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In Search of Multimedia Courseware Development Environment for Effective Teaching Through Multimedia Courseware

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ABSTRACT

Developing tailor made Multimedia courseware ensuring effective implementation of instruction strategies is a challenge that manifests in myriad problems of software design and coding. In this paper an attempt has been made to analyse and identify coding and implementation problems, in the backdrop of using two different multimedia software development tools i.e. Visual Basic and Toolbook, which underpin the development and effectiveness of use of multimedia courseware. Solutions to such problems have been discussed in context of Tool book. The examples presented in this paper are based on the experience of designing and implementation of two large scale professional quality Multimedia courseware development projects.

Key words: Multimedia courseware development environment, Authoring, Instructional design, Assessment, Navigation, Integration, Toolbook, Visual basic, Media control, CD based multimedia, CAL, Presentation requirements, Selection of an authoring tool

1. INTRODUCTION

Software design of Multimedia courseware has been of long standing interest in the area of software technology. This may be the attributed to the fact that multimedia has found favor with business and industry for its strength of providing rich returns on one hand, and the inherent challenges on the other. These challenges are faced in handling multiple media, use of multiple languages for scripting and narration of the courseware, and in implementation of instruction strategies. Needless to say that in a deficient software design and in loosely coding the source, learning using the multimedia package is often the first casualty. Effective software development and implementation, therefore, are key to development of an effective computer based multimedia courseware.

As is the case with any other type of courseware development, instruction design precedes the software design. With selection of an instructional strategy may vary the choice of development environments and tools, and so would vary the techniques of solving/circumventing the problems encountered during the implementation.

The team of authors have successfully tried two different approaches of software design and coding for developing multimedia courseware, in case of two separate large scale real life projects, which pushed the software design skills of the team to the extremes of professionalism while working on the project.

This paper sets out to analyse requirement of features and tools to implement various strategies of instruction, briefly introduces the Visual Basic route for developing the courseware and then sets out to present detailed account of problems faced during coding and implementation of multimedia courseware on Regimes of Lubrication. While designing the second package using Asymetrix Tool Book ver. 4 CBT edition, solutions to the problems discovered during coding and implementation of

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the first package have been given, and their implementation mechanisms have been discussed.

2. MULTIMEDIA COURSEWARE DEVELOPMENT PROJECT

The Institute embarked up on developing the CD based multimedia courseware as part of two large scale and time-bound projects of Instructional Material development on Regimes of Lubrication and Air Brake System. These projects were executed for the Cement Manufacturers Association of India and the Indian Railways respectively. Both of these projects included development of CD-based multimedia courseware having same titles as that of the projects. Target Learners in these cases were the technicians and other skilled workers whos primary responsibility is to do maintenance of related equipment and systems. As the trainee population spoke different languages the courseware had to be provide multi-lingual support in various media forms.

3. INSTRUCTIONAL STRATEGIES AND PRESENTATION REQUIREMENTS

For instruction design of the two projects well established psychological principles, the foundation of which lies in programmed learning, have been used. The underlying principle of such an approach is principles of small step, active responding, immediate knowledge of result (IKR), self-pacing and student testing. The details of these are taken from [1]. Further commonly used instructional strategies, which are also used in CAI design and described in [2] have been used for both of the projects. These instructional strategies are tutorial, drill and practice, simulation, game and inquiry. Depending on expected learning outcome, one or more types of instructional strategies have been combined in which multiple media has been judiciously mixed. The presentation strategy is based on Gagnes nine events of instructions [2], viz. gaining attention, informing the learner of the objectives, stimulating recall of pre-requisite skills, presenting the stimulus material, providing learning guidance, eliciting performance, providing feedback, assessing performance and enhancing retention and transfer. Again building on and adding to the CAI alternatives given by [2], the individual events of instruction have been converted to one or a combination of the following presentation alternatives: textual review, learner option branching, Menu presentation, question with branching, graphics and 2-D & 3-D animations, photographic images, audio and digitized video, Learner controlled speed, options for review, demonstration and short simulation with digital video and animated graphics, prompting and attention focusing, questions and feedback sequences, recycling through incorrect responses, and variety of examples. Hyper linking of text and media, such as graphics or an image, have been used extensively to recall prerequisite content, provide further explanation on identified terms, show real images of graphics thumb-nails, give exploded/enlarged view of a graphics or image, provide audio or video based explanation of concepts or p

To fulfill the presentation requirements and to develop effective courseware, our search of multimedia tools ended in identification of Visual Basic in first case and the Toolbook in the second. The salient features of Visual Basic and the Toolbook, which were available at the time of development of the courseware, have been discussed in the following sections.

