Intelligent System to Teach Programming Languages

Dekson D.E
Research Scholar: NITTTR
Taramani, Chennai, India
dekson@gmail.com

Suresh E.S.M
Assistant Professor: Educational Media Center,
NITTTR
Taramani, Chennai, India
suresh@nitttrc.ac.in

R.Ponnusamy
Professor: Dept. of Computer Science & Engg.
Aarupadai Veedu Inst. of Technology
Paiyanoor, Chennai, India
rponnusamy.com

Abstract— **Technology enabled learning approach has the potential to enhance teaching, learning and assessment process. The technology enabled learning environment provides digitized collection of artifacts including demonstrations and resources with animations and visualizations. The proposed model has incorporated the technology enabled learning concepts to teach programming languages. A model was developed where we can trace the sequence of execution of the program and the arrangement of data in the memory, which gives a clear visualization of the program. The model developed can be used for training learners on programming. This can be implemented in classroom teaching and also can be made online. Online chat is also provided for discussions and facility to post the doubts and clarify them immediately without disturbing the class.**

Finally, it provides an environment for easy learning of programming languages and makes it easier to understand the difficult concepts with simple visualizations. This facilitates the learners to practice the programs as well as to do assignments and to take self-assessment tests to keep track of their learning.

Keywords-component; Interactive Learning, Programming Languages, Program Teaching, Real-time Assistance, Language Animations, and Visualizations.

I. INTRODUCTION

In the traditional method of education, the only medium to learn is classroom teaching. Gradually the research in the education derived some solutions such as paper based material distribution, and with the development of multimedia the same material was distributed in the form of compact disks. These helped the students who are unable to go to the schools or colleges. This type of learning failed due to lack of interaction as in classroom. With the help of Internet, the video and audio records of classroom teaching are transmitted to the students and provide remote login to the classes. This is the base for the web-based learning.

In this paper, the different teaching methods and technologies that are currently being used by the Institutions and Universities for teaching programming languages such as

C, Java, and C++ etc. are discussed. The different problems faced by the students in the traditional teaching methods are also mentioned. Finally an efficient model is proposed with its architecture and working, and how it is more effective to teach programming languages by adapting a technology enabled method.

II. CURRENT TEACHING METHODS AND TECHNOLOGIES

A. Veteran Teaching Methods

For the past decades the lecturers have been using the following methodologies to teach the subjects. One is the lecture with the help of a piece of chalk and board followed by some questions which were answered by fill in the blanks which was developed by F.B. Skinner or choosing the correct answer from multiple responses which was introduced by Crowner. Another one is randomly picking some learner and testing him [1].

But through these types of teaching methods students are not able to learn programming languages effectively.

B. Computer and Web based Teaching

With the evolution of Computers and free availability of presentation tools nowadays Universities and Institutions are encouraging their lecturers to train the students using these technologies. Also they are training their students by distributing the teaching material through CD or DVD [1].

From the nineties the usage of web is increasing at exponential rate every year. The Universities also started using these new web technologies for providing online material to their students. They are capturing the videos of lecturers and publishing them through the World Wide Web [2].

Even though the lectures are hosted in the web they are the replica of class room teaching. This may be useful for distance learners who are unable to attend classes [3]. But this content is not interactive nor assists learning programming languages [4].

C. Problems faced by the learners while learning Programming Languages

The learners who are new to technical education or engineering graduation will have very less knowledge about computers and programming languages [4]. So if the lecturers try to load the new paradigms or concepts with the traditional teaching methods and techniques the learners' fail to grasp the new concepts. Here we list some of the problems faced by novice learners with the traditional teaching methods which we come to know through survey from novice learners.

1. Difficult to understand the new paradigms like procedural or object oriented programming concepts.

2. Lack of proper means to experience or visualize the concepts and the program output, makes them loose interest in learning programming languages.

3. For the distance learners and campus learners it is not possible to practice the program parallel with the lecturer, so when they are trying the same program (at their home) clarifying doubts become difficult.

