
Review based comparative study of visualization techniques for learning on mobile devices

U. S.Junghare*, V.M. Thakare**, R.V. Dharaskar***

usjunghare@yahoo.co.in, vilthakare@yahoo.co.in, rvdharaskar@rediffmail.com

**Brijlal Biyani Science College, Amravati,*

***SGB Amravati University, Amravati,*

****G. H. Raison College of Engineering (GHRCE), Nagpur.*

Abstract:

Visualization is the graphical representation of data or information on mobile devices. Visualization makes the understanding of data or information easy as compare to non-visualized data. To perform visualization on mobile devices different types of data may use like text, picture, maps, physical objects, abstract data etc. Mainly visualization is categorized in two areas of visualization that is, scientific visualization and information visualization. Scientific visualization refers to some specific type of data like physical data and it is used for computer modeling and simulation. Information visualization refers to abstract data and used in business and finance, administration, digital media and other abstract concepts. The physical and abstract data is only one classification but there are others classification like static and dynamic data, structured and unstructured data, or hierarchical and non-hierarchical data classification. Other than information visualization and scientific visualization there are different applications of visualization like educational, knowledge and product visualization.

As the visualized data can be understood more easily so visualization can be used for learning on mobile devices. This paper focuses on use of visualization in learning on mobile devices and also compares the visualization techniques for m-learning.

Keywords: Learning, mobile devices, visualization techniques.

I. INTRODUCTION

Like radio and television, mobile devices can be used as learning resources. Using mobile devices learners can learn any where instead of institutions due to its facility.

Mobile devices have so many features like audio video, recording, wireless connectivity so learning on mobile is possible which is also known as m-learning. It means mobile devices may use for the learning process outside the educational institutions.

Learners can learn any subject data on mobile. If the data is of textual form then it is very difficult for learners to view such data on mobile devices due to small screen. Therefore visualization plays an important role on mobile learning.

Visual data is better to understand as compare to non-visual data. Visual data can be meaningfully display on small screen, which is easily understood by users or learners. It means visualization improves the learning process. There are various applications in which different types of data (educational and/or administrative) can be visualized using various visualization techniques from learner's point of view [1]. According to data different types of techniques are used to perform visualization in mobile learning. So it becomes the problem that which technique is better in mobile learning. In this paper different technique of visualization in mobile learning has been compared and finds which is better for learning on mobile devices.

II. VISUALIZATION IN VARIOUS MOBILE LEARNING APPLICATIONS:

Visualization techniques can be used for any subject. As computer programming is a difficult subject to learn to the learners. Some times learners never ask their difficulties in classroom due to fear or low self-confidence. Mobile learning provides a great opportunity for learners to switch from strict learning to enjoyable learning using supported elements.

Visualization can also be used to learn computer

programming. Whatever contents user wants to learn they must understand it first because without understanding it is difficult to learn. By replacing text heavy content with well-designed visuals it can help students to summarize complicated information and guide students to increased meeting, conservation and remember. It means visualization may help to improves student performance. Images and analogies are used to visualize clear picture of complex concepts and processes in learning. Visual images are generally more powerful than verbal images. Again visualization may be static and dynamic or dynamic features can combine with static like scrolling, zooming etc. which creates more effective learning.

Along with this programmer must know three thing completion, modification and expansion of code. Learning Objects (LOs) and their designing plays an important role in learning programming language [3].

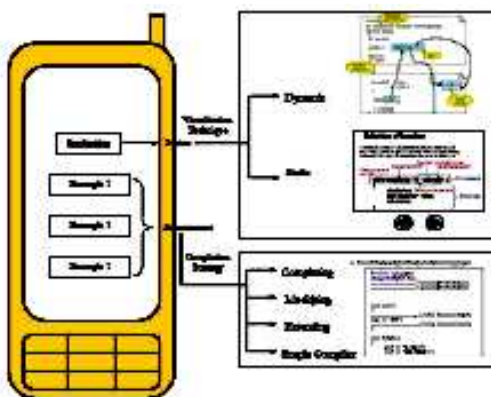


Fig . 1 M-Prog Design Elements.

