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A Study of Mobile Application Based on ARCS Design Strategy & Networking Principles for Interactive Learning

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Abstract:

Development of an interactive application with User Interface Design (UID) principles and requirements by utilizing mobile device as an instrument for Mobile learning purpose. Thus, methods for designing and developing an application for mobile devices that are compatible with small screen interfaces and limited capabilities of mobile devices are planned to ensure the learners are able to grasp the concepts. ARCS learning design strategy has been used which is appropriate for a mobile-based learning application and networking principles like network coding has been used to provide effective delivery of services. The interactive learning application has been developed on touch-screen iPad, operated on iPhone Operating System (iOS). UID principles and guidelines are used for designing and developing the application. Finally, Efficiency of UID has to be evaluated to test the usability of the developed application with six factors like Consistency, Flexibility, Learn ability, Minimal action, Minimal memory load, User guidance.

Keywords: ARCS design strategy, User interface design, Network Coding

1. Introduction

Earlier, Mobile devices were used only for communication purpose. As technology grew mobile devices has many applications like Mobile Banking, Mobile trading, Flight reservation, Gaming etc..

Nowadays, prevalence of mobile devices has become a necessity for everyone in one or the other aspect. There are different types of mobile devices such as PDAs, Tablet PCs and Mobile Phones. People often use the mobile devices to communicate with friends and family, connect to internet, play also been introduced to students as a tool for learning technical and non-technical subjects[1].

Nowadays, children also use their parents mobile devices for gaming, watching cartoons etc. Mobile technology has also been used for interactive learning which could also be developed for the concern of pre-schoolers and children.

An application with the User Interface Design (UID) principles has to be developed considering the following objectives:

- To identify a suitable design strategy that motivates the developers to build an interactive application.
- Utilize the available UID principles to meet customer requirements without any burden on the development
- Examine the usability of developed User Interface to meet higher order demands.

The idea here is to distribute data from a multiple server to single device at the same time i.e. multipoint to point communication

This paper aims at study of design and development of mobile application based on ARCS design Strategy using Networking Principles for interactive learning.

2. Literature Survey

2.1. User Interface

The user interface (UI) is everything designed into an information device with which a human being may interact -- including display screen, keyboard, mouse, light pen, the appearance of a desktop, illuminated characters, help messages, and how an application program or a Web site invites interaction and responds to it[12].

2.2. User Interface Design Principles

Following are the ideal set of UID principles that has to be considered while designing and developing an application.

- Navigation should be simple and clear from a page to any particular section. In short, the navigation should be consistent throughout all pages in an application.
- Complex navigation needs to be avoided by the developer on the application.
- Reduce scrolling frequently.
- Application should be user-friendly and allowed learners to understand how the application works in a few minutes.
- Similar actions and information need to be located in similar positions. For instance, similar buttons must be found in similar positions for the whole pages of the application.
- Flexibility of the display is the significant property for usability of interface design.
- Providing necessary information. Unnecessary information confuses the learners and decreases their performance.
- Decreasing textual information and increasing information which is provided in graphical and animated format to minimize learners' cognitive load and motivate them to learn.
- User control of the learning application should be allowed by the learners[1].

Nowadays, many mobile applications are developed to learn academic subjects. Although there are some considerable research on mobile-based learning applications, there is still lack of research:

- to examine the effectiveness of user interface design and Human Computer Interaction (HCI) in instructional applications based on mobile platforms,
- to figure out the impacts of surrounding environment on learning process when users learn the subject through mobile devices [5],[7],[15].

Regarding these issues, there are two recommendations to increase the research on effectiveness of user interface design, HCI and surrounding environment in a mobile-based learning application.

- The first recommendation is to apply user interface design principles and research on human computer interaction to make the user interaction ease-of use for the users.
- The second recommendation is to use popular and common mobile devices for mobile-based learning application.

In this project iPad is used as a popular mobile device for learning purpose among the learners to improve their learning interest on the application rather than focus on the device and environment [11], [15].