4. VISUAL BASIC VS TOOLBOOK: RELEVANT FEATURES FOR COURSEWARE DEVELOPMENT

Visual Basic is a programming interface. It provides event driven programming paradigm, having very strong third party supports with DLLs

and Active X/ ACTIVE X/OCX controls. By using third party support the strength of Visual Basic is enriched. It is possible to use still graphics, animation, audio, and video using such controls. As the script is very powerful the implementation of any complicated instructional design is possible using this language.

In order to develop a multimedia application in Visual Basic one has to open a project. A project is a collection of form modules, standard modules, class modules and resource file. A form contains the description of a form and the code associated with the form. A form can be created to serve as the interface of application by including one or more controls on it. The controls are tools such as text box to get input or to display output; label box to give titles, captions; image box to display graphical images and so on. These controls have certain properties/characteristics, which can be set using menu options or can be set during program execution through script.

The behavior of form or controls can be controlled by writing codes associated with them. Thus in order to develop a multimedia application using Visual Basic one has to write codes very extensively and most of the features of application are implemented by writing codes for controls and forms. The developer has to be a good programmer to work with Visual Basic for developing multimedia applications. A sample screen developed for the package regimes of lubrication, is shown in Fig. 1. The screen is shown bearing the controls on it.

The development approach in Toolbook is very much similar as Visual Basic. An application is started by opening a book. The book is divided in to pages. Pages have different objects in it. To develop a toolbook application one has to put objects on each page of the book. Depending on need of the instructional design, developer can write codes to handle the behavior of the object. If the design is simple and does not require much interactivity, the developer may not need to write codes on it. Taking analogy with Visual Basic you can think of book as project in Visual Basic (VB), pages can be thought as forms in Visual Basic But as oppose to Visual Basic, many things can be achieved without writing codes in Toolbook, since the design of Toolbook supports the requirement of multimedia applications, it includes many ready to use controls with little or no scripting to control their behavior, such as media control objects, question answer objects and feedback, buttons for navigation and so on. Moreover, Toolbook provides ready to use page layouts known as templates in

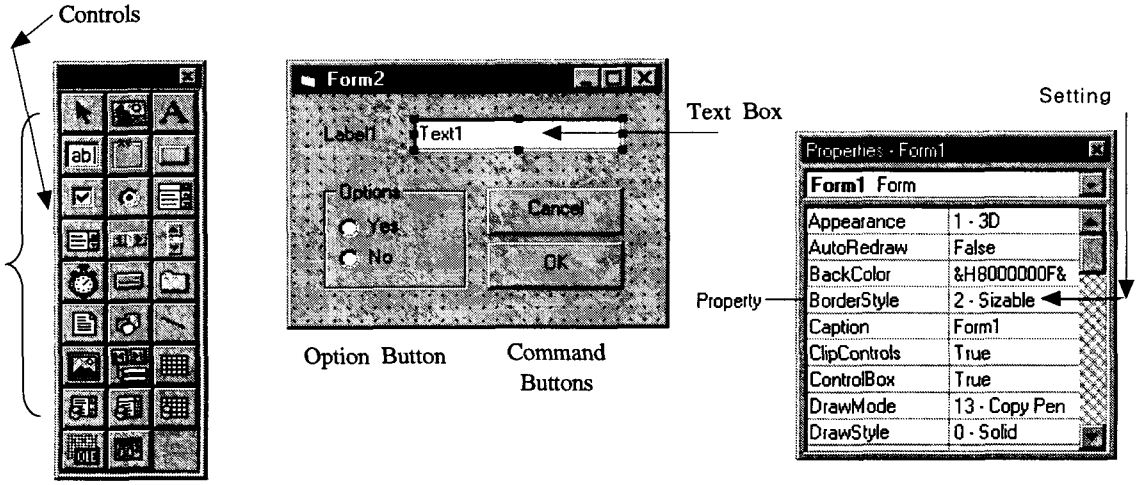

Fig. 1. A sample screen developed for the package "Regimes of lubrication", bearing the controls on it.

which objects are laid by default and a developer has to customize the properties of objects according to his need. In case more interactivity is to be provided to user script can be written for decision-making, looping, and all other structured programming features on that object to solve the problem.