Interactive Weather Information System or IWIS is developed using unique design-oriented visual images to represent a select group of weather information for the learners [4]. In IWIS has location aware system to trap the location of user by providing cell ID or GPS, which is display on Google mobile map. It is necessary to know the location of the user because different location has different weather condition. To represent weather data in visual form visual images has been used of different shapes, size and color. Generally 2D or 3D shapes are used as visual images.

Google map first represent the information like user name, location and weather information (temperature, humidity and rainfall) and then it is visualized on mobile

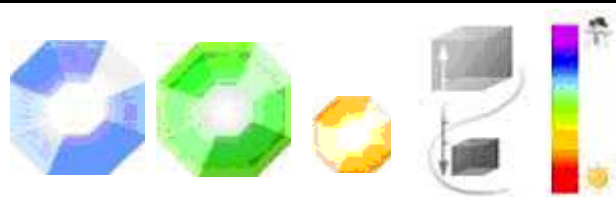


Fig. 2 Visual images in IWIS.

devices. To represent humidity of current weather condition bitmap images with different colors has been used.



Fig 3: Bitmap images to represent the humidity of the current weather condition. From left, heavy shower, light shower, cloudy and clear weather conditions.

Different devices can be used to achieve learning like desktop computers, Notebook computers, Tablet PC, Personal Digital Assistants (PDAs), cell phones and smart phones. One of the common features is that these devices provide access information through Internet. At the same time they much differ from each other due to web browser they use, supported markup languages (HTML, XHTML, cHTML, WML, etc.), supported script languages (JavaScript, JScript, VBScript), file formats and the screen resolution etc. Due to this reason it is difficult to view learning content on mobile devices. If there is a content of university courses, which is large amount of data, so it is not possible to upload that data on mobile. Therefore a new content visualization subsystem have been designed and developed. This subsystem send content to user that use PC with browser and then send it to users mobile with browser [5].

Visualization plays an important role for learning on mobile device. Learning may relate to any field but generally visualization for mobile learning is useful for such field in which there is a use of graphics. Thus visualization is useful in Civil Engineering especially in the field of Civil Engineering, sketches and drawings are very necessary to explain complex engineering models [6].

This application focus on three types of learning contents i.e. non-structure text, structure text without visual

and structure with visual. Comparison has been done between this content and finds the result which one is the most effective from learning point of view. As the mobile devices have so many features so the comparison of three types of content has been done on mobile. If there is huge amount of information that is in non-structure form then it is very difficult to understand and learn. If that information has been arrange in structure form then that will be little more understandable. When structure information is given in visualized form then it is more understandable [7].

Information visualization allows visualization of abstract data and conceptual data in simplest form. Here the authors [8] also compare visualized and non-visualized learning content on web and mobile. Significance information visualization could verify sufficient in mobile learning as an experimental result.

III VISUALIZATION TECHNIQUES IN MOBILE LEARNING:

Content adaptation approach:

The content adaptation is a process of selection or modification of content (text, images, audio, video), so that devices can present it. Because if the learners access the web site directly on mobile then the images must be resize and compact and the text must be formatted in one column. Content can be adapted using web server, proxy server and client but generally server based approach can be used for visualization. In this visualization is divided into two parts content and resource visualization. Resources are categorized according to their contents so there are different visualization modules for different resources [5].

Content adaptation approach is effective in which firstly it selects useful data from huge amount of data on web sites then that data has been compact and resize to display on mobile devices

Interactive visualization:

Interactive learning object (ILO):

New technology iViSiCE i.e. interactive VISualisations in Civil Engineering was founded in 2001. Initially in such technique interactive learning object (ILO) was created which consist of an advanced controller, the

learning material and a problem. Next part of ILO consists of communication and then examination, which is just like problem, based learning [6].

Multimedia interactive learning object (MILO):

Initially there was MLO multimedia learning object can maintain the academic richness of the original desktop based resources . As the mobile devices has so many limitations as compare to desktop so it was difficult to maintain MLO on mobile therefore there was a multimedia interactive learning object (MILO) with animation and auditory things. The main part of this type of visualization is to concentrate on necessary part and avoid unnecessary part. Initially this type of visualization occurs on desktop.



Fig 4: Example of an Interactive Learning Object (ILO).