2.3. Why the User Interface Matters

Human-computer interaction (HCI) is the study of how humans interact with computer systems. Many disciplines contribute to HCI, including computer science, psychology, ergonomics, engineering, and graphic design. HCI is a broad term that covers all aspects of the way in which people interact with computers. In their daily lives, people are coming into contact with an increasing number of computer-based technologies. Some of these computer systems, such as personal computers are used directly. People come into contact with other systems less directly. For example, cashiers use laser scanners and digital cash registers in shopping markets and some systems are easier to use than others. When users interact with a computer system, it is done via a user interface (UI). How to design good user interfaces — interfaces that are easy to use and easy to understand, that meet the needs of the intended users, and that support users in the tasks they wish to undertake. Thus, user interface design and evaluation has to be introduced. In particular, why good user interface design is important has to be explained and highlight the consequences of poor or bad user interface design[14].

2.4. ARCS Design Strategy

In 1987, Keller ARCS provided ARCS model as a motivational design strategy to make the learning environment attractive for learners, which is relevant to their interests and learning goals, leading them to have confidence and satisfaction [9]. Keller's ARCS model is a four dimensional design strategies to motivate learners to learn more in order to obtain their learning goals. These four dimensions are: Attention, Relevance, Confidence and Satisfaction [9]:

- Attention: stimulating and maintaining learner's interest in learning process.
- Relevance: making a relation between instructional system and content with learner's goals.
- Confidence: controlling the system should offer to the learners (learning application); learner's feeling and expectancy are the other measurements for this design strategy.
- Satisfaction: satisfying learners from learning process and obtained experiences via positive and constructive feedback, unexpected rewards and positive outcomes.

2.5. Networking Principles

Networking Principles are the set of guidelines that are used for development, transmission of information over a communication channel. The Networking Principles include Connection Establishment, Reliable Transmission, Multicast Transmission, Network Coding and so on.

This Application makes use of Network Coding as its Networking Principles for Effective Transmission of data from different servers to a single application i.e. Multipoint-to-Point.

The Network Coding Principle was introduced by Ahlswede[3] for fixed networks and later it has been adopted for wireless and mobile networks[6].

The Network Coding differs from the traditional source or channel coding and it extends beyond the end-to-end communication[4].

In simple terms, the Network Coding working Procedure is a Packet is made to recode again in between the source and the destination in the transmission media, according to the needs of the outgoing channel. This technique is different from the traditional store & forward policy where a packet enters one node and exits on the different node[8].

The benefit of the network coding is that a network node is no longer required to gather all data packets one by one but it has to receive large linearly independent encoded packets.[2]

The simple working representation of the Network Coding Principle is as follows[2]:

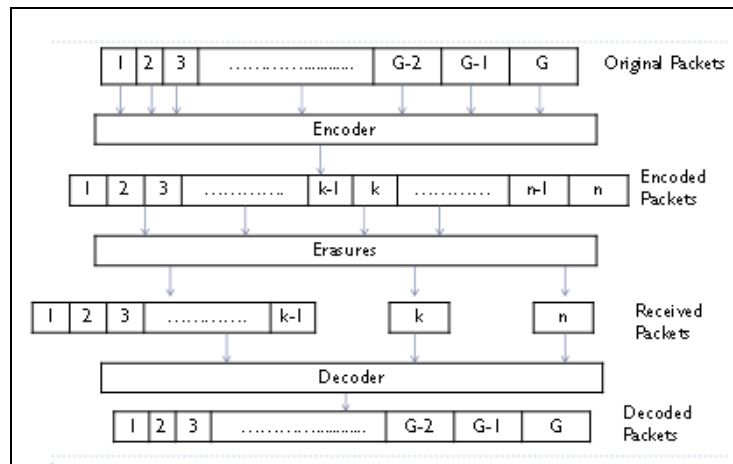


Figure 1: Working of Network Coding

3. Existing System

There are several thousands of applications that are available in iStore for interactive learning. But, these applications have various drawbacks.

- Case 1: Some of the applications have the user interaction with the system where the user has to navigate complex movements for data retrieval which acts as hinderance in the learning process.
- Case 2: Some other applications have easier navigational movements but they utilize very large share of the memory of the device, making it a burden on the system and results in poor performance.
- Case 3: Some applications which are both interactive and make use of efficient memory utilization but do not support the integration of multiple servers into a single application to access data which acts as a barrier in learning process.

Therefore the need of this paper is to design and develop an application that makes use of optimum or limited navigational movements from one screen to other with a very limited utilization of the memory of the device with good speed and accuracy and also incorporation of multiple servers at a time into the single application for effective interactive learning.

4. Proposed System

The main aim of the proposed system is to design and develop an application that is used for the interactive learning along with the effective delivery of services to the user.

