentence. If there is no keywords, the system generates an innocuous continuation statement.

1.2 PROBLEMS WITH CONVENTIONAL TUTORING SYSTEM

The main problem of the current tutoring system and teaching methods is the lack of individual attention to the learner. As every learner has different style and rates of

learning, we should provide an opportunity for the learner to learn at their own capabilities.

Another problem is the materials prepared are not systematic plus the fact that students tend to loose interest in studies easily.

Another issue with the conventional tutoring system is of the time spent for traveling and the cost of tuition classes and revision materials. Students that come from the poor family finds it a burden to attend additional tuition classes due to its cost.

1.3 SYSTEM LIMITATION

The major problem faced in developing the proposed system is applying the natural language dialogues. It is not an easy task to make the system understand each and every word and sentence input by the user. Understanding sentence means among other things, knowing what concepts a word or phrase stands for and knowing how to link those concepts together in a meaningful way. It's ironic that natural language, the symbol system that is easiest for humans to learn and use, is hardest for a computer to master. Long after machines have proven capable for inverting large matrices with speed and grace, they still fail to master the basics of our spoken and written languages.

Another limitation of this tutoring system is that it cannot replace the roles played by teachers. A tutoring system cannot show love or anger towards the behavior of the system users.

1.4 PROJECT OBJECTIVES

1. To create a paperless environment for users at their home comfort.

2. To develop an easy to use user friendly system that will enhance the quality of learning such as improving performance, monitor and provide feedback to evaluate the students understanding
3. To produce a smart and intelligent system which could help students enhance their academic performance.
4. To provide self control learning environment where users can progress at their own rates and own capabilities.
5. To offer some measure of privacy. This is to relieve the students from the fear of being ridiculed by other students for his or her mistakes.
6. To assist the development of smart school system in the country.
7. To save cost, the users can save cost (cost on tutors and tuition fees) by using the proposed system.
8. To save time, this can be a knowledge centre for information related to it. Thus, it saves time in the process of knowledge gathering.
9. To create efficiency. The user will get the required information or knowledge in a fast and efficient manner due to the fact that the data is already organized properly in a database.

1.5 PROJECT SCOPES

The development of this project focusses on the secondary school students and teachers. All the academic information will be based on the Malaysian education system or the Kurrikulum Bersepadu Sekolah Menengah (KBSM) system. It will cover few chapters of the form five chemistry subject. Among the features of this system are :-

1. Access and verification module
2. Latest Notes On Subject.

3. Test On Various Topics.
4. Natural language dialogue box.
5. Questions Editing.

This system will be developed in three modules that is the login module to aceess the system, the student module where the student or user of the system is given authority to access certain links in the system and the instructor module where the instructor or tutor can upload and edit the test and notes in the system.

1.6 PROJECT BENEFITS

This project is expected to benefit students, teachers and also tutors especially those from the secondary level. Students will have the opportunity to study at their own pace and get immediate feedback on their performance. This system will also help them save time in the process of knowledge gathering. The system is also cost efficient as the cost of traveling and tuition classes can be saved. The system to be developed will enhance the quality of learning such as improving performance, monitor and provide feedback to evaluate the students understanding on selected subject.

1.7 SOURCE OF INFORMATION

The main source of information for this project is through journals and articles published on the net, magazines and at the local newspapers. Other source of information are through books or course books written by experts in computer science that is available in the main library. In addition, some relevant reference books are also look into to seek more related information. Information is also gained

through discussions with fellow course mates and through an interview with a form five chemistry teacher from Sekolah Tinggi Muar, in Johor and an IT specialist from Kuala Lumpur.

1.8 PROJECT SCHEDULE

No	Task	Months							
		Mar	Aprl	May	June	July	Augt	Sept	Oct
1	Identify requirements and problems								
2	System specification and analysis								
3	System design								
4	System development and software building								
5	Coding and prototyping								
6	System integration and testing								
7	Documentation								

Figure 1.0 : Project Schedule

This project was carried out through the period of 8 months from the end of February till early October. The project development was done in many different phases. It started of with identifying the requirement and problems of the system and ended with the testing of the system.

1.9 HARDWARE REQUIRED

Windows 98 or later

Pentium III Processor or higher

Hard disk with at least 1.0 GB of space

64 MB RAM or higher

Mouse, Keyboard, Monitor

1.10 PROPOSAL OVERVIEW

Chapter 2 will be focusing on the literature review of the proposed project. This includes the comparisons of the existing softwares in the market.

Chapter 3 is the methodology and system analysis part. It will be focusing mainly on the various types of scripting languages.

Chapter 4 is the system design of the project. It will illustrate the flow diagram, data structure and data dictionary of the system.

Chapter 5 is the system implementation of the project. It specifies exactly how the system was integrated.

Chapter 6 is the testing and evaluation of the system. The system is evaluated according to various aspects.

Chapter 7 is the conclusion of the project.

1.11 SUMMARY

Intelligent Tutoring Systems (ITSs) aim to provide students with individualised, dedicated tutoring based partly upon an analysis of the procedures followed by the user and AI techniques which may provide some assistance on how the user should progress.

The development of this project, An Intelligent Tutoring System Using Natural Language Dialogues is to help create a better learning and teaching environment that is functional anytime, anywhere. The system to be developed will enhance the quality of learning such as improving performance and understanding. In this respect, this system will be serving as a pedagogical expert where it would monitor the student's performance and provide feedback to students.

In this way, it is hope that this project would assist the development of a society of people who are able to cope with the fast changing information and Artificial Intelligence technology. The Government of Malaysia through the education ministry is going all out in enhancing the standards of education in Malaysia by implementing the smart school system. It is also hoped that this project would somehow assist the development of smart school system

CHAPTER TWO

Literature Review

2.0 INTRODUCTION

Research and information gathering were done to gather as much knowledge and information about the system to have brief idea on how the system should work. Methods of information gathering are such as studying and looking for the similar project in the document room, looking for reference books from the library, extra reference material and research papers on the topic from the internet and through discussions with fellow course mates and with the thesis supervisor.

This chapter will give a brief introduction on Artificial Intelligence (AI), Natural Language Understanding, the programming language and authoring tool used to develop this system and also an analysis of the current available system in the market.

2.1 ARTIFICIAL INTELLIGENCE

Artificial Intelligence, AI is a subdivision of computer science developed to create computer software and hardware that imitates the human mind. The main goal of AI is to make computers or applications smarter by creating a system that will allow a computer mimic some of the functions of the human brain. AI strives to build intelligent entities as well as understand them. AI is one of the newest disciplines. It was formally initiated in 1956. The history of AI has had cycles of success, misplaced optimism, and resulting cutbacks in enthusiasm and funding. There have also been cycles of introducing new creative approaches and systematically refining the best ones. An intelligent system would need to possess the following capabilities:

- **natural language processing** to enable it to communicate successfully in English (or some other human language);

- **knowledge representation** to store information provided before or during the interrogation;
- **automated reasoning** to use the stored information to answer questions and to draw new conclusions;
- **machine learning** to adapt to new circumstances and to detect and extrapolate patterns.

2.1.1 Artificial Intelligence Applications

Recent progress in understanding the theoretical basis for intelligence has gone hand in hand with improvements in the capabilities of real systems. Often, scientists in other fields move gradually into artificial intelligence, where they find the tools and vocabulary to systematize and automate the intellectual tasks on which they have been working all their lives. Similarly, workers in AI can choose to apply their methods to any area of human intellectual endeavor. In this sense, it is truly a universal field. AI currently encompasses a huge variety of subfields, from general-purpose areas such as perception and logical reasoning, to specific tasks such as playing chess, proving mathematical theorems, writing poetry and diagnosing diseases.

The AI techniques can be found in areas such as :-

1.Game Playing

You can buy machines that can play master level chess for a few hundred dollars. There is some AI in them, but they play well against people mainly through brute force computation--looking at hundreds of thousands of positions.

2. Speech Recognition

In the 1990s, computer speech recognition reached a practical level for limited purposes. Thus United Airlines has replaced its keyboard tree for flight information by a system using speech recognition of flight numbers and city names. It is quite convenient. On the the other hand, while it is possible to instruct some computers using speech, most users have gone back to the keyboard and the mouse as still more convenient.

3. Understanding Natural Language

Just getting a sequence of words into a computer is not enough. Parsing sentences is not enough either. The computer has to be provided with an understanding of the domain the text is about, and this is presently possible only for very limited domains.

4. Computer Vision

The world is composed of three-dimensional objects, but the inputs to the human eye and computers' TV cameras are two dimensional. Some useful programs can work solely in two dimensions, but full computer vision requires partial three-dimensional information that is not just a set of two-dimensional views.

5. Expert Systems

One of the first expert systems was MYCIN in 1974, which diagnosed bacterial infections of the blood and suggested treatments. It did better than medical students or practicing doctors, provided its limitations were observed.

6. Heuristic Classification

One of the most feasible kinds of expert system given the present knowledge of AI is to put some information in one of a fixed set of categories using several sources of information. An example is advising whether to accept a proposed credit card purchase. Information is available about the owner of the credit card, his record of payment and also about the item he is buying and about the establishment from which he is buying it (e.g., about whether there have been previous credit card frauds at this establishment).

7.TutoringSystem

A tutoring system is a system that provides individualized tutoring or instruction. The notion of intelligent machines for teaching purposes can be traced back to 1926 when Sidney L. Pressey built a machine with multiple choice questions and answers. This machine delivered questions and provided immediate feedback to the user.

2.2 NATURAL LANGUAGE PROCESSING OVERVIEW

Natural Language Processing (NLP) is both a modern computational technology and a method of investigating and evaluating claims about human language itself. Some prefer the term Computational Linguistics in order to capture this latter function, but NLP is a term that links back into the history of Artificial Intelligence (AI), the general study of cognitive function by computational processes, normally with an emphasis on the role of knowledge representations, that is to say the need for representations of our knowledge of the world in order to understand human language with computers.

Natural Language Processing (NLP) is use in computers to process written and spoken language for some practical, useful, purpose: to translate languages, to get information from the web on text data banks so as to answer questions, to carry on conversations with machines, so as to get advice about, say, pensions and so on. There is also a huge range of lesser but interesting applications, e.g. getting a computer to decide if one newspaper story has been rewritten from another or not, a topic in machine learning techniques, automating the construction and adaptation of machine dictionaries, modeling human agents' beliefs and desires etc. The last is closer to Artificial Intelligence, but is essential if computers are to engage in realistic conversations: they must, like us, have an internal model of the humans they converse with.

Currently, the field of Natural language includes a wide variety of linguistic theories, cognitive models and engineering approaches. Although Unrestricted NLP is still a very complex problem, numerous successful system exists for restricted domains of discourse. In the context of Human Computer Interaction (HCI), NLP applications range from various speech recognition systems to natural language interfaces to database, expert and operating system, to a multitude of machine translation systems. Currently, interactive applications may be classified along the following categories;

- Speech Recognition/ Understanding and Synthesis.
- Natural Language Interfaces.
- Discourse Management, Story Understanding and Text Generation.
- Interactive Machine Translation.
- Intelligent Writing Assistants

Natural Language Analysis includes lexical, morphological, syntactic, semantic, and discourse processing.

2.2.1 Natural Language Applications

Natural Language applications can be divided into two major classes:-

1. Text-based
2. Dialogue based

1.Text based applications involves the processing of written texts such as books, newspapers, e-mail and reports.

Examples of text based applications are such as :- Extracting information from messages, translating documents to different languages, summarizing texts and finding documents on certain topics.

2.Dialogue based applications involve human-machine communication. Most naturally this involves spoken language but it also includes interaction using keyboards.

Typical potential applications include :- Question answering system, tutoring system, banking transactions, automated customer service over telephone.

This is a growing area of NLP concerned with the modeling and simulation of human-dialogues, usually with the computer modeling a human dialogue participant. The field thus spans all levels of dialogue analysis and generation: from the processing and understanding of the input to the generation of dialogue response based on stored knowledge bases, pragmatic functions concerning the overall goal or function of the conversation etc. Most research and development are carried out in areas where there is some concrete application scenario in view, such as automating call centres that answer questions on insurance policies

This project , An Intelligent Tutoring System Using Natural Language Dialogues, is a dialogue based natural language application that uses the keyboard to interact with the system which will generate answers to each query by the user of the system.

2.3 REVIEW ON EXISTING SYSTEM

Currently there are two Intelligent Tutoring System that are available in the country. The first one is developed by Buabeng-Andoh Charles & Asirvatham David from the Multimedia University in Cyberjaya. The system is called Multimedia Intelligent System For Online Learning, IMMES.

The second system is developed by Masri Ayob, Kalaivani Chellappan and Nazlena Mohamad Ali from The Faculty of Technology and Information Sciences, University Kebangsaan Malaysia (UKM), Bangi. The system is called Intelligent Tutoring Tool For Digital Logic Design Course (ITDiL).

2.3.1 Intelligent Multimedia System For Online Learning (IMMES)

IMMES is being developed to act as a facilitator to automate learning tasks to assist learners effectively. By incorporating IMMES into online learning, the authors aims at improving the quality of learning experience of the learners.

2.3.1.1 System Architecture

IMMES consists of five components: learner interface, web server, intelligent engine, learner records and learning resources. The learner interface provides interaction among the web server, learner records and learning resources. The web server is used to store and process information and the information is delivered to the intelligent engine. The intelligent engine consists of student-tracker and navigation engines. The tracker engine

keeps track of the learner's access time. Upon completion, the record is saved to the server for further analysis. The navigation engine provides navigation support base on the learner's responses and performance records. Adaptive navigation support makes use of direct guidance where the system can suggest the next part of the learning materials and also aims to help a learner find the best path through a complex learning hyper media environment. The learner records component provides information on the learner's progress scores or overall rating performance, and transfers the learner's record to the core intelligent engine for processing. Finally, the learning resources component

contains learning materials, quizzes, tests and other resources for learning experiences.

2.3.1.2 Features

The Intelligent Multimedia Education System offers various features for learners as well as for teachers. The most important are:- Graphic User Interface, On-line Help, easy to integrate multimedia documents, easy to manage course material, online discussion. The online discussions and email provide opportunities for all the learners to participate in the discussion of key issues as well as contributing to flexible learning approach. The other features are online quiz template which, helps putting quizzes online, learners and teachers registration interface.

2.3.2 Intelligent Tutoring Tool For Digital Logic Design Course (ITDiL).

ITDiL has been designed purposely as a complementary tool for learning Digital Logic Design Course. The concept of self-directed learning has been applied in

this package to provide higher learning skills for the learner. ITDiL gives a clear overview of step by step process in Digital Logic Design, thus it helps student in achieving their confidence in learning the subject. Hopefully, by using ITDiL, students would be able to learn at their own and they can have a better understanding towards the subject.

ITDiL has been implemented using a combination of two different programming languages: Visual Basic and AmziProlog. Visual Basic (VB) is an object oriented programming language that has been designed to make user friendly programs easier to develop.

2.3.2.1 Features

The most importance feature of the system is that the system uses Visual Basic as a GUI (Graphical User Interface). The reason why Visual Basic is chosen is because of its capability to combine Dynamic Linked Library (DLL). DLL enables programmer to import external components that are not provided in VB package. A few modules implemented using VB are truth table, K-map and minimization of Boolean algebra using K-map. Conversely, PROLOG is a popular language for logic programming. It help in identifying patterns to process and implify logic expressions. This advantage has been utilize to construct the module of logic expression minimization in ITDiL implementation. PROLOG creates a DLL for logic expression minimization module. This DLL will be imported to VB program by using Logic Server Engine. The Integration of VB and PROLOG is done by implementing a communication channel called Logic Server Engine. The API (Application Programmer Interface) functions for this engine is to :

- open, close and import the compiled PROLOG code,

- assert and retract logic terms dynamically,
- submit logical queries and retrieve the result from PROLOG code.
- process errors.

The API calls are embedded in the Logic Server application function.