A book based layout of a course structure is given in Fig. 2. The corresponding object hierarchy is shown in Fig. 3.

While implementing the presentation scheme of courseware, varied degrees of difficulties are experienced in using the two authoring tools i.e. Visual Basic and Toolbook. Level of difficulty for the two authoring tools in implementation of presentation scheme is given in Table-1 titled Presentation strategies implementation: level of complexity in Visual Basic 4.0 and Toolbook 3.0.

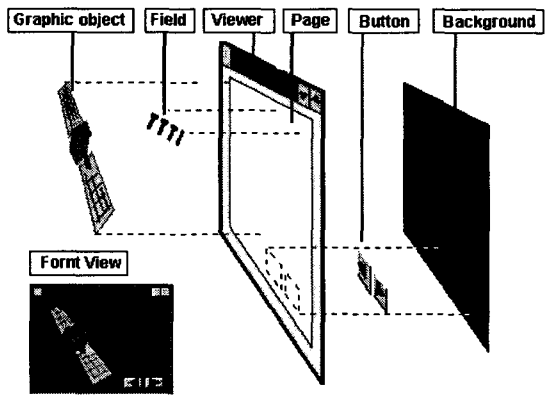

Fig. 2. A book based layout of a course structure.

5. CHOOSING AN AUTHORING TOOL FOR COURSEWARE DEVELOPMENT FOR THE PROJECT REGIMES OF LUBRICATION

At the time of developing the courseware Regimes of Lubrication, the development team had a choice of two development tools viz. Visual Basic 4.0 and TookBook 3.0. The above versions have, therefore, been used for comparison of features in Table 1.

For selection of an appropriate authoring tool, critical factors, as listed in REC module 8 developed by T.T.T.I., Bhopal [5] have been used. Degree of complexity has been taken at three levels i.e. low, medium and high, both in terms of requirements of courseware design and the level of support

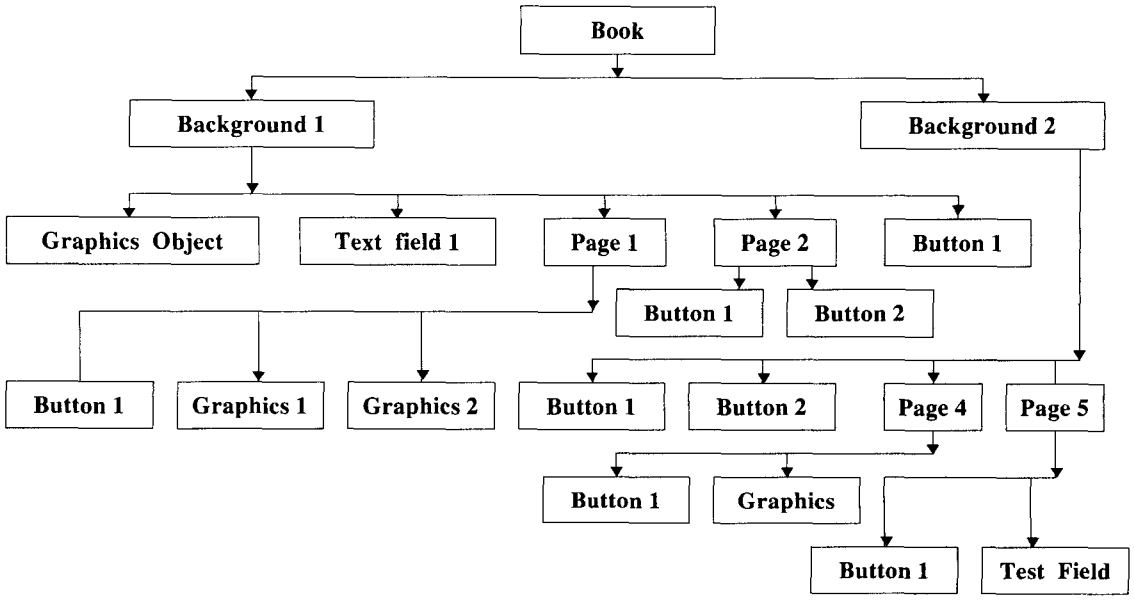

Fig. 3. A sample of object hierarchy in ToolBook.

