Chapter 1

Introduction
1.1. Research Objectives

The main objective of this thesis is to find the effective design and implementation methods for developing the E-learning software. The ultimate goal of any E-learning software is to replace the classroom teaching up to maximum extent. This goal can be achieved only through the simulation of the teacher through software, which is always the most advanced stage of any E-learning software. To do this job more effectively, the new generalized software development strategy has been developed, so as to get most advance E-learning software. This generalized strategy is based on software engineering principles. The figure 1.1 shows the basic framework of this research work.

![Diagram of research framework]

Fig. 1.1: Basic Framework
The figure 1.2 shows this strategy, case studies and suggested methodology.

![Diagram of software development strategy]

**Chapter 3**
Generalized Strategy and Implementation
- Providing more realistic web-based solution
- More user convenience
- E-learning Standards and more effective strategy

**Chapter 4**
Other Simulation Techniques and Security
- For Better than Classroom training
- Protection Mechanism
- For handling large projects

**Chapter 5**

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**Fig 1.2: Software development strategy**

As stated in Synopsis, in this generalized strategy, in the analysis phase, more stress has been given to:

- Requirement analysis
- User analysis
- Objectives and goals etc.
In the design and implementation phase various issues have been considered like

- Object Oriented Approach and Reusability
- Mobile Technology
- Latest programming languages and ActiveX libraries like
  - MobileVB
  - SWF Scout is an ActiveX library
  - Java 3D API etc
- P2P and Client-Server technologies for collaboration activities
- Security aspects
- Interactive Software Simulation techniques
- Other simulation techniques like pseudo simulation etc.
- Multimedia Technology

The main objectives of this generalized strategy are

- Finding the most economical solution
- Time efficient methodology
- Highest priority for user’s satisfaction
- Smooth learning curves and personalization
- Details technical specifications for saving development time and efforts
- Most convenient solution with the help of latest technologies
- Robust software engineering and pedagogy based E-learning solution

The purpose of the research work, which has been carried out here, is

- To find the minute details of analysis, design and implementation phases for most effective and efficient E-learning solutions
- Obtaining the generalized solution which can handle more complex problems
- Saving development time of the E-learning softwares through
  - Exact technical specifications
  - Narrowing the path of tool selection
  - Formulating the pedagogy rules for programmers
- Finding the implementation constraints and providing feasible remedies
- Suggesting the more detail step by step methodologies with the case studies
The strategy developed in this research work has been rigorously tested with the help of case studies of e-learning tutor softwares like

- C language
- C++ language
- Microsoft Visual Basic
- HTML

In addition to this, the generalized strategy has been applied to few more complicated case studies (subjects), without changing the basic approach. These are:

- Computer Graphics
- Microprocessor
- Data Structures

This strategy has been evaluated at every stage and phase. It has produced very satisfactory results.

1.2. Overview of Thesis

The brief introduction of each chapter of the thesis is given below.

Chapter 2: Literature Review

In this chapter the details of the technological development of E-learning software and various aspects of content development has been discussed. This chapter mainly covers the literature review.

Chapter 3: Generalized strategy and Implementation

In this chapter the generalized strategy for simulating the teacher has been discussed. It contains total eight phases. The initial four phases describe the formulation of basic generalized strategy and last four phases enhance this basic generalized strategy.
3.1. Technical Specifications

In the first phase of the generalized strategy main focus is on E-learning software development time efficiency and effectiveness of multimedia technology. For simulating the teacher through software simulation techniques the Multimedia Technology plays a very important role. To formulate this phase of strategy the research has been carried out to find out the exact technical details for obtaining the best multimedia results [1-3].

3.3. Software Simulation Tools and Technologies

The simulation of the teacher of the programming language has been done with the help of software simulation (SS) techniques. The number of tools and technologies are available with variety of features. In this section, on the basis of capabilities, broadly these SS tools and technologies have been classified into three generations. This classification helps to formulate the tool selection strategy [4-5].

3.3. Strategy to Selection of Appropriate Tools and Technology

In the second phase of the generalized strategy again the focus is on time efficiency of E-learning software. The appropriate selection of Software Simulation tools and technologies decide the success and failure of this research experiment. On the basis of time factor and nature of interactivity the strategy has been formulated. This strategy has successfully reduced the development time and complexities of the simulation process of the teacher [4-5].