2.3.2.2 Basic Functions

Basic facilities provided by ITDiL are :

- Truth Table generation. User should select number of variables to be used either 2 or three variables. Then ITDiL will auto generate all the input combination while the output will be set to be '0' as default. User can change the output values just by toggling the output (using mouse click). Therefore student are free to design their own problem to be solved by ITDiL. This will encourage student to think and set their own objective.
- Karnaugh Map. There are two options, one to generate K-map, while the other one for simplification of Boolean equation using K-map sop or K-map pos. From the truth table values, ITDiL will construct a K-map when user selects "K-map" option in the main menu. Then the simplified Boolean equation will be shown in the form of sop or pos (depends on user selections) whenever a simplified K-map option is selected. Due to some constraints, the symbol of logical NOT can be displayed as A'. After simplified K-map options been selected, show groups option will appears to enable user displayed the obtained group.

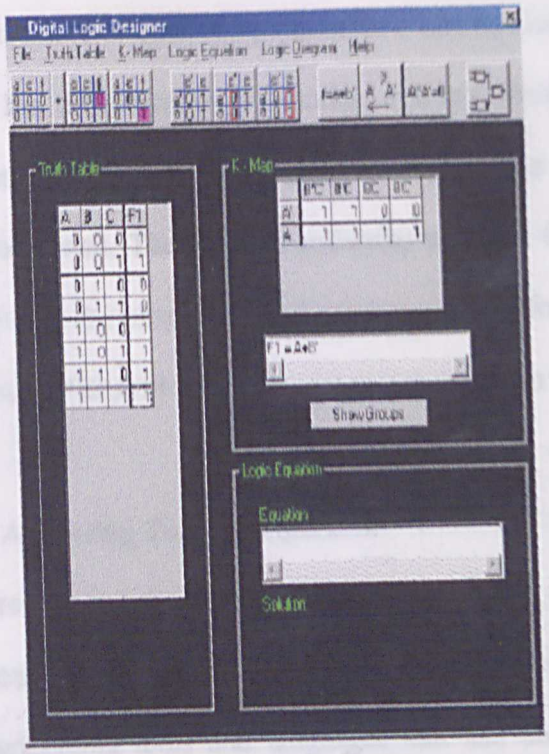


Figure 2.0 : ITDiL user interface

2.3.3 Systems Limitation

The two systems mentioned above have two main limitation. Firstly their objectives are to build a virtual lab rather than assisting student to enhance their basic knowledge. The user interface of this systems are also confusing and difficult to follow. Besides their system doesn't have the natural language features.

2.4 REVIEW ON AUTHORING TOOLS

Authoring Tools are very useful and important in developing the front ends of an application. It is a user friendly working interface, internal interface for accepting external media, a facility to import text, graphics, and drawing capabilities,

animation, audio, video manipulation and editing function. ITS authoring tools can simplify the development of tutoring systems. Before a system is created, it is important to evaluate the possible authoring tools in order to develop a system that can perform well. The selected authoring tools for this system is Microsoft Visual Basic 6.0 and the programming language selected for the natural language dialogue box is Java. Microsoft access is used as a database to store students information.

2.4.1 Authoring Tools Comparison

There are many authoring tools that can be used to develop an Intelligent Tutoring System available in the market. There are also many authoring tools, programming tools and languages that can be used to develop an intelligent tutoring system. Below is a review on the Visual Basic 6.0 programming language, Macromedia Authorware 6.5 and the Java programming language.

2.4.1.1 Microsoft Visual Basic 6.0

Visual Basic 6.0 has many advantages and at the same time it is the most reliable software compared to other softwares.. Visual basic 6.0 has the capability to build full-featured Windows programs the most efficiently. VB 6.0 accesses data easily with the Active X Data Objects. VB 6.0 can also create client/server database applications that connects to SQL servers.

Microsoft has also incorporated native OLE DB drivers into VB, allowing high-speed access to SQL Server 6.5 and Oracle 7.3.3+. But it's data access capabilities don't stop there - Visual Basic can talk to any ODBC- or OLE DB-compliant database.

2.4.1.2 Macromedia Authorware 6.5

Macromedia Authorware 6.5 is the leading visual rich media authoring solution for learning applications. It is also a professional multimedia authoring tool. It actually uses an icon and diagram approach to create graphical user interface (GUI). It also supports interactive applications with drag and drop controls, integrated animation and it is compatible for files produced anywhere. Authorware has the capability to combine a broad variety of multimedia objects, video and animations.

2.4.1.3 Java

Java is a simple, object-oriented, distributed, interpreted, robust, secure, architecture, neutral, portable, high-performance,, multithreaded. and dynamic programming language. The developers of Java based it on the C++ programming language, but removed many of the language features that are rarely used or often used. C++ is a language for object-oriented programming and offers very powerful features. The Java Application Programming Interface (API) is a large collection of ready-made software components that provide many useful capabilities, such as graphical user interface (GUI) widgets. The Java API is grouped into libraries of related classes and interfaces; these libraries are known as packages.

Listed below is a brief comparison of all authoring tools available in the market today.

Table 2.0: Authoring Tools Comparison

Authoring Tools	Advantages	Disadvantages
Microsoft Visual Basic 6.0	Enhanced application design with object-oriented programming techniques	Cannot be integrated with most applications and softwares.
Macromedia Director, Adobe Premier	Easily create multimedia: Synchronized video, graphics, audio, text (sometimes -- that can be hard in these tools)	Real deep content requires big investment
Authorware	Designed for creating interactive educational software: With multiple choice buttons, drag and drop things, ties to multiple media, cross-platform support.	Requires strong programming skills,.
Adobe PageMill, ObjectDancer, Macromedia Flash, Coda, Microsoft Frontpage	Easily put content on the Web, often with animations, interesting interactive widgets, audio, etc	Numerous features may confuse users, PageMill is a basic HTML editor.
Digital Trainer 4.1 Micromedium Inc.	Comprehensive and flexible features, Good training or testing tools.	Needs more support materials for optimum use in school environments.

2.4.2 Designing Software

Adobe Photoshop 6.0 is among the best designing tool available in the market today. Part of the user interface were designed using this software. Photoshop is the single most powerful tool for the creation and editing of graphic images. Photoshop 6.0 rounds out its comprehensive toolset with new capabilities to meet any creative or production demand and to handle the widest variety of image-editing tasks in the most efficient way. Photoshop 6 is the next generation of

image editing software with powerful new features that offers something for everyone. Photoshop 6 can expand beyond pixels with the vector drawing tools. Images can also be exported with resolution independent vector shapes and text.

2.5 SUMMARY

Research have been made to gather information regarding the intelligent tutoring system and also of the content, available techniques and technology and also studies on existing systems. The major source of information is the internet, journals, books and also through interview and discussion with fellow course mates.

Function to be included, the features and overall philosophy of the intelligent tutoring system were duly documented for this information, decisions were made concerning the scope of the system, its objectives and how to accomplish them.

CHAPTER THREE

Methodology

3.0 METHODOLOGY

Methodology is term as a recommended collection of philosophies, phases, procedures, rules, techniques, tools, documentation, management and training for developers of information systems.

In order to choose the correct and appropriate methodology, we have to bare in mind that it is to improve the end product to the extend of perfection of the development process. This is only referring to the particular rationale and not to be confused with the quality of development process. It was found that, by using methodologies to develop products, the outcome or the results can be improved dramatically in terms of quality and zero defects.

Different methodology methods utilize different development process and strategies. Therefore the suitability in selecting a methodology may vary from the type of product that is to be developed. Besides, different methodology method may require different level of system analyst involvement in terms of quality and skills (interpersonal, analytical, technical and management). Therefore, there must be some certainty of how many system analyst and to what extent those system analyst are capable.

A careful selection of a methodology method could lead to a great exploitation of the soon to be develop system to the fullest potential, indirectly provoking the beneficial aspects of the methodology, techniques for the system and finally improving the project management and control. This leads to enhancing the productivity and in addition building the system faster. There must be a balance between the type of information system to be develop and the knowledge about the characteristics of the methodology.

3.1 WATERFALL MODEL

The waterfall model was derived from engineering models to put some order in the development of large software products. It consists of different stages which are processed in a linear fashion. Compared to other software development model it is more rigid and better manageable. This model makes a development process easy to understand, especially to those who are not familiar with system development. The waterfall model gives a high range view to system developer while developing the system The waterfall Model is an important model which is the basis of many other models, however for many modern projects it has become a little outdated, but it is still widely used.

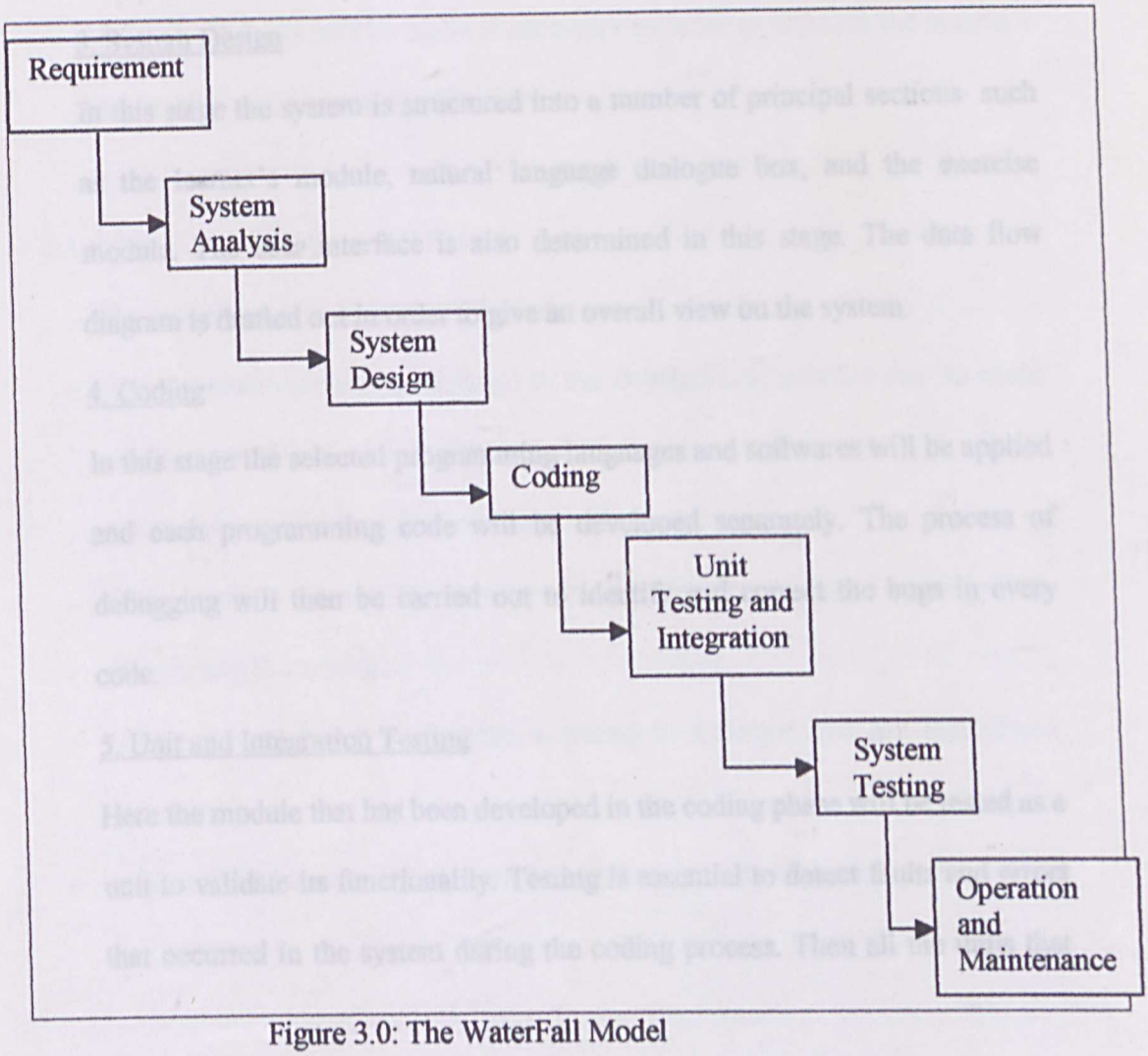


Figure 3.0: The WaterFall Model

There are seven stages in this model. Description of each stage is given as below:-

1. Requirement Analysis

This is the first stage in this model. In this stage, all the information about this project is gathered through the Internet, books, magazines, and interview. The system's functionality and constraints are also established and the problems are identified. The software and system requirement of this project also need to be determined during this phase.

2. System Analysis

In this stage, the author have to study the existing system that is available and do a planning for a new system.

3. System Design

In this stage the system is structured into a number of principal sections such as the learner's module, natural language dialogue box, and the exercise module. The user interface is also determined in this stage. The data flow diagram is drafted out in order to give an overall view on the system.

4. Coding

In this stage the selected programming languages and softwares will be applied and each programming code will be developed separately. The process of debugging will then be carried out to identify and correct the bugs in every code.

5. Unit and Integration Testing

Here the module that has been developed in the coding phase will be tested as a unit to validate its functionality. Testing is essential to detect faults and errors that occurred in the system during the coding process. Then all the units that

have been tested and is confirmed that it is free of errors will be integrated to create an application.

6. System Testing

In this stage all the integrated units are tested as a system application to ensure that the system meets the user specification and requirements. The system is tested together with the user after the delivery process. After testing, the system is run.

7. Operation and Maintenance

This stage helps the users understand and feel comfortable about the system. After the system is put into implementation, the discovered errors will be corrected. Changes will be made if necessary in order to improve the system's functionality and processing efficiency.

3.1.1 Advantages of Waterfall Model

The benefit of using this model includes :-

- The documentation of each stage in the development process can be made easily since this model is clearly split into stages and therefore, it will be more understandable and more structured.
- This model creates a lay out on what the developer should expect while developing the system.
- Allows an approach to develop a system in an organized and disciplined manner.
- Able to keep the project on track during the whole development process.

3.1.2 Disadvantage of Waterfall Model

The only disadvantage of the Waterfall Model is that it is quite difficult to revert back to the previous phase to make minor changes incase there are any faults or errors in the system

3.2 SYSTEM ANALYSIS

Efforts must be made to gather data concerning what type of system to be developed, existing systems and also methods of development, which have been covered in the second chapter. Listed here is the modus operandi for collecting the data and analysis of the information.

3.2.1 Information Gathering Techniques

Information is collected via the technique of data gathering and best practice observations described below. After a sufficient amount is amassed, the information would be analyzed and subsequently, a summary of it is produced. Informations are gathered by :-

3.2.1.1 Internet

The internet is the largest data warehouse in the world. Its contains many useful information and facts that are related to the project. Research articles and conference papers can also be found on the internet.

3.2.1.2 Abstract Data Gathering

Documents, journals, and thesis on existing systems, techniques, of devising an Intelligent Tutoring System and tutorials on programming in

Visual basic 6.0 were referred to get a better understanding of the project. The library and the internet was a major source of information.

3.2.1.3 Interviews

Interviews were conducted with two people. The first person is a form five chemistry school teacher from Sekolah Tinggi Muar in Johor. The interview was conducted to gain some knowledge about the subject and also to get a feedback on how the system should work and to whom it will benefit. The second person interviewed is a programmer, to get the gist of the technologies, tools and techniques involved in creating a system.

3.2.2 Best Practice Study

A study of existing systems, how they were built and the features they incorporate into the system was done. The recommendations of the developer on what to do and what not to do were recorded for future use. The main highlight would be the achievements and failures that the developers face in the past and a dissection of what happened and why.

3.2.3 Information Summary

After gathering all the raw data, an analysis were carried out to isolate relevant and critical data, summarizing them as a guidance or framework for the system.

3.3 REQUIREMENT ANALYSIS

Requirements are the features and functions of the system, for example what is the system capable of doing in fulfilling its objectives. Here, we break it down into two parts, the functional requirements and the non-functional requirements.

3.3.1 Functional Requirements

Functional Requirements define how the system interacts with its environment, The functional requirements for this Intelligent Tutoring System are :-

- Access and verification page

  This is incarnated in the form of a login page which controls the access to certain predetermined functions. A student will only be able to access the most basic functions while instructors and administrators will have a more augmented version with more functions and options added to give more control over the system.