The delivery of services includes

- Easy understanding of the application.
- Less number of page movements.
- Attractive User Interface Designs.
- Minimum Memory Utilization
- Faster Execution with Accuracy and Speed
- Effective Interaction of server with systems
- Synchronization of contents from different servers
- Interactive and user friendly editor that allows user to make notes, memoirs, draw images that can be saved and shared with friends over the internet.

- Incorporation of GPS into the application for utilizing location based services.

The developed product is able to synchronize different websites and servers into it and provide a good quality of service to the end-user without any delay or loss.

5. Implementation & Analysis

The proposed functionalities are implemented on the iOS Platform. The iOS Platform is selected for achieving the proposed system functionalities due to its user friendly user interface design kit that helps us in the testing the design architecture for its robustness, accuracy, consistency and learnability[10][13]. The development environment of iOS provides tools like X-Code, Simulator SDK and instruments that helps in building product.

The proposed functionalities are implemented using Objective-C and the compilers used are GCC for the Backend Code and LLVM GCC for Front end UI.

The application developed has four modules through which Proposed functionalities are achieved. The modules are as follows:

- News:
- Video Gallery
- Interactive editor
- Maps

The Process flow of the application is shown below

- **News:** The News module incorporates various connections to different websites to access the data. The data from different Web Servers are accessed and retrieved simultaneously by using Network Connection Delegates and Parser Delegate Methods. The News module is designed using the techniques of Network coding principle. It uses a multipoint-to-point architecture.
- **Video Gallery:** The Video Gallery is designed in a manner in which a connection is established to a website that is located on different server and integrating its contents onto the device with the creation of local host internally. The application place the video by synchronizing with the default video player provided on the iOS device by continuously feeding incoming packet from the server and caching into the playlist. The technique here is a POSIX Thread that is of a 8 byte size is used to achieve synchronization with the device and it is classified into three sections. The first two bytes acts as indicator, next five bytes contain the information and the last byte contains information about the next byte.
- **Centres:** This Module integrates the location based service into the application. The Geometer is used that takes the latitude and longitude of the device where it is located and based on these positioning are determined. The application is provided for 20 second time to accumulate the readings and to send to the server. Once this time stamp exceeds it is considered obsolete. When the user starts the application streaming of the maps starts with matching IP address of the device and co-ordinating between the Broadcast address with respect to the Network Interfaces.
- **Editor:** This module creates an interaction between the user and the system. The editor is designed with HD Quality where the user can Sketch images, Add colors to them ,can use different fonts and tools. Also, the Editor is incorporated with the Mail Composer that helps the user to share the sketches. UIPopOver Controller and INFCColorPicker Controllers are used to implement this.

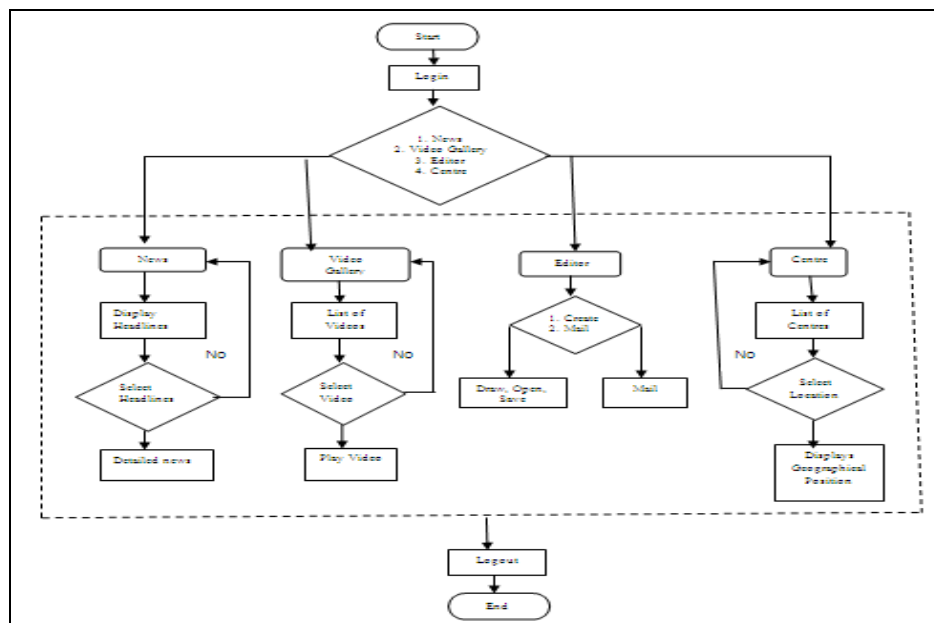


Figure 2: Process Flow Chart of the application

- Performance Analysis** The application was tested for the performance evaluation in two modes:
 - Testing the application for the load of it on the device, utilization of memory& execution
 - Testing the application for usability level & learning ability level.