D. Current Works on teaching Programming Languages

The Current work to teach programming languages suggests to use 3D animations [5] or visualizations as a supplementary material. Osman Balsi et. al [6] developed some visualizations interactively for some Computer science subjects which can be used in our teaching course material. Michael D. Byrne et. al [7] who analyzed the students in the context of "Evaluating Animations as Student Aids in Learning Computer Algorithms" telling that animations may aid learning of procedural knowledge is by encouraging learners to predict the algorithm's behavior.

Andreas Holzinger and Martin Ebner [2005] from their project they experienced that interactive visualizations, animations and simulations will take major role for teaching complex models. These interactive visualizations and simulations can also demonstrate the conditions of actions and events in the real world and subsequently support a constructive learning approach which is more student centered. Visualization can be seen as a simplification of a complex model with the aid of moving figures. An interactive learning object consists of an advanced organizer, learning material and a problem [8]. Visualizations help the students to create mental models of complex processes [9] and to remember and grasp them quickly [10].

So it is proved that with the help of animations, visualizations and simulations we can teach the programming languages by simplifying the complex models, interactively and make them to remember easily. In the following sections we introduce our proposed model which will make use of the current works and we will explain how it can overcome the mentioned problems.

III. TECHNOLOGY ENABLED APPROACH TO TEACH PROGRAMMING LANGUAGES

A. Introduction of Proposed Model

This model will work based on the ALN model which was described in [2]. With this model we can provide material to the distance learners or we can encourage distributed learning. In the following sections we will once again list the problems which are faced by novice learners and the possible solutions suggested by our model.

Problem 1:- Difficult to understand the new paradigms like procedural or object oriented programming concepts.
Solution: - with the help of 3D animations and visualizations we can make them understand easily [5].
Problem 2:- Not able to visualize the changes in the variable values, loops, flow of control in program execution.
Solution: - We provide simple visualizations such as marking the lines with different colors and some transformations which make them understand easily as described in [4].
Problem 3:- Not able to see the output of the program with the board teaching.
Solution: - We provide space for self-practicing at real time simultaneously as the program is being taught and realize the output.
Problem 4:- Not able to practice when lecturer is teaching, and facing difficulties while practicing at home.
Solution: - Making it online with the video of the class room teaching we can solve this problem [2].

B. Comparison of current teaching techniques and our Technology Enabled method
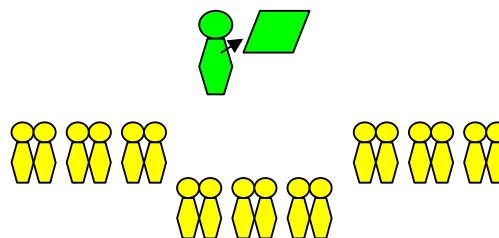

Figure.1. Description of Class Room Teaching

With the traditional class room teaching we can visualize only the pictures that were drawn on the board. Simultaneously visualizing the 3D animations and practicing the problems is not possible.
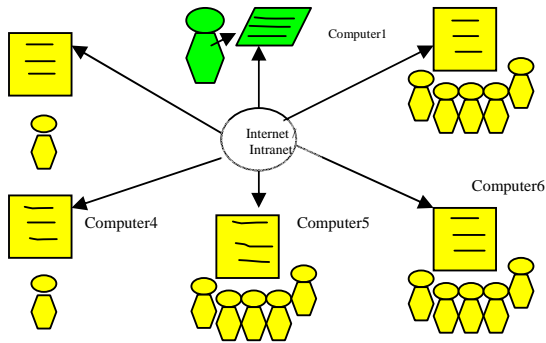
Figure.2. Description of distributed learning achieved by our model.

In this model all the computers are networked. Here classroom teaching is live telecasted by the studio assistants. The sample program illustrated by the lecturer will be shared among the learners. While teaching a program, the required animations and visualizations are also telecasted to the same audience. The learners can visualize the changes in values of variables used in the program, memory allocations, objects creation and usage and flow of control with highlighted colors.

With the proposed model we can achieve distributed learning. Where we can watch the video recordings of lecture, animations, and can practice the problems simultaneously. By using the message services provided by the different providers like windows messenger, Google Chat, Skype (instant messenger) we can discuss from discussion rooms and can post the doubts immediately.

C. System Architecture

The system contains lecturers, learners, studio assistants and Innovative Model system with the central database system.