- Main menu page for student and instructor

  The main page is the primary source of navigation for users of the system. There are few options to click on at the main page. The main page will guide the users and bring them to the available links or features.

- Content/Notes

  In this function, all the contents of the course are displayed, broken down to chapters. Only certain chapters are available and accessible. This is a concept used in adaptive navigation. Students can refer to the notes available to answer the test questions in this system.

- Test Questions

  Test questions are displayed here. This page is to evaluate the students understanding in the subject. If the student fails the test , the system will notify them and advice them to retake the test and if the student requires assistance in answering the exercises and tutorials then they can go to the natural language dialogue box .

- Natural Language Dialogue Box

The main function of this dialogue box is to help students or users of this system in answering the exercises and tutorials. This dialogue box will generate hints and give formulas on related subject. For every sentence that is input by the user, the system finds for a keyword and try to match the keyword with the ones in the database. From there, the system gives an output which is the hint.

- Test Modification

  For the sake of reusability and error handling, the test page in the system is deemed necessary for review, the instructor would have the power to alter the test questions and answers through this function.

3.3.2 Non-Functional Requirements

Non-Functional Requirements or constraints explains the restrictions on the system which limits the options for problems solution. The Non-Functional requirements are :-

- Scalability

  With the future in mind, the system should be able to expand or shrink according to the user's needs.

- Modularity

  The system should be built in the form of modules to ensure easy maintenance and debugging.

- Response Time

  The response time for data access should be within a reasonable allocation. This means that the data inside the system should be ready at any time and presented with minimal delay.

- Effectiveness

  The system should be easy to understand, clear, relevant, compact and prioritize data accuracy and achieve the predetermined goals and objectives laid out in the planning session.

- User Interface

  The user interface should be attractive and comfortable to use. Icons should be clear and direct to the point, without confusing the user.

3.4 AUTHORING TOOL ANALYSIS

A study of the available software tools for the development of a system was conducted to get the right tool to ensure that the system being built is an intelligent system and also to make sure it meets the requirements by the user and that is by the students and the teachers.

3.4.1 Operating System

- Microsoft Windows 2000

  This operating system was developed by Microsoft and remains the most popular choice to date. With the windows 2000 version, the file system has been changed from FAT 32 to NTFS, allowing a more secure framework for softwares installation. Its added security features and overall ease of handling, in addition to the compatibility with a majority of other softwares has made Windows 2000 the operating system of choice for this project.

3.4.2 Softwares

3.4.2.1. Microsoft Visual Basic 6.0

After doing some research, the author has decided that the best authoring tool that can be used to create the proposed system is Microsoft Visual Basic 6.0. Visual Basic is used to develop the system, the user interface of the system and also the natural language dialogue box. Microsoft Visual Basic 6 has emerged as the most popular environment for building full-featured Windows applications quickly and easily. The Visual Basic programming system empowers developers to create applications that provide fast and effective solutions to pressing business needs.

Visual Basic 6.0 is a robust, object-oriented, sophisticated and powerful development platform, ideally suited for producing impressive Windows applications. The Visual Basic (VB) syntax forms the core of the scripting languages built into all the Microsoft 97 and 98 applications like Word, Excel, Power Point, etc. In simple terms, VB allows users to develop applications in an intuitive graphical environment. As opposed to code-only C++, VB allows you to visually design forms - screens the user views - and add components - items such as check boxes and radio buttons - to gradually build up a graphical user interface.

Then, it's time to add the code, the techno-blabble that tells the program what to do when a user clicks a specified button. But VB's much-improved interface simplifies even this feature - with it automatically completing many component properties for you via the IntelliSense function, added in VB 6.0

The major advantages of VB are:

- It is a powerful and complete Windows application development system that enables us to use built-in functions and subroutines for dozens of different tasks. It also provides capability to produce custom libraries and objects that can be loaded at runtime or bound into the distributed application.
- It is a hugely successful product preferred by millions of developers at virtually all skill levels.
- It is well supported by third party products
- It supports the principle of object driven design
- It is very flexible and user-friendly as it is a GUI (Graphic User Interface)

Visual Basic 6.0 also has a new productive visual Data Environment Designer that allows table-style query design, easy generation of complex SQL code and a live results preview. The new MS-Access-like DataReports also simplify the entire reporting process.

Microsoft has also incorporated native OLE DB drivers into VB, allowing high-speed access to SQL Server 6.5 and Oracle 7.3.3+. But it's data access capabilities don't stop there - Visual Basic can talk to any ODBC- or OLE DB-compliant database. And binding controls to a simple data source is as easy as version 5.0. Setting two properties in the Properties windows is all that's required

3.4.2.2. Microsoft Access

Microsoft Access is fast becoming the dominant computer based database management system for most database applications. Thus, Microsoft Access

is chosen as the database management system for the development of this ITS. As a relational database management system, Access stores data in the form of tables, which can be related to each other based on the system developed. A system administrator can manage the database done through Access more easily compare to other database software in the market.

Microsoft Access has an easy menu driven interface that lets the user issue commands without a deep understanding of the software. With the new applications in Microsoft Access, data can be dropped into HTML pages that can be shared and manipulated over the World Wide Web.

Microsoft Access provides two methods to create a database. The first method is by creating a blank database with the tables, forms, reports, and other objects being added later. This is the most flexible method, but it requires one to define each database element separately. The second method is by using a Database Wizard to create an operation in the required tables, forms, and reports for the type of database chosen. This is the easiest way to start creating a database. Either way, the database can be modified and extended at any time after it has been created.

3.4.2.3 Adobe Photoshop 6.0

According to the Adobe Web Site, Photoshop is software that allows designers and photographers to create original artwork, correct colour, retouch and composite scanned images, and prepare professional-quality separations and output with more flexibility than ever before.

With a wealth of powerful painting and selection tools, plus multiple layers, special effects filters, and lighting effects. Adobe Photoshop has always dominated the world of computer-based photo-editing and following the seminal release of version 6, which added vector-based shape handling and an enhanced interface. Photoshop 6.0 is the next generation of image editing software with powerful new features that offers something for everyone, whether you are a beginner or an experienced user. Photoshop has been used to design certain parts of the user interface in this system.

3.4.3 Hardware

The hardware listed below is considered essential to develop the system and to run the ITS.

- An Intel Pentium II Desktop Computer

The Pentium II processor computer is chosen as the minimum requirement for ITS multimedia processing capability.

- 64 MB main memory (128 MB recommended)

64 MB main memory is required to run windows 2000 and to smooth things along the way, 128 MB would be sufficient, so as not to encounter hiccups while developing and running the system.

- 1.0 GB hard disk space

The system deals with graphics as well as a substantial amount of text and coding. Therefore, the 1.0 GB estimate is considered safe to accommodate the data needed to develop and run the system.

3.5 SUMMARY

This chapter discusses the methods and techniques used in information gathering and construction of the system. The use of the waterfall model is to get the best results for a risk-based model, ensuring a good quality of the end product. The reason why the waterfall model is chosen, its advantages and disadvantages are discussed in this chapter.

It is also included in this chapter the requirement analysis, detailing them in the listing of the functional requirements and non-functional requirements. Authoring tools and all the softwares and tools needed to develop the system is also discussed in this chapter.

The next chapter gives an overview of the database design and the overall system design.

CHAPTER FOUR

System Design

4.0 SYSTEM DESIGN

In this phase, system analysis will use the data and information gathered beforehand to complete a logical design of the system. The system analyst will design a detailed structure of the system which would finally be implanted in later stages.

This phase would also touch on database.

4.1 STRUCTURE

This ITS has five main features which are :-

a) Login/access feature = Enables the system to filter out differing groups of users as well as keep track of users details. Here there is a database that stores the users latest information and marks.

b) Notes/Content= Displays the contents of the course, that is the form five chemistry, revealed through adaptive navigation.

c) Test Questions = This feature is designed to evaluate the students understanding on the subject. The Instructor or tutor is given full authority to upload , modify or edit the questions here.

d) Natural Language Dialogue Box = The main function of this feature is to provide assistance and help to students in answering the tutorials. What the system does is it gives hints and generates related formulas.

e) Change User Information = This feature is to enable each student and instructor change their user information. Here they can change their user ID, first name, last name and password. Each details changed will be stored in the database straight away.

Structure Chart

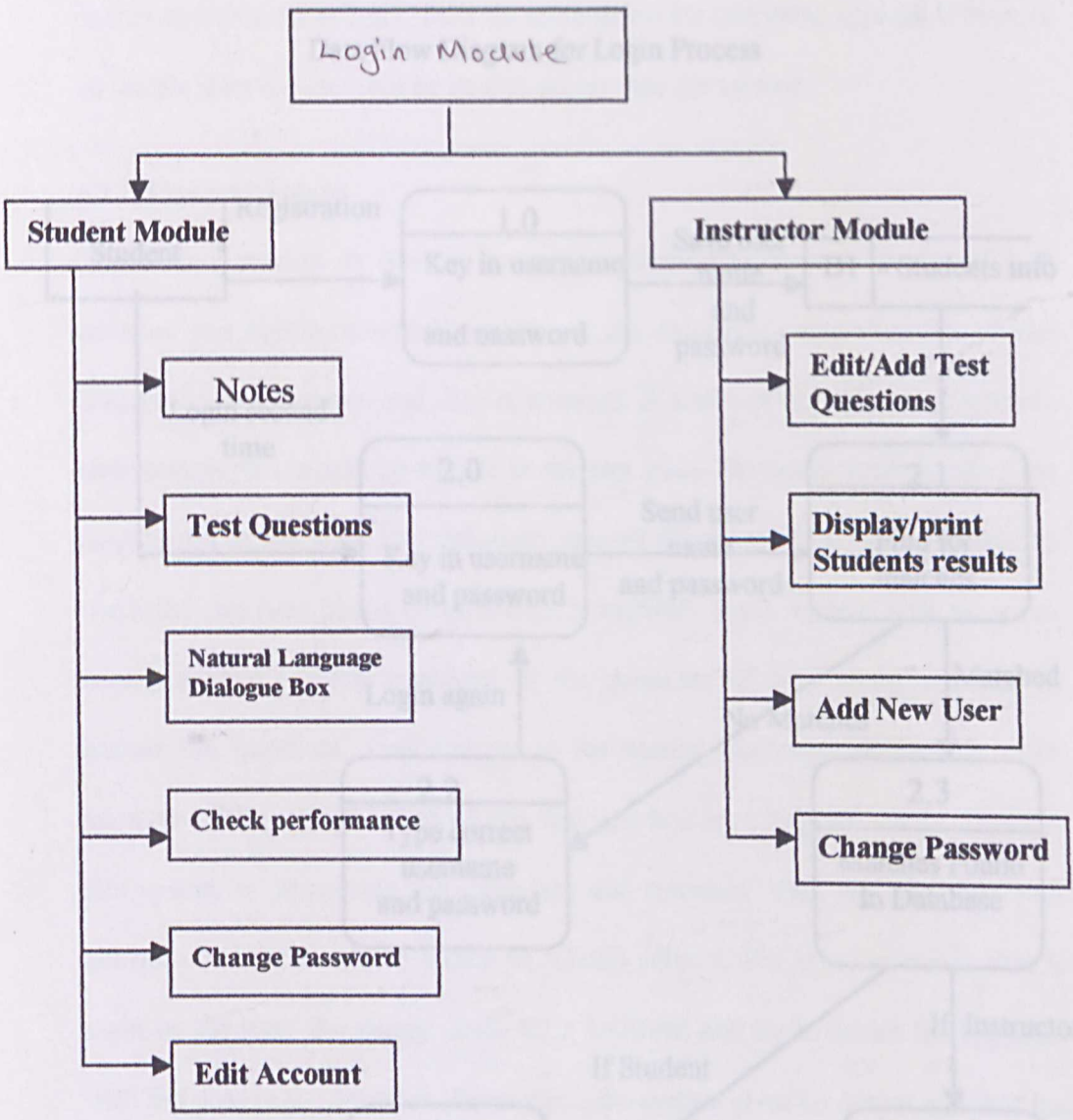


Figure 4.0 : System Structure Chart

4.1.1 Login / Access Module

This module is to allow authorized users to enter the system by logging in their userID and password. New users that wish to use the system can register themselves by clicking on the register button and filling in their information. When a student registers for the first time, the system inputs the students

information in a database and stores it. Below is a data flow diagram of the login process.

Data Flow Diagram for Login Process

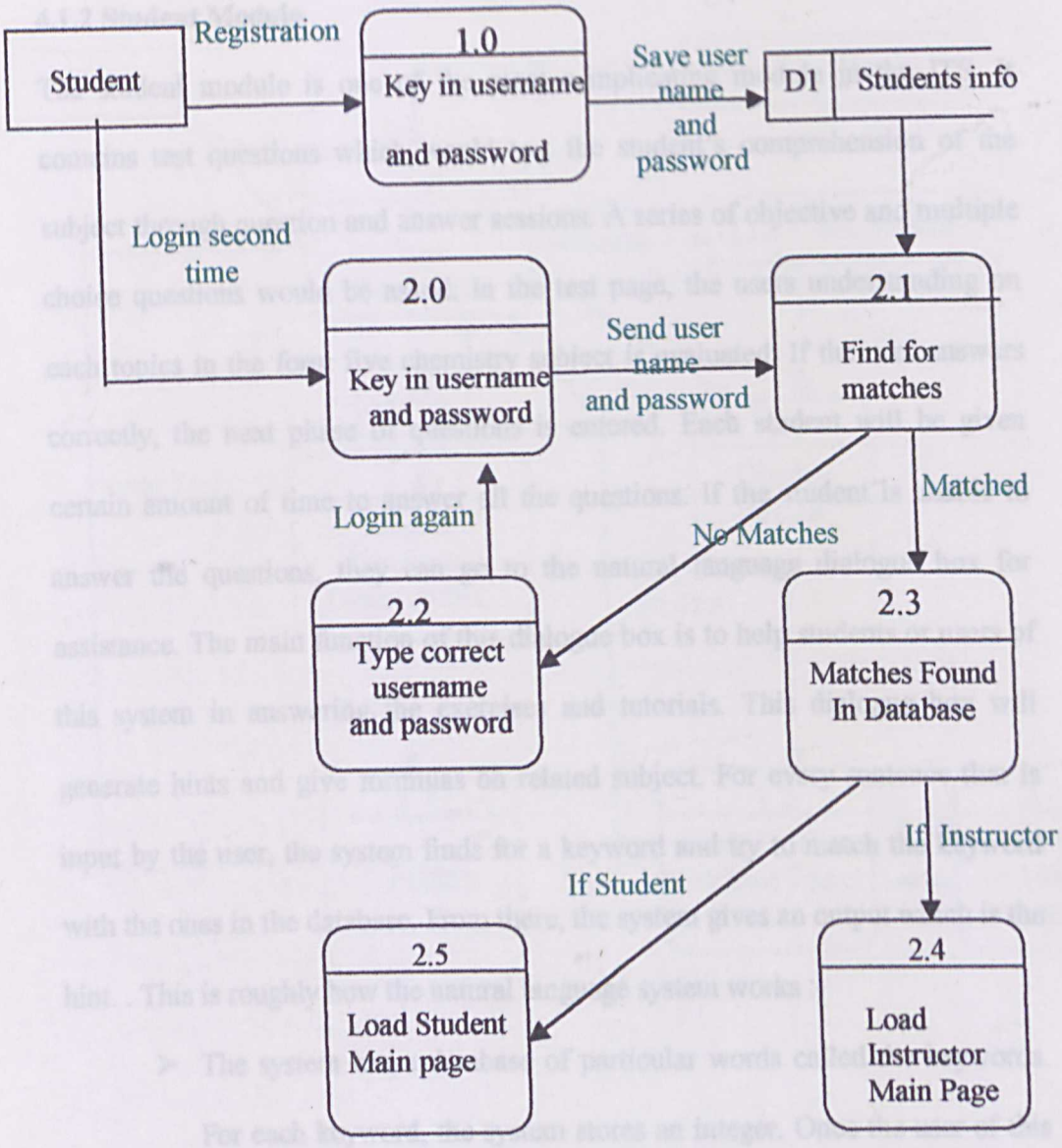


Figure 4.1 : Data Flow Diagram For Login Process

When a user or user logs in, the system will try to find a match between the userID and password given by the student and the one in the database and try to

determine whether the user is a student or an instructor. If a match is found, and the user is a student then the main menu for the student module appears. If the user is an instructor or tutor, then the main menu for instructor appears If there is no match, then the user will be denied access into the system.