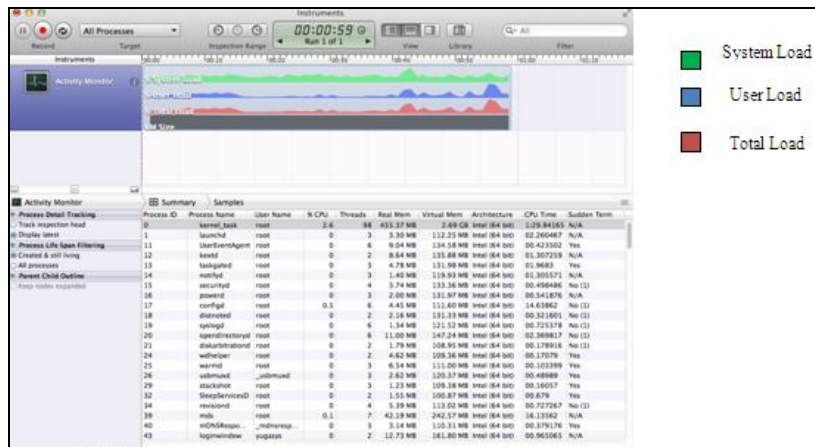


Figure 3: Memory Utilization, Speed and total load of the application

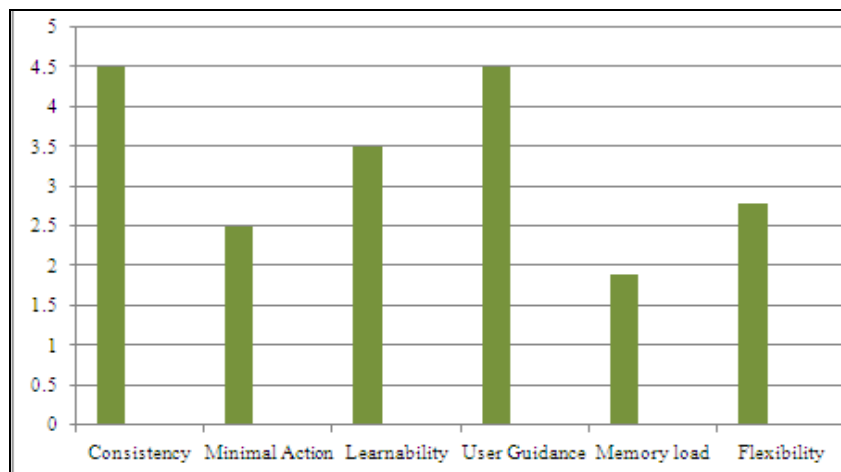


Figure 4: Results of the application w.r.t Six factors

The Application is tested for the factors to determine its level of learning ability and usability

- Consistency:** Consistency is achieved by designing all the pages of the application with the same display and background color. Here score of consistency of application is 4.3 which show that the application remains consistent in all the sections.
- Minimal Action:** The minimal action is achieved by designing application to work with less number of navigations and interactions from one page to any other required pages.
- Minimal Memory Load:** Any Mobile application should make use of very less memory space of the device and through the system testing it shows this application makes use of minimal memory.
- Flexibility& Learnability:** this factor indicates the user control over the application& ease of learning the subject and it was tested from learner’s point of view
- User Guidance:** This includes quality, feedback, errors and warnings which helps user. It was tested from learner’s point of view

6. Conclusion

Here, in this work a mobile application using two independent concepts like ARCS Design Methodology and Network Coding Principles has been proposed and it is developed on iOS Platform. The application developed first recognizes the limitations of the existing system and a new set of delivery of services is listed as the requirements that have to be met. Then the product is developed and tested on iOS Platform devices like iPhone & iPad respectively. The results show that the application satisfies the six factor test for UI design Principle and also system requirements like user load, faster execution have also been achieved(Fig 3 & Fig 4).

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