3.4. Generalized Pedagogy Rules for Effective Multimedia Based E-learning Softwares

In the third phase of the generalized strategy focus is on pedagogy aspects of E-learning software development. In the E-learning software the content is the king. The quality of the E-learning software depends upon quality of contents. The quality of contents depends upon the e-pedagogy plan. For developing efficient multimedia based E-learning
softwares the synchronization of flow of information from computer to human brain is essential. The Pedagogy and Human Computer Interaction (HCI) are crucial factors for maintaining this flow. Before developing the E-learning solutions, the developer should know the working of human brain, the human psychology, the process of memorization, the memory retention techniques, memory overload problems etc. To develop the better teaching aids and E-learning tools, it is necessary to understand the mind’s natural process of learning. There are many theories of teaching and learning but the developers are always in dilemma for selecting the particular theory. To develop Pedagogy Plan, the crystal clear rules are necessary. Thus in the third phase, most generalized pedagogy strategy has been formulated for developing Multimedia based E-learning content development process. It contains well defined 13 rules, which will help the E-learning developers in all the phase of development like analysis, planning, design and implementation. This comprehensive rule-base has helped a lot to develop a sound and robust E-learning system [6-9].

3.5. Model Development and Optimization

In the forth phase of the generalized strategy, the general-purpose model for simulation of a teacher has been developed. The teaching learning process is a complex psychological process. Thus the model development is the most tricky, difficult and complex process.

The second step of the forth phase of this strategy is the optimization of the teaching learning process in that model with the help of software. It’s an e-learning based iterative technique, which requires expert subject teachers and programmers. The goals of the Model Optimization technique are to maximize the student’s Intellectual grasp of a subject, apprehension, conversance, familiarity and mastery of the subject. The iterative processes designed for highest level of apprehension even for difficult concepts at the same time minimizing learning efforts for less important topics [10].
3.6. Case Study: E-learning Software for C language

All the techniques mentioned in the initial four phases of generalized strategy have been successfully applied for developing the E-learning software for simulating the C language teacher. It’s an approximately 50 hours duration multimedia based E-learning or Computer based Training (CBT) kit. This CBT covers almost every aspect of the C programming language. Each concept has been taught with the help of recording of online program execution, diagrams, animations etc. In this CBT, the online outputs, compiler errors, warning messages, integrated development environment, help files, etc. can be watched along with the audio explanation. In development phase more than 100 books on C language have been referred. It has been designed for beginners to most advanced level C language learner. Over 1000 kits of this film have been distributed throughout India and thousands of students are getting extensive training of C language programming without the help of a teacher. It’s a teacher less classroom.

3.7. Personalization and Further Optimization

In the fifth phase of the generalized strategy, the general purpose model for simulation of the teacher has been further optimized. After the development of the Teaching model and optimizing it for minimizing the learning efforts and for enhancing the apprehension level of the students, it is found that it can be further extended for better teaching quality. If the e-learning software has the capacity to identify the category of the student as well as the capability to automatically adjust the learning curve according to the level and category of the student then the process of teaching-learning can be greatly enhanced and optimized. In this section, the generalized software technique has been successfully formulated for doing this job [11].
3.8. Revised Case Study

The new technique for further optimization of the model has been successfully applied to the previously developed e-learning software namely “simulating the teacher of C language”.

3.9. Web based P2P Technology and Collaborative Environment

In the sixth phase of generalized strategy, the strategy has been further extended to provide more realistic E-learning solution by providing the collaborative environment. The CBT based E-learning is a passive learning. The user is simply an observer. To make the learning process live, the active participation of the user is necessary. The collaborative learning is very effective solution to this problem. But the CBT kit users are geographically scattered. The collaborative learning of these users was an impossible task. The Internet and Peer to Peer network based collaborative tools show the ray of hope. Thus the very effective collaborative learning technique has been developed with the help of P2P & Client-Server (hybrid) technology based Collaborative tool, for such geographically scattered CBT kit users [12-14].