4.1.2 Student Module

The student module is one of the most complicating module in the ITS. It contains test questions which would test the student's comprehension of the subject through question and answer sessions. A series of objective and multiple choice questions would be asked. In the test page, the users understanding on each topics in the form five chemistry subject is evaluated. If the user answers correctly, the next phase of questions is entered. Each student will be given certain amount of time to answer all the questions. If the student is unable to answer the questions, they can go to the natural language dialogue box for assistance. The main function of this dialogue box is to help students or users of this system in answering the exercises and tutorials. This dialogue box will generate hints and give formulas on related subject. For every sentence that is input by the user, the system finds for a keyword and try to match the keyword with the ones in the database. From there, the system gives an output which is the hint. . This is roughly how the natural language system works :-

- The system has a database of particular words called the keywords. For each keyword, the system stores an integer. Once the user of this system inputs a sentence, the system will find a keyword from the sentence and try to match the keyword with the ones in the database. If there is more than one keyword then the system picks the keyword with the highest integer value. The system then uses the output

specification that is associated with this keyword to generate the next sentence. If there is no keywords, the system generates an innocuous continuation statement. Below is the data flow diagram (DFD) for test in the student module .

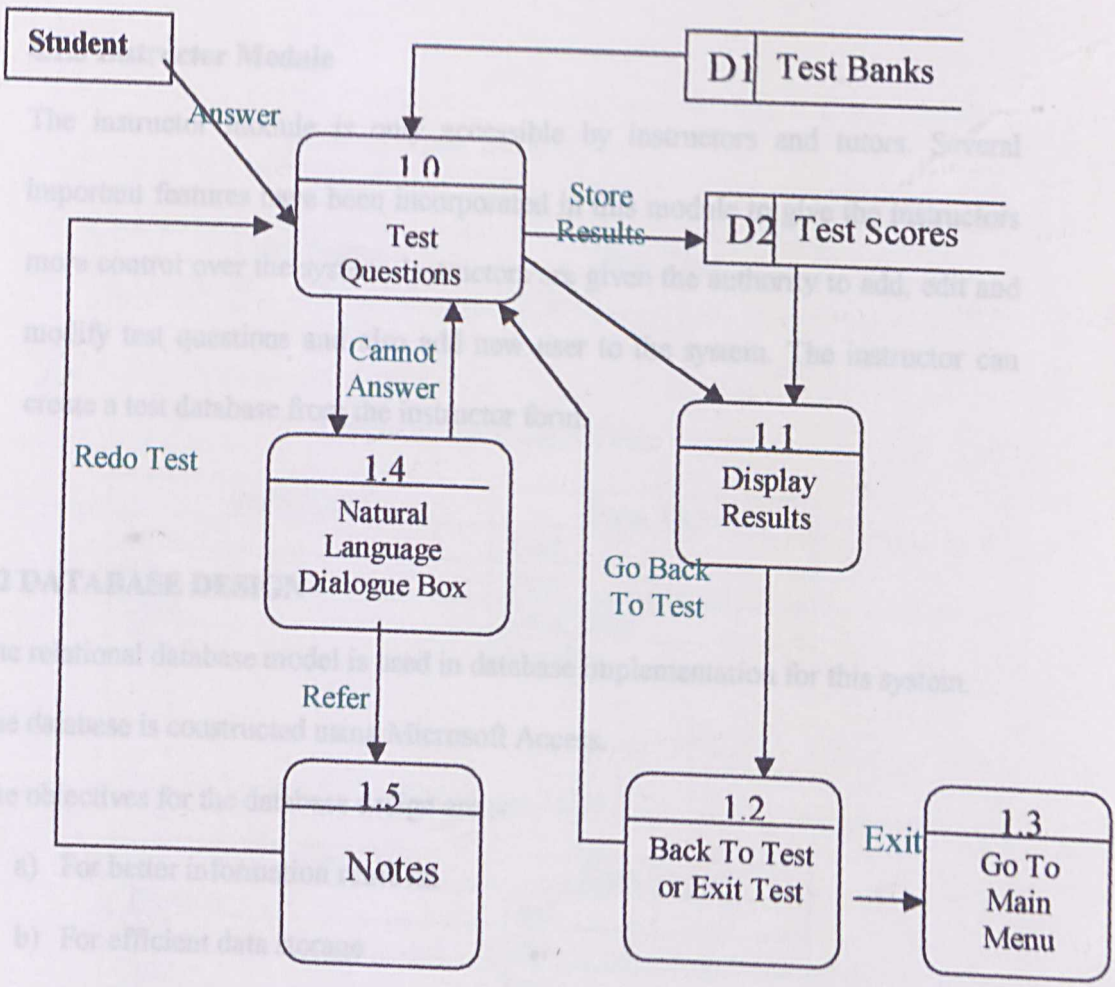


Figure 4.2 : Data Flow Diagram For Test In The Student Module

The test stops as soon as the time is over and the test questions are disabled after that. The system would then ask the student if he or she wants to continue with

the next set of questions , wants to know their marks and grades or if they want to exit from the test page and go to the main menu. This module also contains the notes of the chemistry subject sorted down in chapters. System users are also given authority to edit their account information in this module for security reasons.

4.1.3 Instructor Module

The instructor module is only accessible by instructors and tutors. Several important features have been incorporated in this module to give the instructors more control over the system. Instructors are given the authority to add, edit and modify test questions and also add new user to the system. The instructor can create a test database from the instructor form.

4.2 DATABASE DESIGN

The relational database model is used in database implementation for this system. The database is constructed using Microsoft Access.

The objectives for the database design are :-

a) For better information retrieval

b) For efficient data storage

c) For easy data availability

d) For better data integrity

During the designing process of the database, we need to identify the database, then the attributes and data types of the database. Below are the tables in each database.

Table 4.0: Login Table

Fieldname	Data Type
User ID	Text
LastName	Text
FirstName	Text
I/C Num	Text
Password	Text
Instructor	Yes/No

Table 4.1 : Test Table

Field Name	Data Type
TestName	Text

Table 4.2 : TestScores Table

Field Name	Data Type
Test	Text
ID	Text
Date	Date/Time
Grade	Number

Table 4.3 : TestQuestions Table

Field Name	Data Type
Question	Text
Opt1	Text
Opt2	Text
Opt3	Text
Opt4	Text
Answer	Text

4.2.1 Database Relations

Any object or event about which someone chooses to collect data is an entity. An entity may be a person, place or thing for example, a student, faculty, a city, or a

product. Entities can also be an event or unit of time such as a machine breakdown, a sale or a month or year. Entities inside the system's database have relationships between each other, either in the exchange of data, or requests for certain services.

In this ITS, the entities that would be considered are :-

- Users

Users use the system by making requests, sending data and responding to questions and prompts of the system.

- System

The system does not represent the whole ITS. Rather it actually performs non-specific functions which were not covered by the modules.

- The Modules

The three modules either act through the system, or responds directly to the users prompt. The three modules are ; login/access module, student/user module and the instructor module.

These entities react to the user, the overall system and also to each other, according to their own pre-determined functions. Entity relationships are recorded in a table, listing almost every connection for each and every entity. From that table, a diagram, the entity-relationship diagram is created to better understand the database that is being built by seeing it in pictorial or graphical form.

Below is a table for entity relationships ;

Table 4.4 : Entity Relationships

Entity	Relationships	Entity
User	Sends	Login ID / Password
Login Module	Receives	Login ID / Password
Login Module	Sends	Appropriate Module
User	Requests	Content
Student/ User Module	Sends	Content
User	Requests	Test
Student/User Module	Generates	Questions
Student/ User Module	Sends	Questions
User	Receives	Questions
User	Sends	Answers
Student/ User Module	Receives	Answers
User	Requests	Dialogue Box
Student /User Module	Sends	Dialogue box
Dialogue Box	Generates	Help
Student/ User Module	Receives	Help
Student/ User Module	Sends	Help
User	Receives	Help
User	Sends	Answers
Student/ User Module	Receives	Answers
Student/ User Module	Checks	Answers
Student/ User Module	Generates	Marks

Student/ User Module	Sends	Marks
User	Receives	Marks
Student/ User Module	Stores	Marks

Here we have the entity relationships diagram based on the table above, broken down according to the main entities.

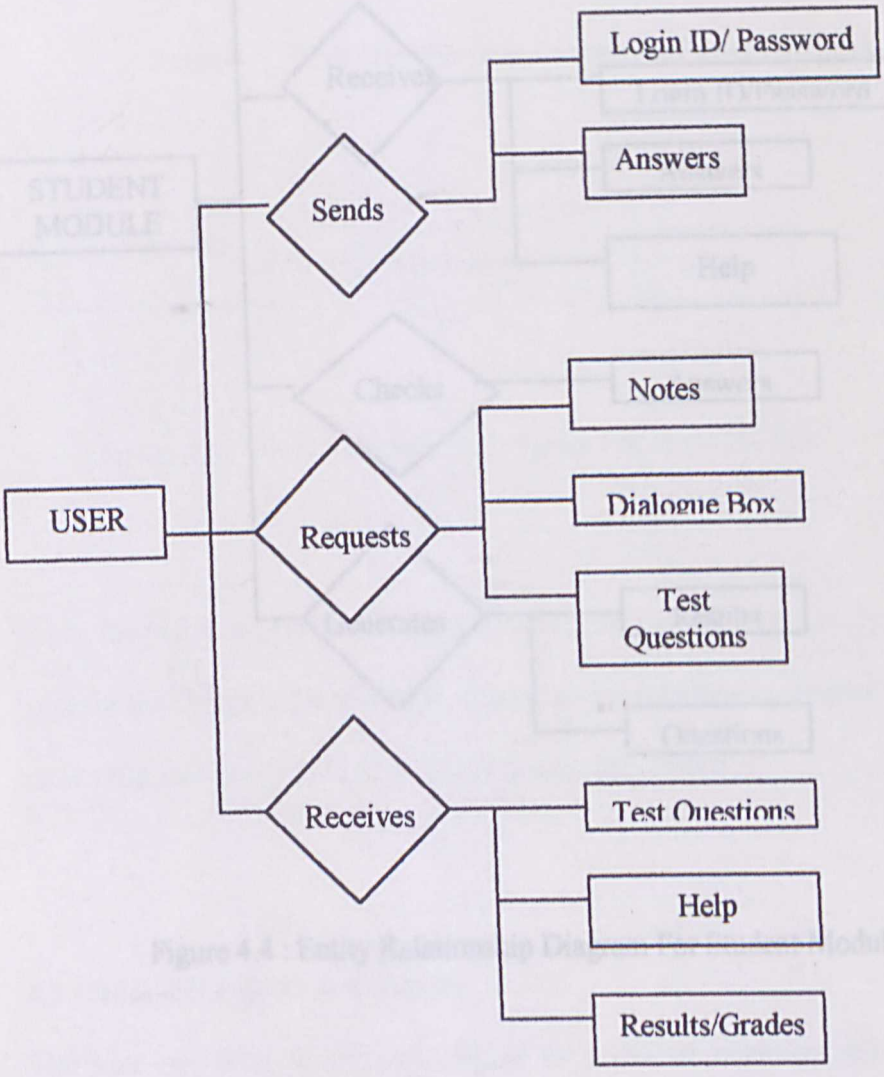


Figure 4.3 : Entity Relationship Diagram For User

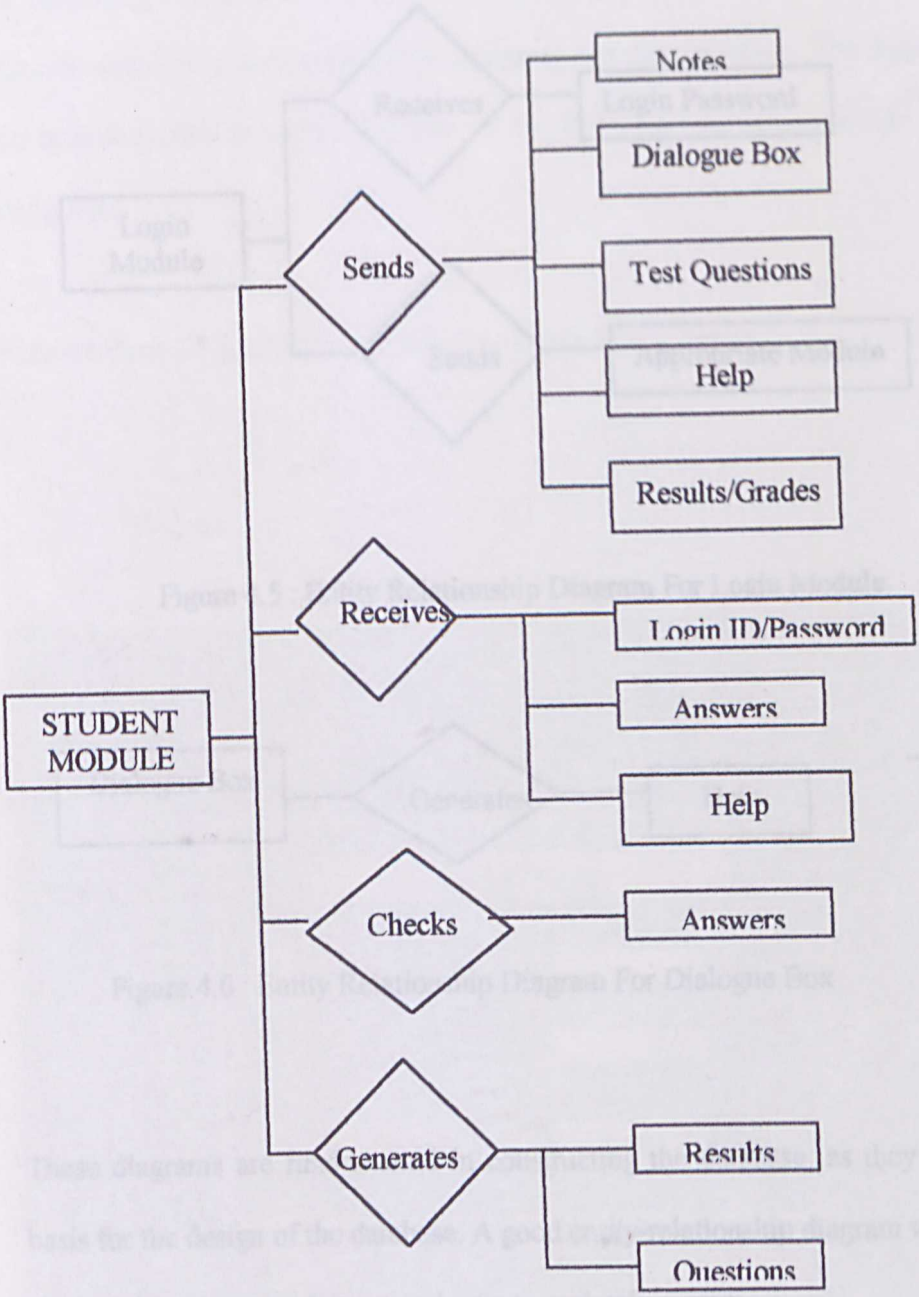


Figure 4.4 : Entity Relationship Diagram For Student Module

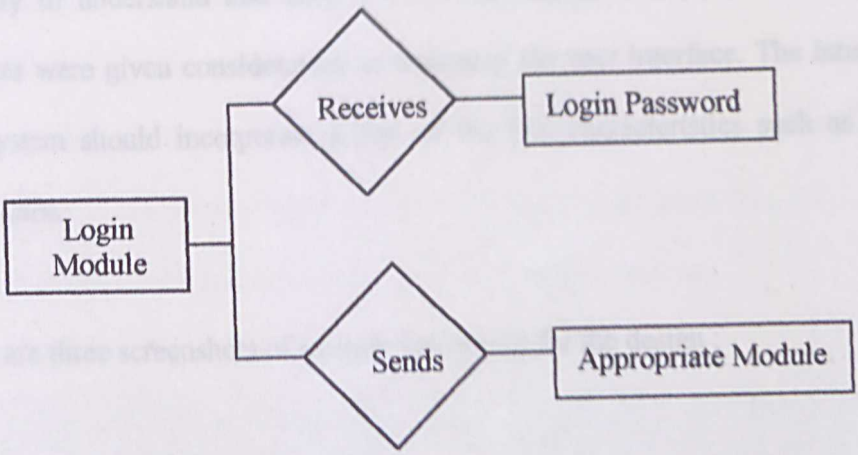


Figure 4.5 : Entity Relationship Diagram For Login Module

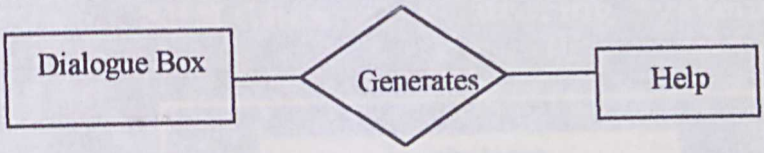


Figure 4.6 : Entity Relationship Diagram For Dialogue Box

These diagrams are fundamental in constructing the database, as they provide the basis for the design of the database. A good entity-relationship diagram would ensure a powerful easy to implement and easy to maintain system.