Table 1. Presentation strategies implementation: level of complexity in Visual Basic and ToolBook

PART-I Presentation requirements of Instructional design			
S.no.	Presentation Requirements	**Level of complexity**	
		Implementation Using **Visual Basic**	Implementation Using **ToolBook 3.0**
	Navigation scheme of the courseware	High	Low
2.	Hypertext and hypermedia support to explain a term/concept/phenomenon/ icon in greater details by presenting similar or other forms for media elements	Medium	Low
3.	Assessing learners performance through variety of tests items such as: True / False, Objective type, Questions based on Media elements etc	High	Low
4.	Providing feedback on self assessment	High	Low
5.	Varying page layouts to break monotony and to satisfy instructional needs	Medium	Low
6.	Synchronisation of multiple media elements	Medium	Medium
7.	Support for multiple language	Medium	Medium
8.	Exploding the Thumbnail images for large view	Medium	Low
9.	Pre-test items to assess the entry level knowledge of learner and post-test items to assess learning out comes at end of courseware	High	Low
10.	Random generation of questions in Pre-test and Post-test sessions	High	Not Possible
PART-II Technical Features			
11.	Distribution on CD-ROM	High	Low
12.	Programming features to control media elements	Medium	Low
13.	Database approach to store the contents of each page	High	Not Possible
14.	Third party support	High	Medium

provided in the authoring tools. The same is depicted in Table 2.

Analysis of data presented in Tables 1 and Table 2 reveals that the Visual Basic environment provided the much sought after features of assessment, database support, third party support of ACTIVE X controls and availability of higher level of programming skills with conceived flexibility, and better control over development. This led the development team to decide in favour of the Visual Basic based courseware development. During the development, however, following difficulties were faced:

i. Tagged file used for hyper linking the text, as shown in Fig. 4, became difficult to maintain, and every change in the file name or the hyper linked word led to chain of multiple changes due to which development became not only complex but difficult in tracking the changes.

ii. ACTIVE X controls for media handling could not be arranged from 3rd party hence, programming for this aspect also had to be done.

iii. Level of complexity in implementation of multiple language support was very high that forced to resort to simplistic design for which efficiency while switching the languages had to be sacrificed.

iv. Customized distribution support program re-

Table 2. Critical factors for selection of an appropriate Authoring tool

Critical factors	Courseware Design requirement	Suitability of tool	
		VB 4.0	Tool Book
Time available for integration	Limited and fixed	Low	High
Size of CAL	Moderately large	Case: Data stored in database - Manageability: High - Programming Complexity: High - Performance: High Case: Form based - Manageability: Low - Programming complexity: Low - Performance: Low	Case: Text file based - Manageability: Low - Programming Complexity: High - Performance: Low (Hyper links not available) Case: Page Based - Manageability: High - Programming Complexity :Low - Performance:High (Hyper links also available)
Types of media elements are to be used	All types	All Supported	All Supported
Delivery platform	Windows 95	Supported	Supported
Hardware available for development	PC-486 with 256 colors & 16 MB RAM	Supported	Supported
Available expertise in programming	-	Medium	Relatively low
Level of interactivity required	Very High	Very High	Very High
Methods for student assessment used in instructional design	Tests including true/false, Multiple choice with feed back, Multiple-media based, Random generation of question	High (with higher level of programming complexity)	Low
Money	Fixed & low budget	-	-
Man power	Small team of 2 persons to handle	Larger team required for development	Relatively smaller team will do

In this regime: @@ * two surfaces are completely separated by film. @@ * There is no metal-to-metal contact. @@ * Thickness of film(h) is much larger than required to cover surface ##asperities|M22A1D3.bmp~. @@ * Metal to metal ##friction|M22A1C4.wav~ is absent. @@ * Surface properties do not influence friction. @@ * Only ##fluid friction|M22A1C5.WAV~ is present. @@ * Only ##viscosity|M22A1C6.wav~ influences fluid friction. @@ * Load is carried by lubrication film only. @@ * ##Wear|M22A1C7.wav~ is negligible as there is no metal-to-metal contact. @@

Fig. 4. Example of tagged file used for hyper linking the text, in Visual Basic used for project Regimes of lubrications

quired large amount of programming, testing and debugging.

v. Programming approach to implementing assessment required development of separate forms for each type of questions, and writing of separate code for them. Similar complexity was experienced while implementing media based questions and in providing feed back.