3.10. Multimedia Based Standalone M-Learning Applications for Series 60 Nokia Devices

In the seventh phase of the generalized strategy the software has made more time efficient and convenient with the help of mobile technology. To take the advantage of mobile devices the new technique has been formulated. The target device of E-learning software for simulation of teacher for C language was the desktop computer. The new mobile technique could not be applied to it because of certain technical difficulties. Thus instead of developing the C language software again from scratch, the new technique has been applied to the E-learning software for simulating the teacher of Microsoft Visual Basic and C++ programming language. These E-learning softwares have been recorded
using TechSmith’s Camtasia Studio version 2. The new techniques have been tested using series 60 Symbian Operating System based Nokia 6630 device [15-16].

3.11. Object Oriented Approach and RLO

In the eighth phase of the generalized strategy, the SCORM based Object Oriented approach has been considered. To develop independent Reusable Learning Object (RLO) for linear teaching method is a straightforward job. But the process becomes tedious for non-linear Funnel approach teaching because of two characteristics of RLO namely reusability and independent nature. The text based RLO can be modified easily. But the multimedia based RLO development is an irreversible process. The magnitude of complexity increases if these SCORM based RLOs are used to simulate the teacher of programming languages. To achieve this goal the new software based technique has been developed and successful tested for simulating the teacher of Microsoft Visual Basic programming language [17].

Chapter 4: Other Simulation Techniques and Security

Basically this E-learning software development strategy shows the generalized way of developing E-learning software for simulation of the teacher through the e-learning technology. For few typical complicated subjects the additional measures are required to generalize strategy. The various case studies have been considered to show this fact like

- Simulation of the teacher for Visual Basic
- Pseudo Simulation E-learning Technique for developing Data Structures E-learning software [18]
- New E-learning Software for Microprocessor [19-21]

Out of these cases the first case has been covered in previous chapter. The remaining three cases have been discussed in this chapter.
In addition to this, the special protection mechanism for CD based E-learning softwares has been discussed at the end of this chapter [24-25].

4.1. Pseudo Simulation E-learning Technique

To provide the better e-learning solution to teach algorithms the new technique, which is based on generalized strategy, has been developed namely Pseudo algorithm simulation technique (PAST). This technique has been applied to data structure algorithms to develop DS-PAST based E-learning product [18].

4.2. New E-learning Approach for Microprocessor

The new innovative E-learning technique has been developed, which is based on generalized strategy, to teach the one of the most difficult subject in the computer and electronics discipline namely Microprocessor. In the beginning the solution has been successfully developed for desktop computers with the help of simulation techniques, assembler and cross compilers. In the second stage the web-based solution has been implemented for borderless education. In the third stage the collaborative environment has been introduced using peer to peer computing technology. In the final stage the m-learning solution has been provided [19-21].

4.3. Innovative E-learning Software for Graphics

The main objective of this work is to provide most effective and time efficient e-learning solution to teach Computer Graphics to the students of computer discipline with the help of generalized E-learning strategy, innovative e-learning methods, latest tools and technologies. To achieve this goal, the entire syllabus of this subject has been divided into four parts namely algorithms, 2d/3d Graphics (Transformations), 3d Graphics and Working of Computer Graphics System. For each task different e-learning techniques have been developed [22-23].
4.4. E-learning CBT Security Mechanism

Without the help of economical and reliable CD piracy protection mechanism the Research & Development activities cannot be accelerated in the field of Computer Based Training (CBT) through CDs. Nobody would like to invest time, energy and money in digital multimedia for education field without the reliable CD protection. Thus there is a need of new economical and robust CD protection mechanism. Every existing protection mechanism has strengths and weaknesses. To overcome the weakness of one technique, the strengths of another technique can be utilized. In the new CD piracy protection technique this basic principal has been used very effectively with the help of combination of techniques like Bad sectors creation, dummy files, Blowfish and MD5 algorithms, CD parameters etc [24-25].

Chapter 5: Software Engineering based E-learning Content Development Methodology

The generalized strategy for development of simulation of teacher follows the basic principles of software engineering. The step by step methodology for handling the large E-learning projects has been suggested in this chapter. This step by step process covers various aspects like requirement analysis (need analysis), user analysis, task analysis, goal priorities, affordable methods and technologies etc [26-27].

Chapter 6 and 7

The overall result analysis and conclusion have been included in chapter 6 and 7 respectively.

This generalized strategy has been evaluated at every stage and phase. It has produced very satisfactory results.