4.3 USER INTERFACE DESIGN

The user interface of a system works as a central communication between the processing functions and the user request. The interface is aimed to improve the efficiency and effectiveness in using the proposed system. The user interface should

be easy to understand and easy to use. The Human Computer Interaction, HCI features were given consideration in designing the user interface. The interface for the system should incorporate a few of the ITS characteristics such as adaptive navigation.

Here are three screenshots of a rough framework for the design ;

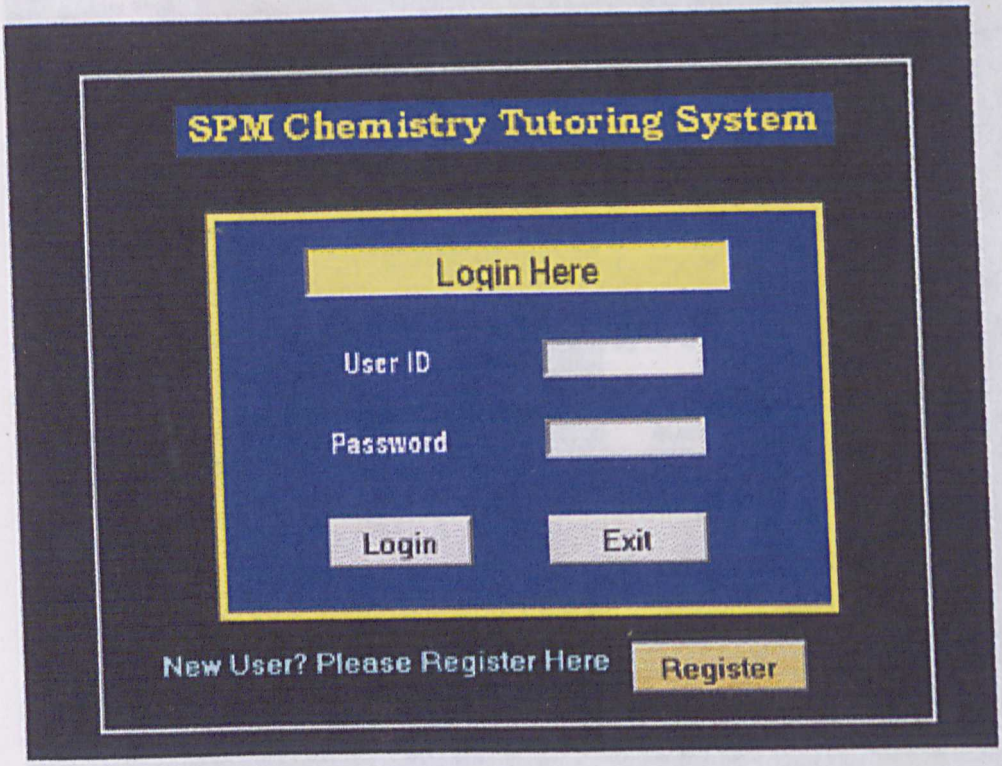


Figure 4.7 : User Interface Of Login Module

In the login module, the user will have to key-in their username and their password. If the user is a first time user of this system, then his or her individual details would

be stored in the database of the system straight away after the user registers with the system.

The main menu in the student module is the primary source of navigation for users of the system. There are few options to click on at the main page. The main page will guide the users and bring them to the available links or features.

Figure 4.8 : User Interface For Student Module Main Menu

The instructor module is only accessible by instructors and tutors. Several Important features have been incorporated in this module to give the instructors more control

over the system. Instructors are given the authority to add, edit and modify test questions and also add new user to the system.

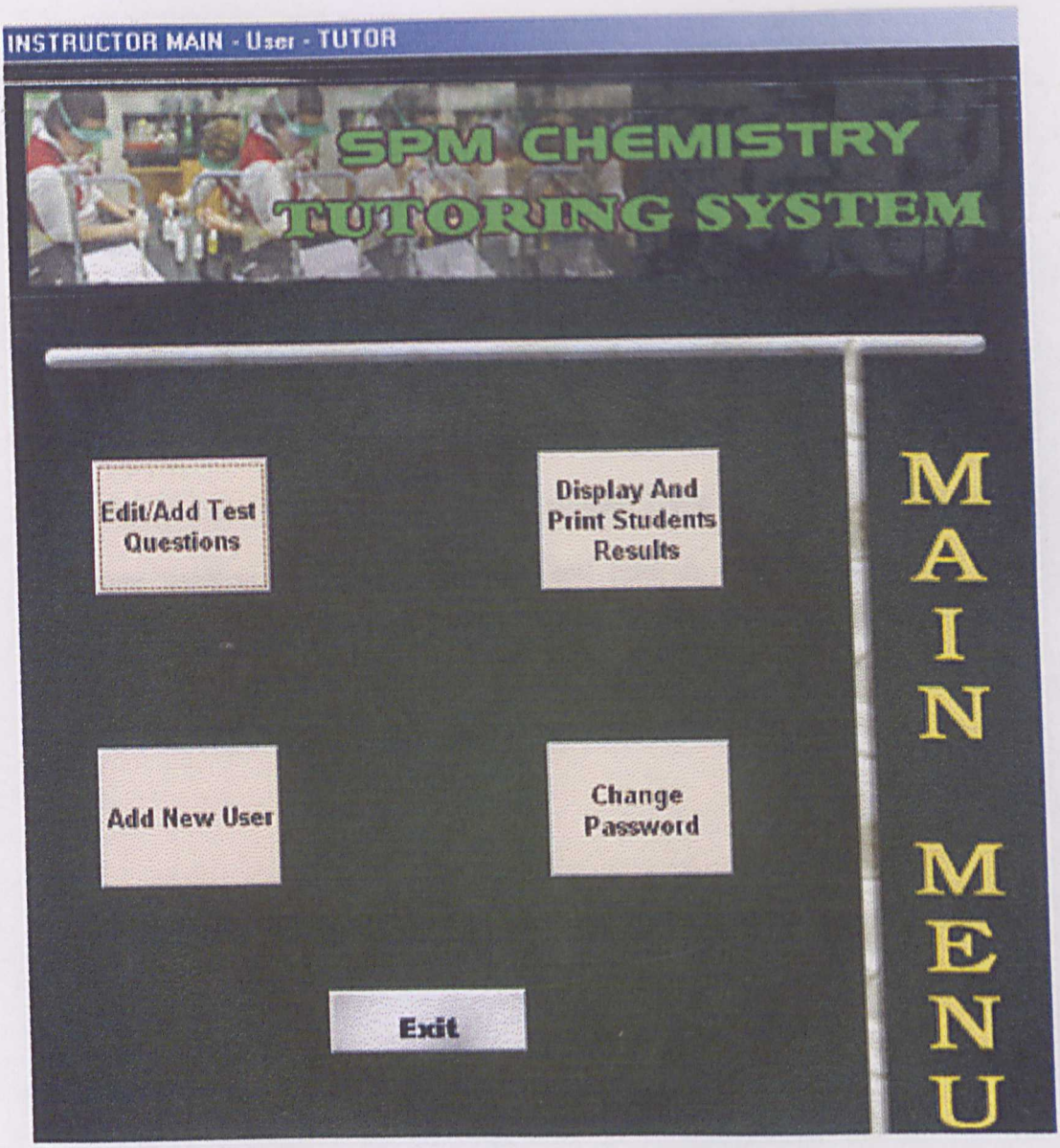


Figure 4.9 : User Interface For Instructor Module Main Menu

All the interface in this system were designed using Adobe Photoshop 6.0 and some other designing softwares.

4.4 SUMMARY

System design is important for planning the overall structure of the system. Through this chapter, the system's layout, structural blueprint and database design are documented for future use, when the developers would actually develop the system

This chapter goes through the main structure of the system, the entity- relationships that exist between elements in the system, the data flow diagram for the modules in this system and also the user interface of the system. These features would determine the future implementation of the system and help in overall maintenance and debugging issues.

CHAPTER FIVE

System Implementation

5.0 INTRODUCTION

System Implementation is the acquisition and integration of the physical and conceptual resources that produces a working system. It is the physical realization of the database and application design. System implementation includes building and testing its contained modules and sub-modules, involving system requirements and design conversion into program codes.

5.1 DEVELOPMENT ENVIRONMENT

The initial stage of system implementation involves setting up the development. The usage of dynamic and suitable hardware and software could help accelerate the development or construction of the system. The hardware and software tools used to develop the entire system are discuss below.

5.1.1 Hardware Configuration

The following hardware specification have been used to develop the system.

a) AMD Athlon 600 MHZ Processor

b) 256 MB SDRAM

c) 15 GB Hard Disk Space

d) CD-RW Burner

e) Keyboard and mouse

5.1.2 Software Configuration

There are a lot of software tools, which are used in designing and writing report. The design process involves drawing and designing the images, chart, data flow diagram and other foundation implementation of the software development.

Table 5.0 : Summary of the software tools for the development of the system

Software	Usage	Description
Microsoft Windows Millennium	Development platform	Operating System
Microsoft Visual Basic 6.0	System Development	Coding and Interface Design
Microsoft Access Me	Database	Database Design, construction and implementation for data storage and manipulation.
Adobe Photoshop	Interface design, image editing	Editing image data and interface images

5.2 DATABASE DEVELOPMENT

The first step in the system development is to develop the system's database based on the logical data model of the system created during the system design phase. The database used for the initial development stage of the system was Microsoft Access Me.

The database development is started by creating an empty database called login2. All the tables are then created by specifying all the fields for each table and the field properties. A primary key is allocated for each table in the database.

5.3 APPLICATION DEVELOPMENT

5.3.1 The Tool And Principles

Application development involves code generation that translates all the algorithms and designs into visual basic. Visual basic is a visual and event driven programming language. In traditional programming languages, programming is done in a test environment and the program is executed sequentially. In visual basic, programming is done in a graphical environment. Each sub-program in the system is a program independently to complete the system. The sub-program is trigger when the user of the system invokes the event.

The Active X Data Object (ADO) is used in the system to connect the code with the database that was developed using Microsoft Access. ADO is an easy to use yet extensible technology for adding database to the VB application.

Several programming principles have been employed in writing the the program to ensure consistency, maintainability and reliability. All the programming principles are as follows :-

a) Choosing meaningful variable names, procedure names and form names helps a program to be self documenting without excessive use of comments.

b) All declarations are placed at the beginning of sub routines of procedure and declarations are separated from the executable statements in that procedure to make the declarations stand out and contribute to program readibilty.

c) Insert comments to document the program and for better understanding when referring back to the codes and also to improve codes readability.

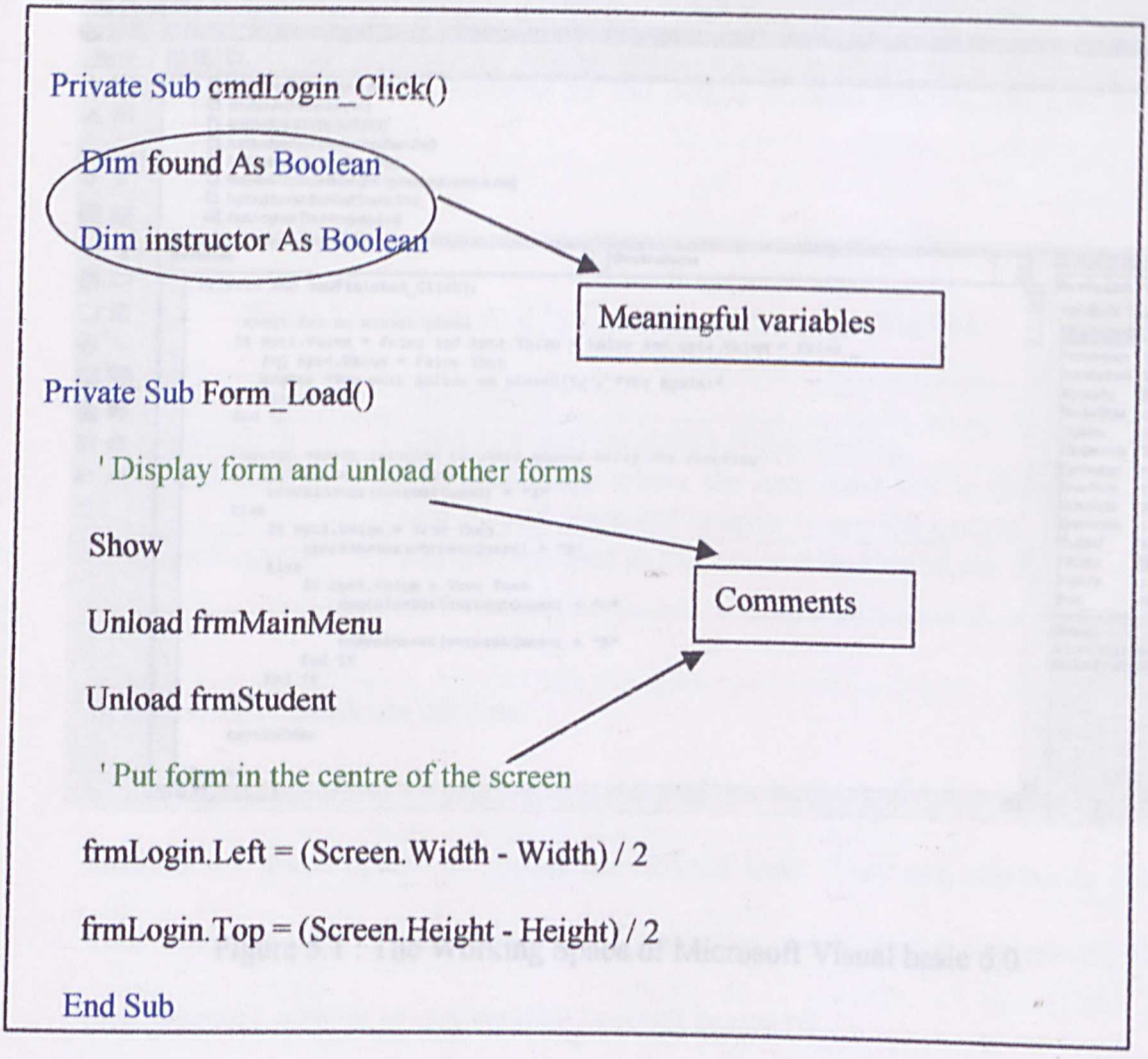


Figure 5.0 : The sample of coding.

All the programming principles were followed when writing the program.

5.3.2 The Working Space

The working space of the Visual Basic 6.0 is an integrated development environment which contains of the graphical interfaces.