The project on development of multimedia courseware on maintenance of Air Brake System was taken up after the project described above. In view of the problem faced in the 1st project, it was decided to undertake an analysis of features of Toolbook specially those suitable to provide solutions for the difficulty faced in using Visual Basic authoring environment. For each of these points the outcome of analysis is presented in following section.

6. TOOLBOOK BASED SOLUTIONS FOR THE PROBLEMS EXPERIENCED IN VISUAL BASIC ENVIRONMENT

Objective of this exercise of finding solutions, using Toolbook, for the problems experienced in implementation of courseware in VB, was to ascertain technical viability of alternate authoring tool for development of course ware of the new project on maintenance of Air Brake System. For this purpose Multimedia Toolbook 4.0 CBT edition was used that became available at the time of this development. The solutions to the difficulties listed above are given below.

i. Using Toolbook 4.0 CBT edition one can directly mark a word as hypertext and can write codes on it to hyperlink it with any object, a much simpler approach then Visual Basic. A sample script to play audio file in response to click on hypertext is given blow:

```
To handle buttonclick
        Mmopen clip "e11w021"
end
```

ii. For implementing many of the features for which ACTIVE X were required in Visual Basic can directly be handled in Toolbook without requiring ACTIVE X support. Offcourse for dealing with more complex features ACTIVE X support may be required in Toolbook also.

iii. Implementation of multiple language support is much easier with Toolbook, as the approach of development in Toolbook is page by page with controls on page. One can handle these controls very easily by writing code based on some event for each page. By setting appropriate fonts for page, switching the language is easier. The script needed to implement the same is also easier than Visual Basic.

iv. A user-friendly utility is clubbed with Toolbook package with all necessary runtime file support to pack the application for distribution purpose. The total utility is menu driven and does not require programming. Although some of the options can be customized by writing few words only.

v. Perhaps the biggest strength of Toolbook lies in its features related to assessment part. Toolbook consist of big library of question objects. By using Question objects, one can construct different types of questions including multiple-choice questions, true/false questions, fill-in-the-blank questions, match-item questions, Drag and drop items and so on. Question objects also manage the tasks of determining user responses, scoring responses, and providing feedback.

There are many types of question objects available from the Toolbook library. One can customize their appearance and behavior or use them as they are provided and simply add their own content.

All these features are very user friendly and do not require any kind of programming. A sample question page created using Multimedia

Toolbook for project Air brake system is shown in Fig. 5.

In view of the above finding that Toolbook 4.0 CBT edition can be successfully used to overcome those problems which were faced in developing a courseware in Visual Basic and the fact that the level of complexity, in implementation of presentation requirements of instruction design and technical features, is low, it was decided to use Toolbook 4.0 CBT edition as authoring tool for the second project. The project was successfully implemented and observations of the development team are summarized below.

- Implementation of hypertext was very easy that led to great efficiency improvement from developers point of view.
- Development time was decreased drastically as most of the features for Navigation, Media control and assessment could be accomplished with less complex script or without script.
- Better control over media could be achieved such as frame-by-frame control on video and animation was quite helpful in synchronizing animation with audio.
- Multilingual support on each screen could be achieved more easily by changing the text font properties during run time by writing simple script.
- By using question wizard of Toolbook, the assessment part with determination of user responses, scoring responses, and providing feedback could be done easily that led to time saving and reduced Complex programming.
- Distribution and packaging utility is quite simple and a person with less familiarity with programming can also handle this utility.
- The major Strength of Visual Basic is its Active X support which is also well supported in Toolbook 4.0
- In general it was observed that with Toolbook 4.0, most of the development work can be achieved with menu driven utilities. For implementing more advanced features, a very rich set of script support is also available.