Lecturers: - Here the role of lecturers is to guide the studio assistants to design the animations and visualizations required for the explanation of programs. He will teach the learners through online. He clarifies the doubts raised by the students.

Learners: - Here learners are two types, one is campus learners and others are distance learners. These two learners share the same material but distance learners will use Online System which is connected by the Internet and campus learners will use Offline System which connects through LAN.

Studio Assistants: - The team of studio members will consult the lecturers and prepare the learning material [11].

Innovative Model System: - It connects the learners with lecturers and studio assistants with central database. Central Database stores all the information that is may be the details of learners or training material.
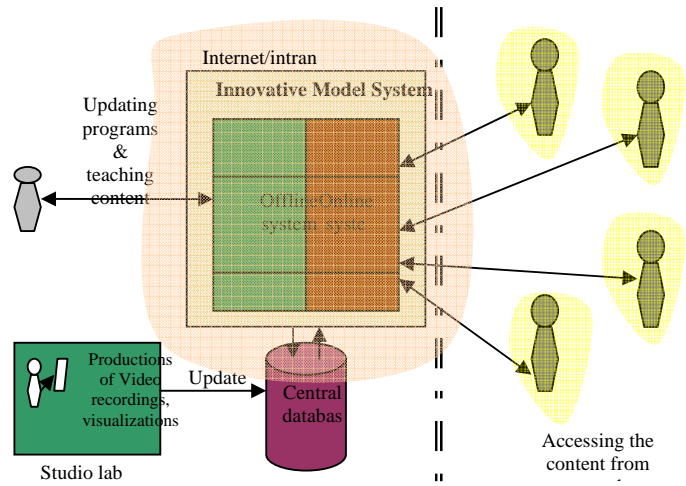

Figure. 3. Architecture

D. Working

The system works as follows

Step 1:- The lecturer announces the program for discussion. The related animations and visualizations are immediately shared to the students by the studio assistants. The current program which the lecturer is explaining will be displayed on the students' screen.

Step 2:- The lecturer will start discussing the program with the help of animations and visualizations. If the students have any doubt they can post their doubts as explained in the previous section using message services. The entire class room teaching is recorded and stored in the database, which can be viewed by the students later and can be used by the distance learners.

Step 3:- The doubts posted by the students will be clarified by the lecturer. These questions and answers will be saved to the database for future needs. This will be helpful for the distance learners who are not participating in the program at real time, and they can post their doubts to the lecturer.

Here we need to discuss about the lecturer screen and student screen which have various features. The following figures will show these screens.

These screens contain the following windows.

E. Student Window

The student window contains the following windows: program execution window, presentation window, notes window, navigation window and answer tool box window.
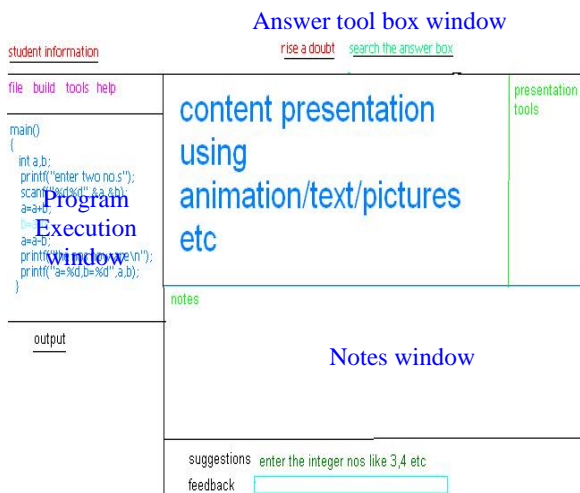
Figure.4. The typical window presented at student side.

Figure.5. The typical window presented at faculty side.

Program execution window visualizes the flow of control of the program, in which line the current explanation is going on and output is also displayed.

In the presentation window the visualization of the program will be displayed. It contains some tools for the presentations.

Notes window facilitates the student to take any notes on the presentation.

Navigation window provides the navigation to different places.

Answer tool box window provides the search for previously answered questions and to post queries to lecturers.

F. Faculty Window

The features of the faculty window include space for explaining the program, program execution and output and visualizations and queries posted by the students.