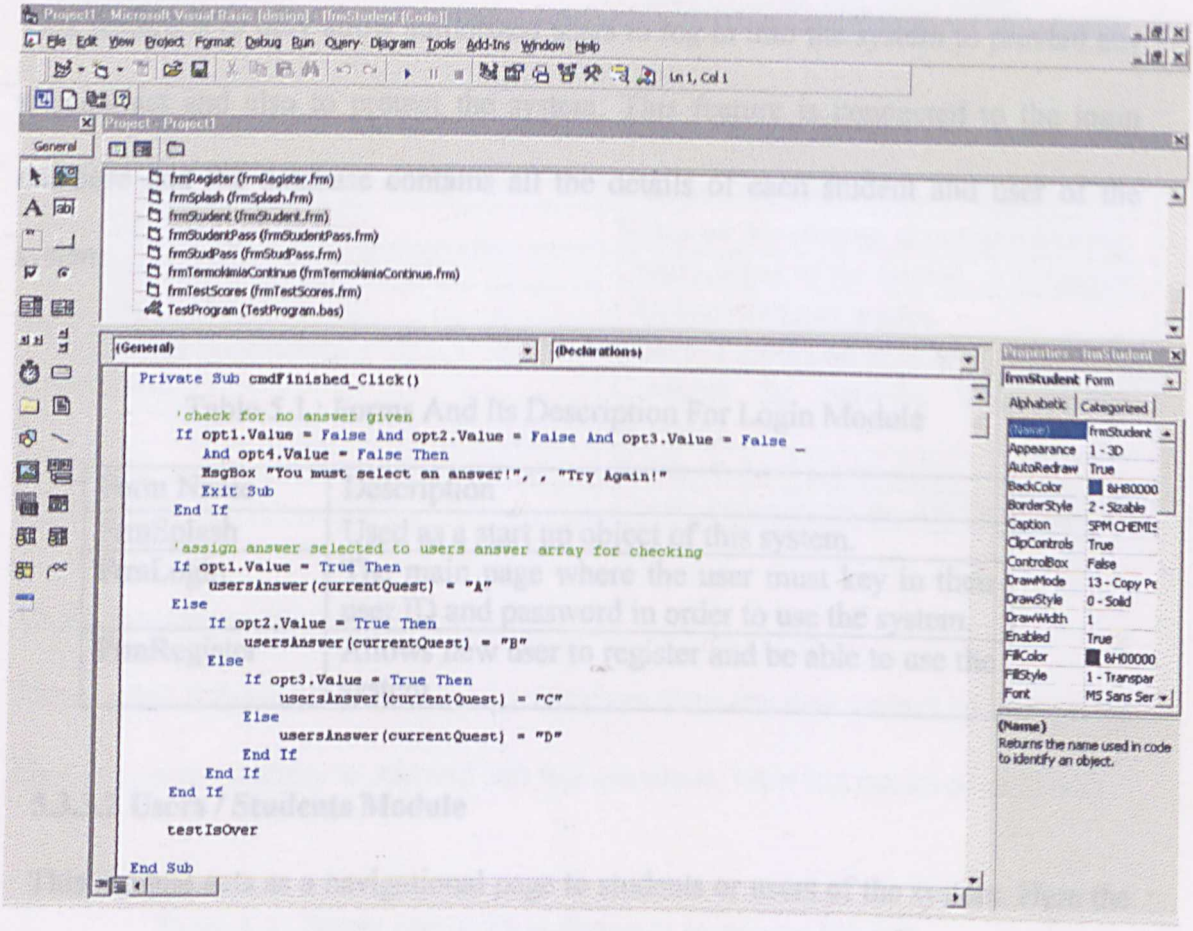


Figure 5.1 : The Working Space of Microsoft Visual basic 6.0

5.3.3 The Method

The coding approach used in the development of this system is the top down approach. This approach allows the higher level modules to be coded first before the lower level modules. This approach is very suitable in developing a system using VB in which a main form is created first followed by the sub forms.

5.3.3.1 Login / Access

This feature is to only allow authorized users to log in into the system to prevent any misconduct and also to protect the system. This feature is connected to the login database and the database contains all the details of each student and user of the system

Table 5.1 : Forms And Its Description For Login Module

Form Name	Description
FrmSplash	Used as a start up object of this system.
FrmLogin	The main page where the user must key in their user ID and password in order to use the system.
FrmRegister	Allows new user to register and be able to use the system

5.3.3.2 Users / Students Module

This module acts as a navigational page to students or users of the system. Here the students are given option to choose the desired links. They can choose to either view notes on form 5 chemistry, take a test, check their grades and results, Edit their personal account or change their account password.

Table 5.2 : Forms and Its Description In The Student Module

Form Name	Description
frmMainMenu	The main form of the student module.
frmAccount	Allows user to edit their account for security reasons.
frmStudent	Here each user can take a test to evaluate their understanding in each chapter
frmDialogueBox frmStudentPass	Provides answers to users queries Allows user to change their account password for security reasons.
frmNotes	Contains notes for each chapter of form five chemistry.

frmCarta	Contains notes in a chart form.
frmCarta1	Contains notes in a chart form.
frmChapter1	Notes on the first chapter of form five chemistry.
frmChapter2	Notes on the second chapter of form five chemistry.
frmGaram	Notes on the chapter about garam.
frmChapterTermokimia	Notes on the chapter about termokimia.
frmTermokimiaContinue	Continuation of the termokimia chapter.
frmDisplayGrade	Displays students grades.
frmDisplayTestStudent	Displays scores on each test.
frmJadual	Contains the periodic table (Jadual Berkala)
frmAcid	Notes on Asid Karbosilik
frmAcid2	Continuation notes on Asid Karbosilik

5.3.3.3 Instructor Module

This module is for instructors or tutors that gives them absolute control on the system.

They are given authority to add and edit test questions, view test marks of each user,

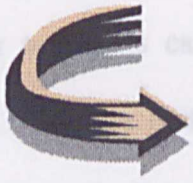
Table 5.3 : Forms and Its Description In Instructor Module

Form Name	Description
frmInstructorMain	Acts as a source of navigation for instructors.
frmInstructor	Allows an instructor to add, edit and modify test questions to and from the test bank.
frmInstructorPass	Allows an instructor to change their password for security reasons
frmAddtobank	To add test questions to the test bank.
frmEdit	To edit test questions
frmAccountTutor	Allows an instructor to edit their own account
frmTestMarks	Displays test marks and average marks of each student and each test.

5.4 SUMMARY

This chapter explains the system implementation which is regarding the transformation of the designed modules and algorithm into the executable instructions by using the appropriate programming language and that is the Microsoft Visual basic 6.0 and the database that is the Microsoft Access database. The system testing will be followed in the next chapter.

CHAPTER SIX



System Testing

6.0 INTRODUCTION

Testing is one of the main phase in the development of the system In this phase, the process of testing and debugging are done to detect defects and faults in the system. The process are usually done incrementally with the system development.

6.1 TESTING OBJECTIVES

The objective of the system testing is as follows ;

- To identify, isolate and correct as many bugs as possible. Most programs have bugs, the most insidious of which appears only with unique combinations of data or events.
- To make sure that the functionality of the system is being met.

6.2 TEST CASE DESIGN

Any system can be tested using one of the two types of test case design. They are white-box testing and black box testing.

6.2.1 White-Box Testing

White-Box testing is carried out at the early stages of the testing process. It is performed to ensure that the internal operation of a system performs according to specifications and all internal components have been adequately exercised. Using these methods, a system engineer can derive cases that.

- Guarantee that all independent paths within a model have been exercised at least once.

- Exercise all logical decisions on their true and false sides.
- Execute all loops at their boundaries and within their operational bounds
- Execute internal data structure to assure their validity

6.2.2 Black-Box Testing

Black Box testing is concluded to demonstrate that each function is fully operational at the same time to search for errors in each function. This testing approach enables a system engineer to derive sets of input conditions that will fully exercise all functional requirements for a program. Black-Box testing is not an alternative to White-Box testing. Rather it is a complementary approach that is likely to uncover a different class of errors that was uncovered by White-Box testing.

Black-Box testing attempts to find errors in the following categories.

- Incorrect or missing functions.
- Interface errors.
- Errors in data structures or external database access.
- Performance errors.
- Initialization and termination errors.

6.3 TESTING STRATEGIES

There are various type of testing strategies available to assess the completeness and correctness. The testing strategy for the system is divided into 3 main tests, unit testing, integration testing and system testing.

The testing process of this system is shown in figure 6.1

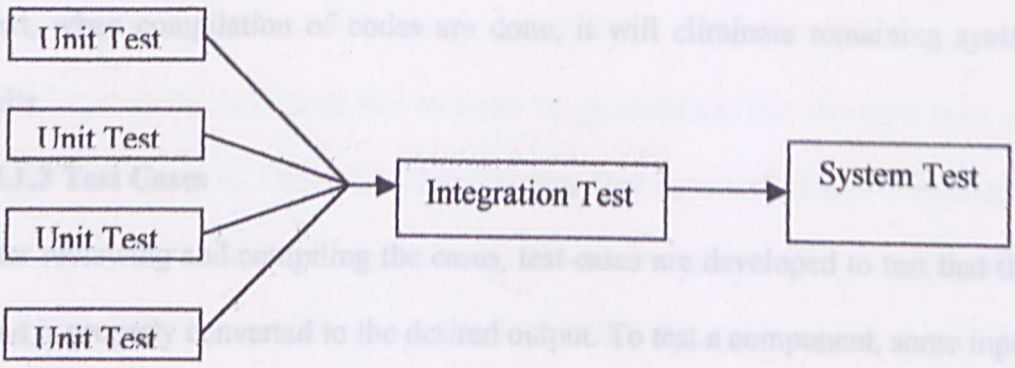


Figure 6.0 : Testing Process

6.3.1 Unit Testing

In the unit testing, each component is tested individually. All the important control paths in the project are tested to uncover errors within boundary of the modules. There are three kinds of testing strategy carried out for the unit testing. They are code review, compilation and test cases. All of these activities were carried out together in a time.

6.3.1.1 Code Review

The code are examined line by line to ensure that any uncovered semantic errors during the implementation could be revealed. There are two types of code review, a walkthrough and an inspection.

In a walkthrough, the codes and documentation will be presented then the comments on their correctness will be collected. During inspection, the testers check the code and documentation against a prepared list of concerns. Review on the algorithm and computations will be taken to ensure their correctness and efficiency.

6.3.1.2 Compilation

Next, when compilation of codes are done, it will eliminate remaining syntax faults.

6.3.1.3 Test Cases

After reviewing and compiling the cases, test cases are developed to test that the input is properly converted to the desired output. To test a component, some input data and conditions are chosen and then allow the component to manipulate the data and observe the output. In the unit testing, all the independent components are tested and make sure all the outputs are correct and meets the requirements.

6.3.2 Integration Testing

When the individual modules and components are working properly and meets the objectives, these modules are integrated into a working system. Integration testing is a systematic techniques for constructing the program structure while at the same time conducting tests to uncover errors associated with the interfacing. The objective is to take unit tested components and build a program structure that had been dictated by system. The appropriate strategy need to suit not only the integration timing and coding order, but also the cost of the testing. Bottom up integration strategy had been chosen for this project. Bottom up integration testing begins construction and testing of modules at lowest levels of the system and then moving upward to the modules at the higher levels of the system.

6.3.3 System testing

System testing is a series of different tests designed to fully exercise the software system to uncover its limitations and measure its capabilities. The objective is to test an integrated system and verify that it meets specified requirements. Although each test in the project has a different purposes, all work to verify that system elements have been properly integrated and perform allocated functions. There are several types of system testing that are worthwhile for a system. For this project, two types of system testing are used :-

6.3.3.1 Function Testing

System testing begins with function testing which focuses on the system functionalities. Each function can be associated with the components of the system that accomplish it. Function testing compares the system actual performance with its requirements, so the test cases for function testing are developed from the requirements document.

6.3.3.2 Performance Testing

The purpose of this testing is to test the run-time performance of software within the context of an integrated system. It requires both hardware and software instrumentation. Resource utilization is measured in an exacting fashion. Performance testing addresses the non- functional requirements of the system after all the functional testing has been completed. System performance is measured using performance objectives set by potential users as highlighted in the non – functional requirements section as guidelines. In the case of this system,

performance testing examines how effective data manipulations are carried out, query(record retrieval, searching and sorting) speeds and inter- module communications speed.

6.3.3.3 Acceptance Testing

Acceptance test assures the users that the system they requested is the system that was built for them. The system built should meet the criteria and requirements of the user and students.

6.3.3.4 Installation Testing

A final installation Test is run to allow users to exercise system functions and documents additional problems that result from being at the actual size.

6.4 SUMMARY

Software testing is a critical element of software quality assurance and represents the review of specification, design and coding. Testing is essential especially to check if there is any bug or error in the system. After the testing, the system should be able to perform correctly and should be free of errors. The next chapter is about system evaluation and conclusion and discusses about the problems faced during the system development and also the significance of the system.

CHAPTER SEVEN

System Evaluation And Conclusion

7.0 INTRODUCTION

Throughout the system development, problems are encountered and most of them were resolved eventually. The system was evaluated through system testing to identify its strength, weakness and limitations and proposals were made for future enhancement.

7.1 PROBLEMS ENCOUNTERED AND SOLUTIONS

The following are the major problems encountered from the beginning of the project through the end of the system development process.

7.1.1 Problems With System Integration

Microsoft Visual Basic 6.0 cannot be integrated with the java programming language and Prolog. Combining this programming language is a difficult task to do because it involves translating and converting the visual basic codes into java codes or creating a Dynamic Linked Library (DLL) for logic expression minimization module. This DLL has to be imported to VB program by using Logic Server Engine. It is not easy because it involves a lot of hard work and a lot of testing. Because this problem cannot be solved, the natural language part of this system cannot be done using java or prolog.

7.1.2 Lack of Knowledge in the Language and Tools Chosen

Due to the time constraint, the learning and developing process was done in parallel. The visual basic 6.0 is a new programming language that was never taught and learnt before. Most of the problems faced were manageable through the references from

books and manuals from the internet and also with a more efficient way such as trial and error.

7.1.3 Difficulties in Designing The User Interfaces

Problem that was faced during the development of the system are lack of knowledge and experience of the real system flow and layout of standard user interface. Therefore it is difficult to design the appropriate logic and user friendly interface. To get the knowledge of the system flow and user interface design some real commercial computer aided learning packages were taken as a reference.

7.1.4 Difficulties In Collecting Information.

Due to the time constraint, the process of information collecting must be fast, but there was lack of information especially on the latest notes on chemistry for spm.

7.2 STRENGTH AND SIGNIFICANCE OF THE SYSTEM

7.2.1 Attractive and Friendly User- Interface

The user interface for this system is attractive and simple where the graphical user interface features have been integrated in the system. All of the functions and links were presented to the user clearly and consistently.

7.2.2 Flexibility in Changing Data in Database

The database maintenance module can be considered as the back-end system. It is used by the instructor to manipulate data in the database. The Instructor can choose to add, search, modify or delete records in the database.

7.2.3 Easy To Use

The system can be considered easy to use for several reasons. First it is because, all the buttons and links in the system are clear, readable and understandable. Users of the system will not have problems understanding the system. Second, the instructor can easily manipulate the database without knowing how the database functions. All the features are incorporated into the system to make it more transparent.

7.2.4 Security Features

The security issues are taken into consideration for the system as to prevent any unauthorized users from manipulating all the information in the database and in the system. The system is protected by the login/access module.

7.3 WEAKNESS AND LIMITATIONS

7.3.1 Not Compatible With Certain Operating System

As the system was developed using the latest programming language. Some of the operating system such as Microsoft Windows 98 needs some extra components to be installed such as the Microsoft Data Access component 2.7 in order to execute the system. The system is only able to execute in Microsoft Windows Platform.

7.3.2 Doesn't Provide Much Information

Due to the time constraints, the information collected were not complete especially on the notes for SPM chemistry. Only notes on certain chapters were added into the system.

7.3.3 Cannot Represent Certain Chemistry Formulas

This system cannot represent certain formulas. For example the formula for the Avogadro number is 6.02 x 0^{23}. This is represented as 6.02 x 10 23. This may cause confusion to students.