Flash lite:

The technology iViSiCE is transport on mobile device using flash lite which compact file size, due to the use of vector based graphics, for fast access via the Web. Thus iViSiCE on mobile improves learning due to the

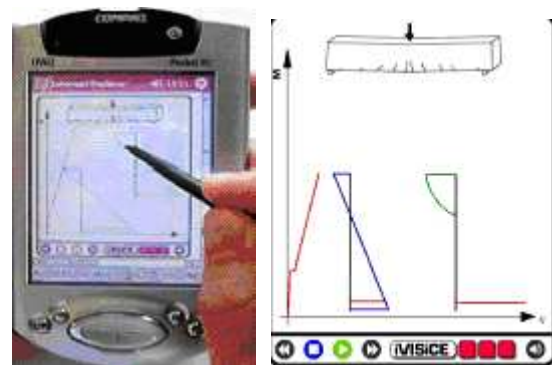


Fig 5: A typical iViSiCE application for a mobile device.

features of mobile devices and Macromedia Flash Lite. This technique is also useful for constructor of different site.

Reusable Learning Object(RLO):

Like ILO there is RLO to study learning ability that how to refer books, journals, and websites. It also encourages the student to go at referencing their work. RLO uses different approaches like Team Enhanced Creativity enables students to become concerned in an iterative and highly creative process of reusable learning object design, implementation, evaluation, and reuse.

It allows user to deconstruct learning process. RLO allows to solve realistic problem by constructing knowledge by working.

Information visualization:

Information visualization can enable users to understand information better, to receive information more quickly, and to make more logical and appropriate decisions. The main aim of information visualization is to give support for users to easily understand and learn large quantities of information from search results and other questioning environment. Finally the results suggest that information visualization is the most effective type of learning for mobile devices, after structured text. Visual information is easy to understand and learn as compare to auditory information. Cognitive learning theory explains that information received by the eyes and ears transform into knowledge and skills in human memory by mental processes then transform in visual form [7, 8].

Generative learning object (GLO):

In GLO actual understanding of learning object is separate from underline design or educational patterns. In GLO educational structure of learning object is presented as network of educational choices.

As the mobile devices has small screen problem so to provide educational richness on mobile is challenging task so there is use of two-dimensional navigation. But different learning objects provides various techniques such as vanishing from video to schematic representations and transferring text to speech these techniques works naturally within navigation structure [9].

IV USE OF VISUALIZATION IN MOBILE LEARNING

If there is huge amount of data that upload only on desktop computers they cannot be used with mobile devices due to small screen and other things. Hence it is necessary to display that data in visual form so that it can view on small screen and easily understood by users/learners.

- Visual data can display effectively in small space.
- Visualization reduces the complexity of data.
- Visual data is better to understand.
- Creates interest in learning.
- Make easy the learning of interrelated subjects away from the classroom.
- Learning can be done any where any time without handling heavy books etc.

V WHAT ARE THE REQUIREMENTS TO PERFORM MOBILE LEARNING WITH VISUALIZATION?

- High-configured mobile devices are required.
- Mobile with audio video facility.
- To provide multimedia contents it requires larger high quality color screens.
- Learning may be on line or off line. If the learning is off-line the applications have to be loaded in the mobile device's memory, which often required high memory capacity.
- If the learning is on-line then it requires Internet connectivity with Bluetooth and WiFi.

VI ANALYSIS AND DISCUSSION:

Common Visualization techniques on mobile for learning are:

- Static and dynamic visualization.
- Scrolling and zooming visualization.
- Information visualization
- Interactive visualization.
- Interactive information visualization.

As the mobile devices has so many limitations as compare to desk top, laptop etc so it's a challenge for all to perform effective learning on mobile, for that visualization plays an important role. A range of

visualization techniques can be used for mobile learning among all these some techniques augments educational richness to the learners like interactive visualization and interactive information visualization. It provides different learning objects, flashes technique having flash rendering, animation, easily connect to network, supports various symbols, dynamic text, additional audio support, rendering contents, navigation etc.

CONCLUSIONS

Previously e-learning was the very famous technique that is performed through various devices like radio, TV, PCs etc. Today mobile devices are very popular having so many features. Visualization plays an important role in m-learning. Visualization makes learning content more effective by reducing its complexity. Interactive visualization is a good visualization technique for mobile learning. It has so many features which construct effective and efficient interactive learning on mobile.

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