The query window shows the status of each student whether he understood a particular line of code or not. And also the queries posted by the students.

History window contains the history of program and at which lines of the program the students felt difficult to understand. It also helps him to get a feedback on his explanation.
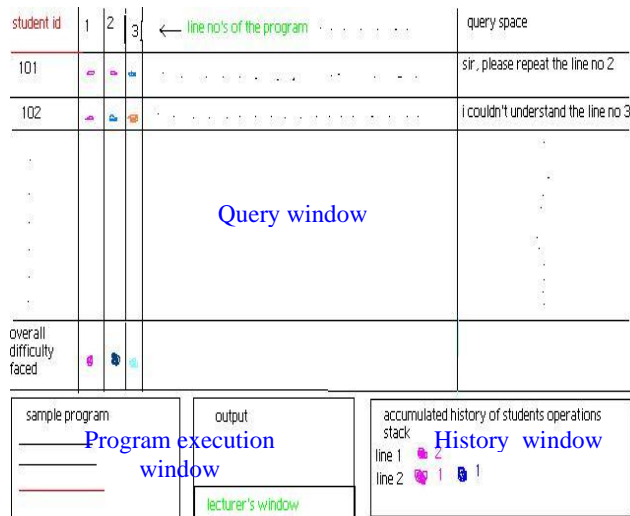
IV. CONCLUSION

While teaching programming languages, the main problems faced by the students are lack of visualizations and experiencing the output in real time. The proposed system can solve the problems faced by novice learners due to current teaching methods and techniques followed by Institutions and Universities. The proposed model overcomes such difficulties and makes it easier for the students to learn programming languages. This is an efficient teaching system for teaching programming languages through online and offline. It encourages distributed learning. It features the automatic answering and gives real time experience for distance learners also.

REFERENCES

[1] G. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. (references)

[2] Klaus Tochtermann, Gisela Granitzer, " The Long Way towards Workplace Integrated Learning", Eighth IEEE International Conference on Advanced Learning Technologies, 2008.

[3] Haniph A. Latchman and Denis Gillet, " A New Approach in the Use of Multimedia for Technology Enhanced Learning", Proceedings of the American Control Conference, June 2000.

[4] Azzedine Lansari and Abdallah Tubaisht, "Using an Outcome-Based Information Technology Curriculum and an E—Learning Platform to Facilitate Student Learning", Issuses in Information Science Information Technology, Vol. 4, 2007, Page(s) 461-471.

[5] Youzou Miyadera, Kunimi Kurasawa, Shoichi Nakamura, Nobuyoshi Yonezawa, Setsuo Yokoyama, "A Real-time Monitoring System for Programming Education using a Generator of Program Animation Systems", Journal of Computers, Vol. 2, No. 3, May 2007, Page(s)12-20.

[6]   T.Storer and I. Duncan, "3D Animation of Java Program Execution for Teaching Object Oriented Concepts", Visualization, Imaging, and Image Processing (583), 2007.

[7] Osman Balsi, William S.Gilley, Robin J. Adams, Emre Tunar, N. Dwight Barnette, "Animations To Assist Learning Some Key Computer Science Topics", 2001 ACM.

[8] Michael D. Byrne, Richard Catrambone and John T. Stasko, "Evaluating Animations as Student Aids in Learning Computer Algorithms", 1999.

[9] Andreas Holzinger and Martin Ebner, "Visualization, Animation and Simulation for Mobile Computers: Experiences from Prototypes", Central European Multimedia and Virtual Reality Conference, 2005.

[10] Holzinger, A., Kickmeier-Rust, M., & Albert, D, "Dynamic Media in Computer Science Education; Content Complexity and Learning Performance: Is Less More?" *Educational Technology & Society*, *11* (1), 2008, Page(s) 279-290.

[11] Caryn Meissner"Animation Brings Life to Science", Science Animations, Lawrence Livermore National Laboratory, S&TR March/April 2008, Page(s) 17-19.

[12] Maria Dolores Afonso Suarez, Cayetano Guerra Artal, Francisco Mario Tejera Hernandez, "E-learning multimedia applications: Towards an engineering of content creation".