7.4 FUTURE ENHANCEMENT

Many new and good ideas came about while the system was being developed. Because of time constraints and due to some other factors, not all of the ideas could be incorporated into the system. It is hoped that that the following aspects would be considered in future.

- Improve in interface design

  More complex graphics and animation graphics can be incorporated into the system. The functionality of the system should also be improved.

- Add in more information

  The information provided in the system can be enhanced in the future. The notes on each chapter should be updated and improved.

7.5 SUMMARY

Overall, this project has achieved and fulfilled the objectives and requirements as a tutoring system that provides knowledge and academic assistance to students.

Throughout the development of the system, a lot of knowledge were gained such as knowledge on the programming language, visual basic and programming concepts.

All the problems faced and experienced in developing the system should be useful in the future endeavor. It is hope that this system will be taken as a platform and a foundation for more comprehensive and innovative system in the future.

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APPENDIX

USER MANUAL

1.0 About the System

Intelligent Tutoring System Using Natural Language Dialogue is a system that provides a self control learning environment where students can progress at their own rates and own capabilities. The main objective in developing this system is to enhance the quality of learning such as improving performance, and understanding.

2.0 Run Time Requirements

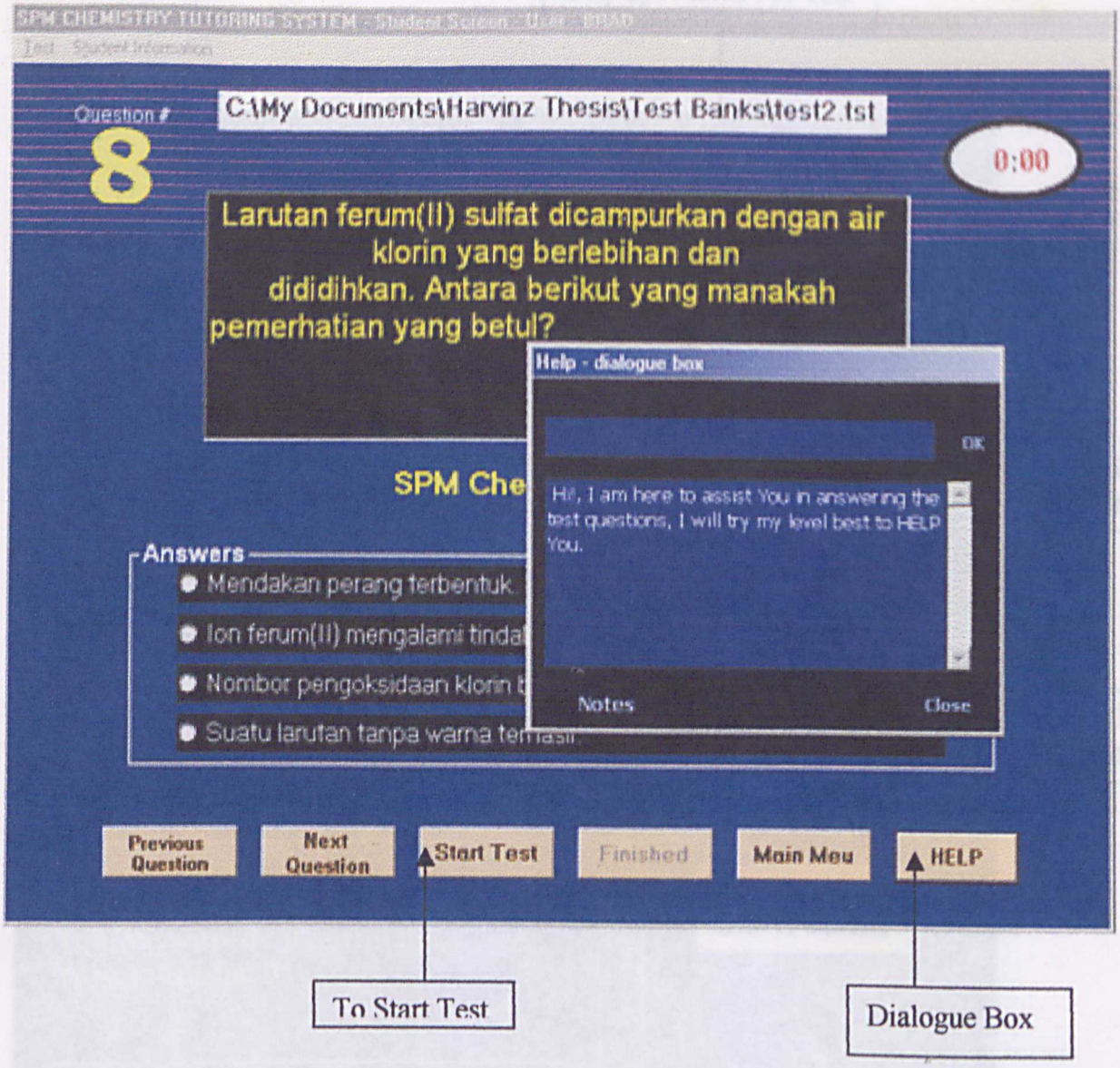
This system requires the following software and hardware configuration in order to execute perfectly.

Software

- Microsoft Windows 98, Me, NT, 200, XP.
- Microsoft Access 98+
- Microsoft Visual Basic 6.0
- Microsoft Data Access Components 2.7

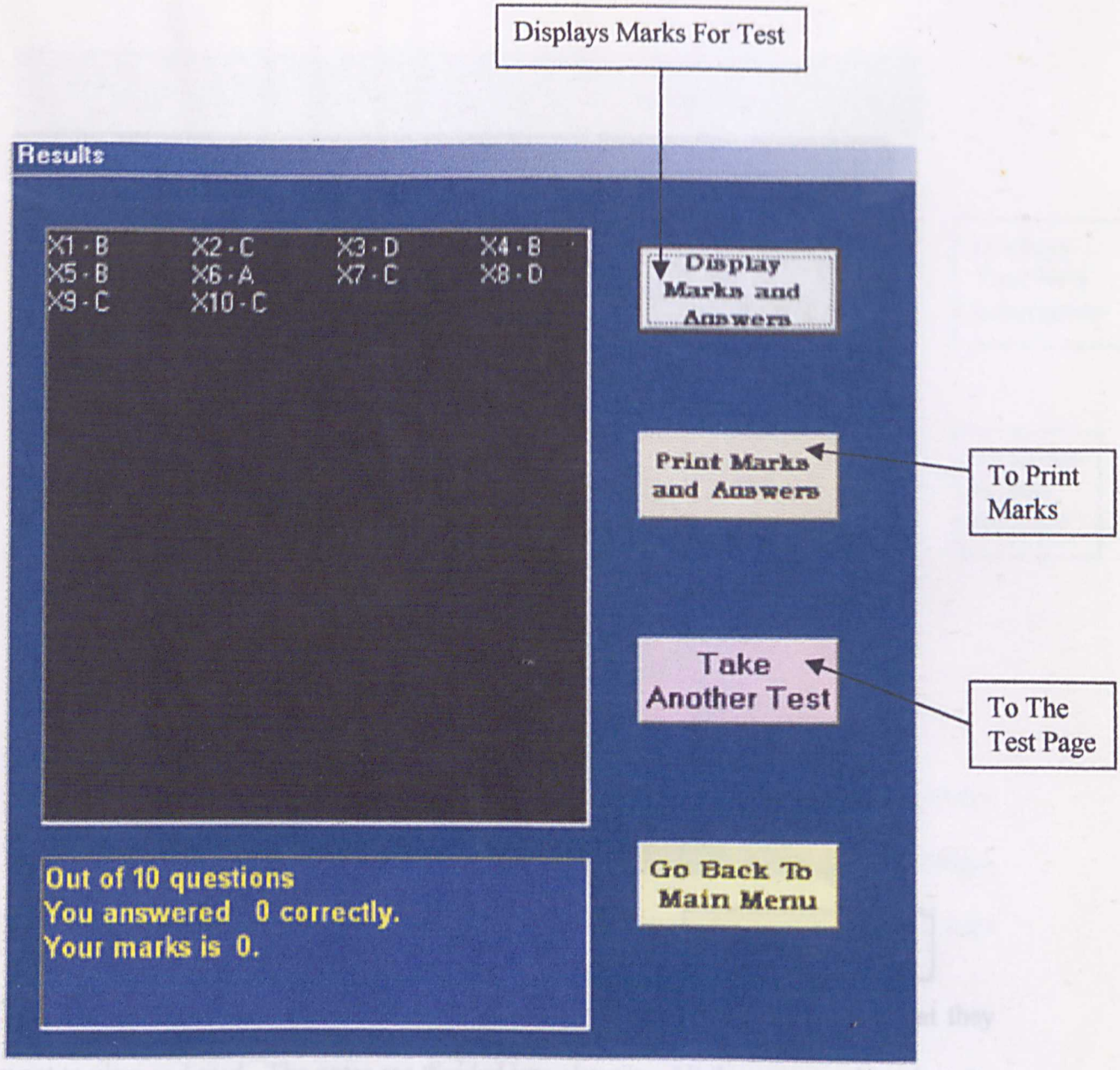
Hardware

- Intel Pentium III 500 and above
- 1.0 GB Hard Disk Space
- 128 MB SDRAM or higher
- Screen Resolution- 800 x 600 (Recommended)

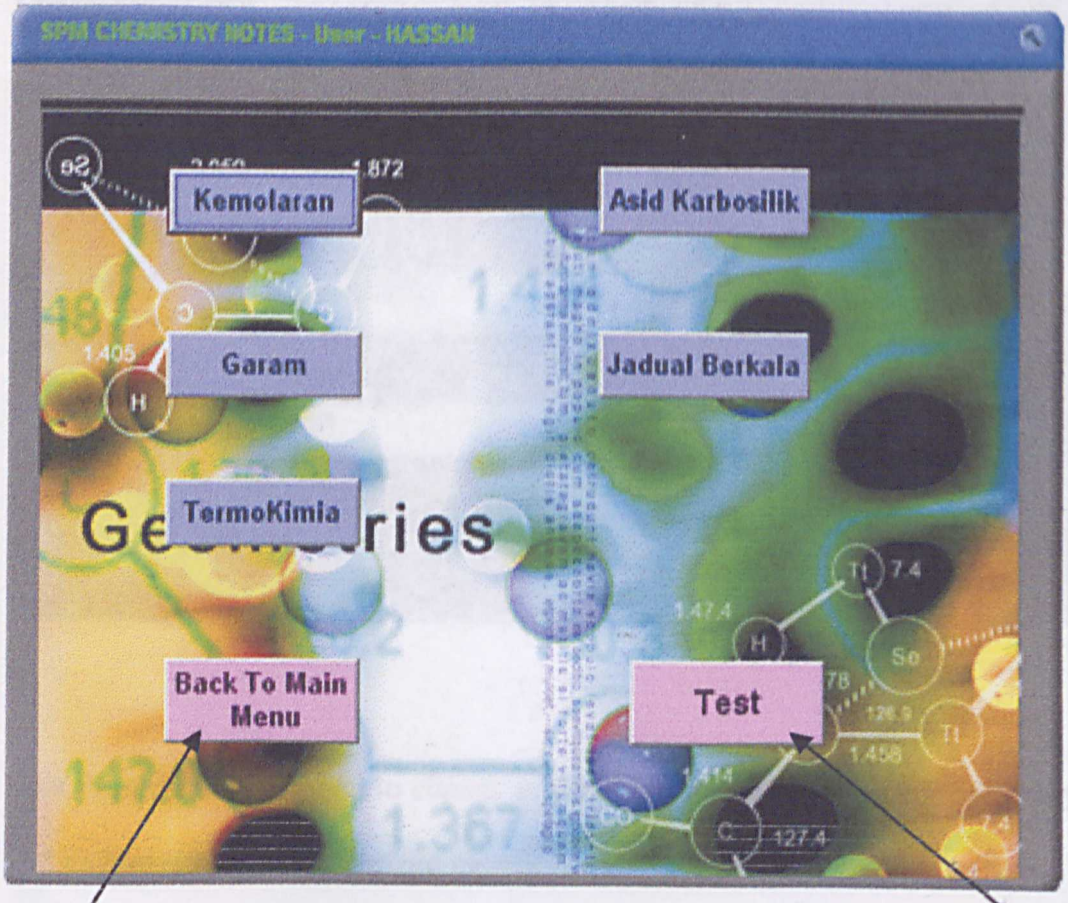


This is the test page where a user or student can take a test to evaluate their understanding in certain topics. Some of the test here are timed, meaning that each user are given certain amount of time to finish certain amount of questions. If the user or student fails to answer all the question within the time period given, then the test will be disabled and the system will display the results for all the questions answered straight away

All the test questions are in bahasa melayu as required by the KBSM system and the education ministry.



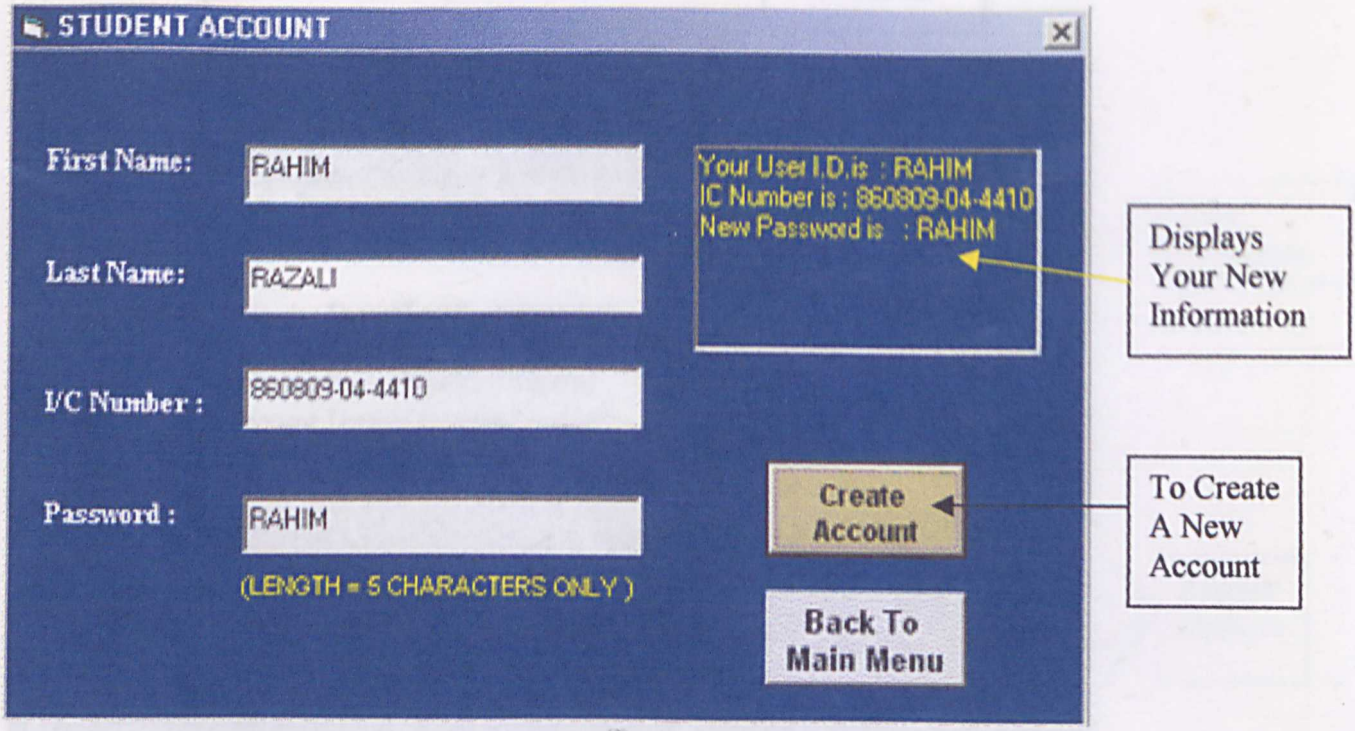
This form displays the results for each student. What is displayed is the number of questions the student is able to answer correctly and the marks for the test.