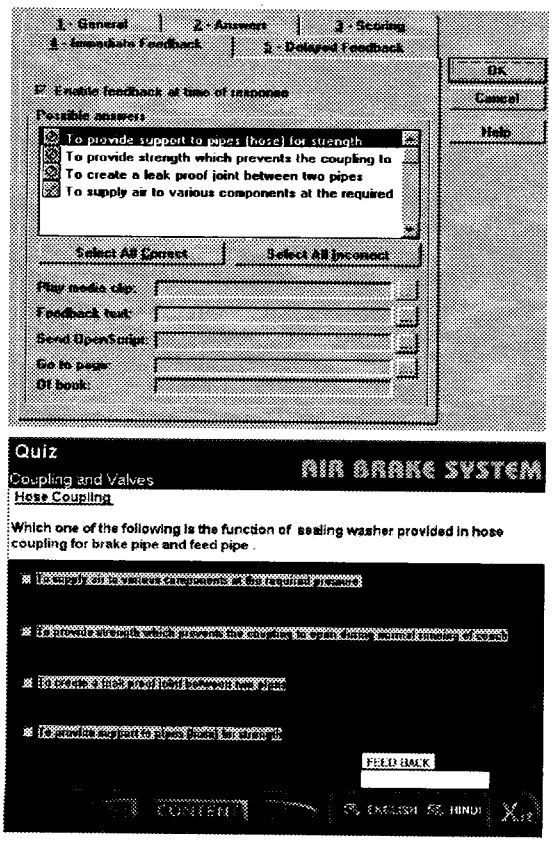

Fig. 5. Question object (above) and its corresponding output page created using Multimedia Toolbook for the project Air Brake System.

7. CONCLUSION

Development of Multimedia courseware requires that the content be presented to the learner using the instructional strategies deemed suitable for the intended learning outcome. The instructional strategies are than converted into presentation strategies and thus the presentation scheme of the content is developed. The presentation scheme when combined with navigation control and assessment requirements give rise to complexities, the coding and implementation of which requires

special consideration.

In developing the multimedia courseware on Regimes of Lubrications, the Visual Basic 4.0 environment was used and the specific problems related to coding and implementation as applicable to Visual Basic were identified though the solution to these problems was provided, it has been realized that the time spent in coding of such problems using Visual Basic can hardly be afforded in time bound projects, having constraints of human resources and limited budget, albeit, how so ever, flexible coding and implementation tool may be.

While developing the software for another multimedia courseware, therefore, a search for alternative development environment had to be made , that resulted in using Toolbook 4.0 CBT edition for development of multimedia courseware on Air Brake System. The way in which the problems of coding and implementation faced by using Visual Basic be solved using Toolbook 4.0 CBT edition had been highlighted earlier.

It has been also realized that with the release of newer versions of Toolbook which is Toolbook Instructor 8.0, more and more enriched features are available which directly addressed the instructional requirements of multimedia courseware in context of presentation schemes, coding and implementation.

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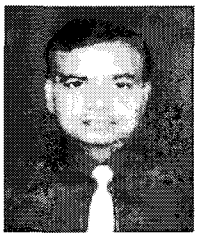

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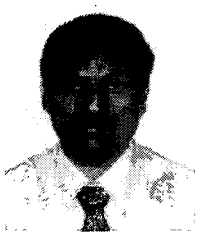
Prof. Dr.D.Singh Karaulia is Professor of Computer Science and Head of the Computer Centre at TTTI, Bhopal, India. He is a Teacher Educator, Information Technology Academic and a Consultant in Technical Education by profession. During last 22 years his main contributions, besides teaching and research, have been in the areas of technical education system development in the western regional states of India and quality improvement through nationally and internally funded projects. He has successfully implemented several turnkey systems development, computerization and packaged software / Multimedia courseware development projects and consultancies for various agencies. Introducing educational innovations, curriculum and instructional material development in Computer Science and other ICT areas, have been main focus of his work in recent years. He has conducted joint programmes and projects for Indian and overseas institutions with experts from other countries. Feasibility studies, IT policy planning and development of programme of action, HRD including Training of Trainers are some of the other areas of work where he has significantly contributed. His other contributions include Institutional development and Project specific research studies.

Currently Prof. Karaulia is Coordinating the Technical Education Quality Improvement Project, being implemented in the country through World-Bank assistance. His research interests include Multimedia, Soft-Computing and Web based learning. Prof. Karaulia is also working as a referee for several international journals and conferences.



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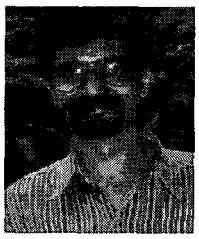
c. System design, development, testing, implementation, Maintenance
d. Research in technical education
e. Computer hardware and Networking infrastructure development and maintenance
f. Curriculum Development.
g. Laboratory development and management.
h. Design of proposals for various projects.
I. Preparation of Technical and operational manuals for software packages, Documentation of monographs, proposals, reports, etc.



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g. Laboratory development and management.
h. Design of proposals for various projects.
I. Preparation of Technical and operational manuals for software packages, Documentation of monographs, proposals, reports, etc.
j. Examination conduction

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