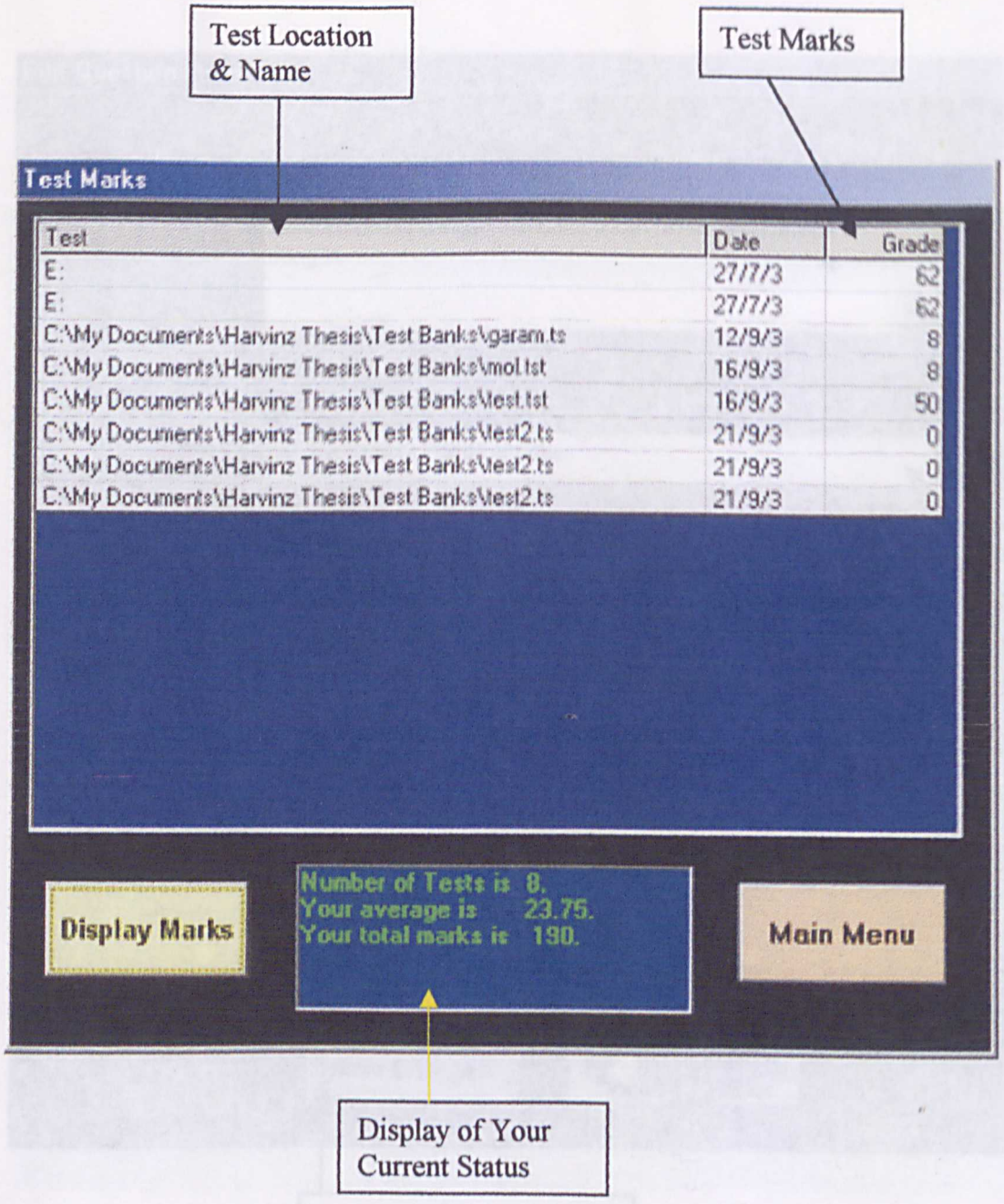
To The Menu Page

To The Test Page

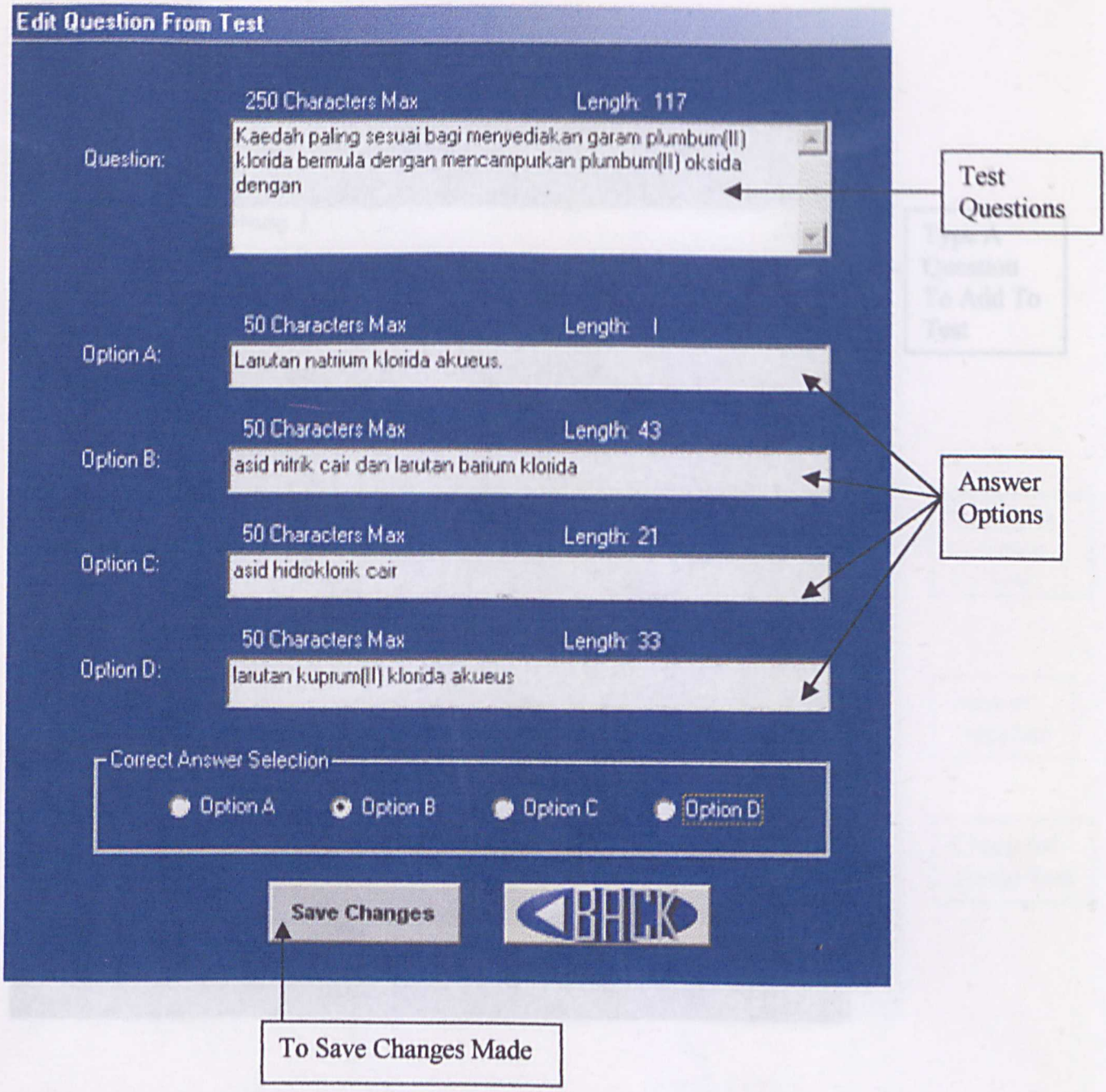
The notes menu acts as a navigational page for students to choose the topics that they want to view and read. The notes are divided into chapters. All the notes are based on the SPM chemistry syllabus provided by the educational ministry.



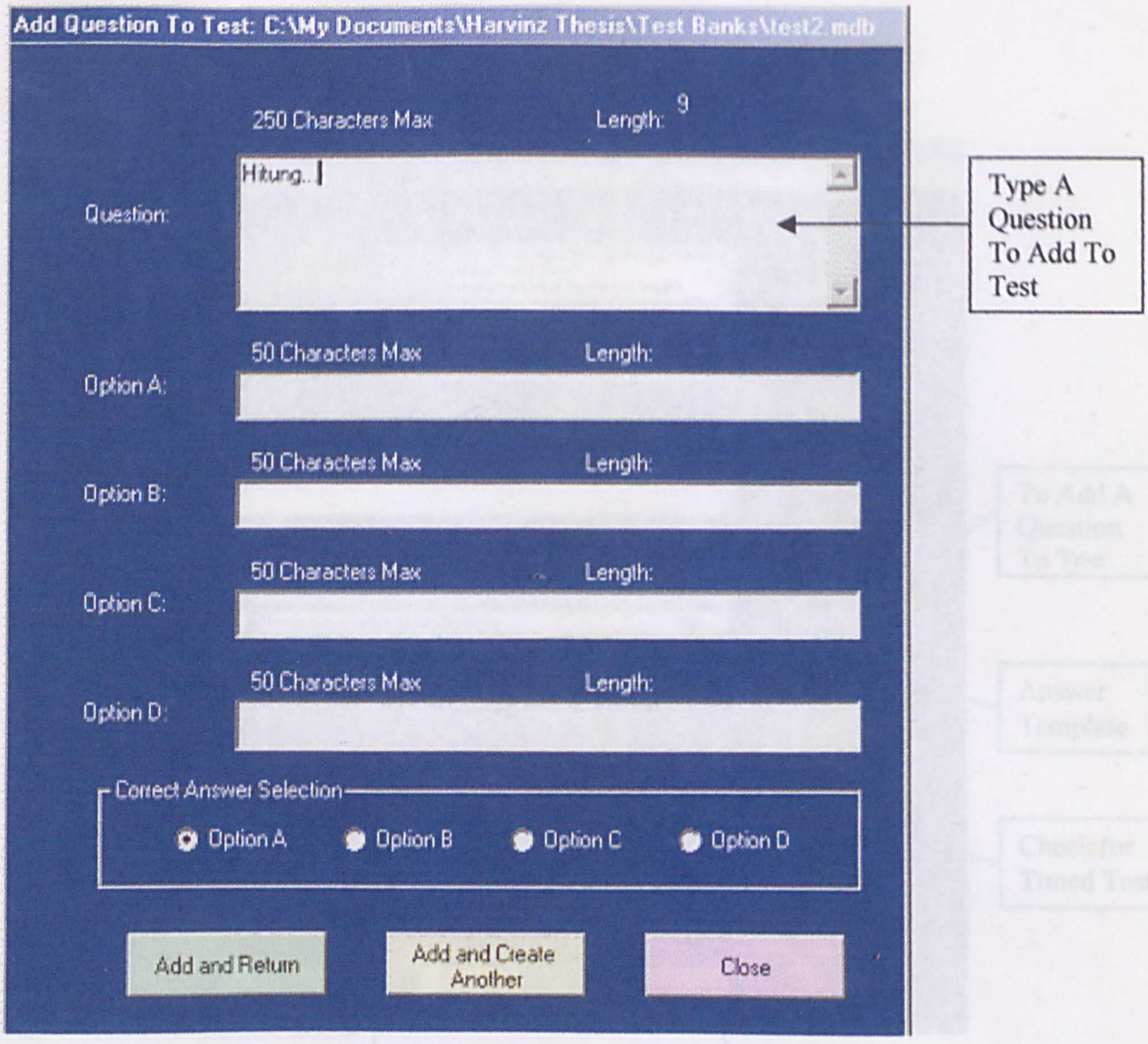
This form allows a student to change or edit their personal account for security reasons and to prevent any unauthorized members into the system. All the information changed will be displayed once so that the student can make any necessary changes if they want to. Each information changed will be stored in the login2 database straightaway.



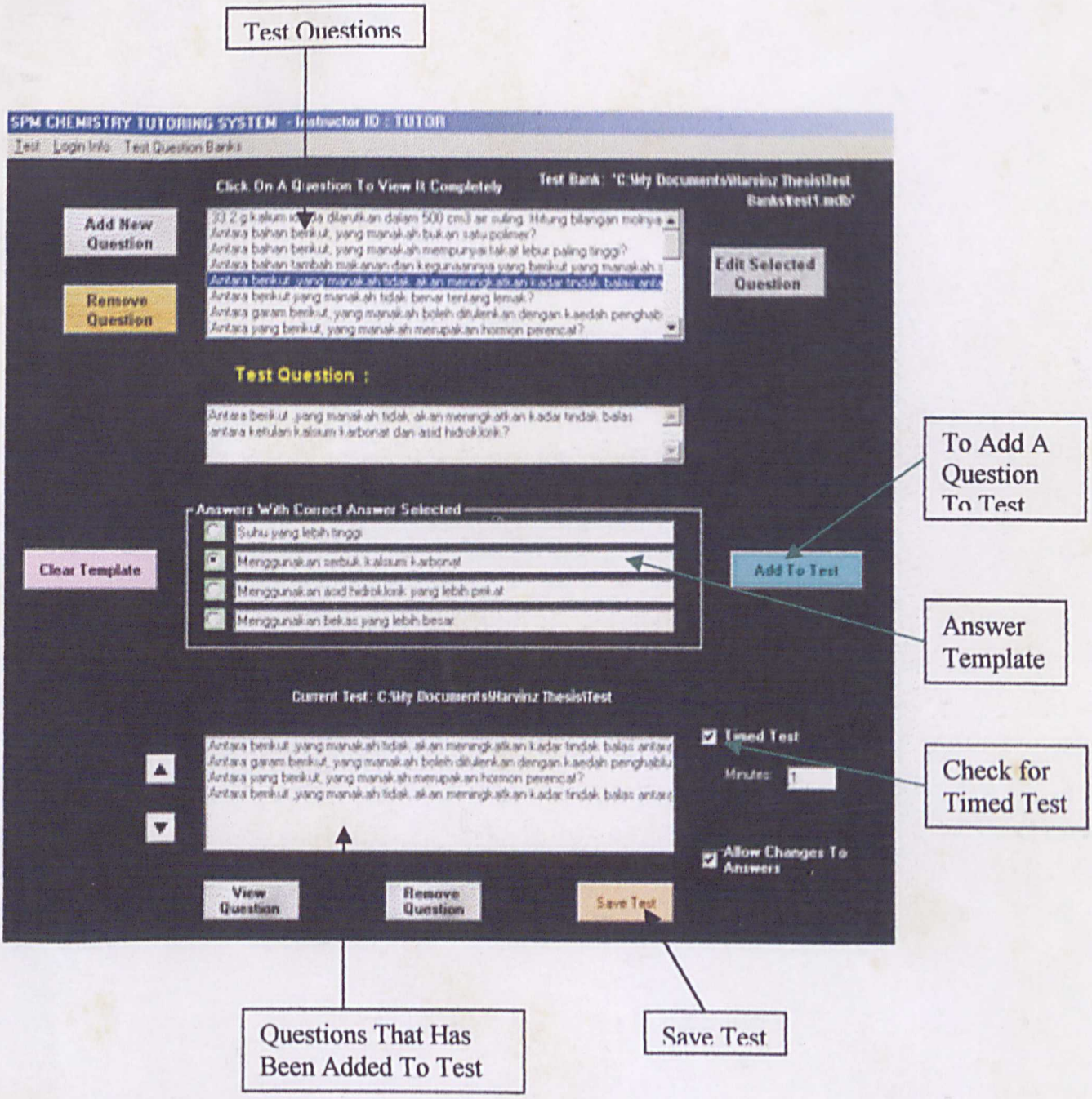
This form displays all the test marks, the number of tests, average of all the tests marks and the total for all the marks that the student has answered .



This form allows a tutor or an instructor to make changes or edit the test questions or the answers in the test questions database. Only the tutor or instructor are given authority to do the changes.



This form allows an instructor to add a question to the test bank. The instructor only need to type the question and answer options and also the right answer for the question, the system will add the question to the test database straight away.



This form enables an instructor to pick the appropriate question from the database to be added to the test.