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THE FUNCTIONALITY OF A WEB BASED TUTORIAL MODEL

Japheth B. R[1], and Spencer Patience[2]
[1]Department of Mathematics/Computer Science, Niger Delta University, Yenagoa, Nigeria
[2]Department of Computer Science, Ignatius Ajuru University of Education, Port Harcourt, Nigeria
E-mail:jbunakiye@yahoo.com; Pakaye_kirime@yahoo.co.uk

ABSTRACT
In this paper, we present the architecture and describe the functionality of a Web-based tutorial model, which uses component codes for dynamic representation. Components are a type of hybrid rules that generates graphical data from the server side for the client side. The use of components as the functionality representation basis of a web based tutor results in a number of advantages. Part of the functionality of the system is controlled by using client-side code and a range of special objects, in tandem with generated pages. Apart from that, the system consists of four other components: the tutorial knowledge base, containing the structure of the domain and the educational content, the user component, which records information concerning the user, the interaction routes, which contain knowledge regarding the various request and submission decisions, and the query services unit that controls the functionality of the whole system.
Key Words: *Server-side script, Components, Internet Information Service, JavaScript*.

INTRODUCTION
Web-based system [6], is a system that can be accessed from anywhere in the world through the Web. The simple reason is they are applications or services that are resident on a server that is accessible using a Web browser. A Web-based learning system can therefore be considered as a client-server system which gives and receives education between the players through the Internet. Internet technology therefore, has made it possible in a way that results in much theories and methodologies for the development of online learning systems. All these methods somehow tend to deviate from conventional software development tasks, the reason being that the productive aspect of learning, which focuses on understanding rather than an activity that can be held directly could be involved [5]. Therefore, progress in Web-based learning will come only from a better understanding of the learning process and the fact that they are multi-functional systems which are integral to the user's experience.

The quality of interaction being represented in a web based learning system [7], determines its level of functionality, because for real learning to take place, interactivity content must be central at design time. In order to achieve learning, such content should be capable of facilitating quality of interaction. It is evident that more educational technologies are evolving, and students are becoming more independent from the teacher due to the paradigm shift from teaching to learning. It is therefore crucial that a web based learning system contains a functionality that triggers interactivity [3]. A learning system's functionality [11] encompasses issues of pedagogical knowledge support, time and cost reduction and availability of resources, and feedback that gives the student the response from the system.

Having considered a Web-based learning system as a client-server system, this paper focuses on the functionality of the learning model presented as components of cooperating programs, which culminate into division of processing and process management, an aspect that has been overlooked by researchers on web based learning systems. These components can facilitate allocation of tasks, and for interoperability and efficient processing of messages between clients and servers. Typical tasks include [5], the presentation code to maintain the graphical user interface, and to displays objects, monitors events, and responds to events. The validation code to ensure the consistency of the database and user inputs, controlled by validation logic often expressed as integrity rules that are stored in a database. Data access code to extract data to answer queries and modify a database. Data access code consists of SQL statements and translation code that is usually part of the DBMS. Since this functionality can allow a web page to query and update remote databases, this will help to improve student learning outcomes and make data-driven decisions [2]. The remainder of this paper is organized as follows. Section 2 gives an overview of Web-based learning development and the state of research while section 3 illustrates an example of design alternatives that supports functionality in such systems and outlines the development processes essential to web based learning. The next section describes the methodology that depicts functionality in evolutionary Web-based learning construction. The paper concludes with an implementation report as well some remarks on further work.

LITERATURE REVIEW

In examining research on the functionality of web based learning systems, this work is more focused on client–server architecture in which presentation, application processing, and data management functions are logically separated. Xiaofei Liu et al.'s research addresses design issues of combining the information model with the component model and how to define an appropriate interface between each component and subsystem to achieve interoperability [13].They noted that, a functional architecture defines components that make up an e-learning system and the objects that must be moved among these components. To achieve desired functionality, the system has to be a distributed one; their proposal divides the learning system into a content management system and a learning management to make the functional responsibility clearer and try to cover all the e-learning function components. Efficient exploitation of previous designs has been hampered by lack of a complete methodology to structure a clearly defined functionality component [12]. With a well-structured method to make new designs workable, the issue of functionality of web based learning systems could be greatly simplified. Jim et al. [9] provided a detailed study into the functionality of a tutorial architecture for knowledge representation. What was given is the use of neurules as the knowledge representation basis of the intelligent tutorial system (ITS). The system therefore comprises the structure of the domain content, the user modeling component, the pedagogical model, which encompasses knowledge regarding the various pedagogical decisions, and the supervisor unit that controls the functionality of the whole system.

Capturing the issue of guidance as the learner makes use of the learning tool is also a great interest. Teresa et al. [13], emphasized that a tutor should be able to help guide students through the course material, to generate dynamic quizzes which are appropriate for the student's knowledge, and to "prefetch" parts of the course to the client's site before they are explicitly requested. In this direction, new methods of accomplishing appropriateness of a web based system using adaptive hypertext techniques including adaptive navigation support and adaptive presentation were adopted [4].The main idea towards measuring system functionality is that the tutor suggests to the student which topics he should view, as well as determines the content of the page displayed. The tutor selects, from a question database constructed by the instructor, questions which cover the correct topics and are at the right level of difficulty. Anohina et al. [1] based their findings on the many benefits offered by distributed learning, such as increased accessibility and improvements in web based learning systems. Unlike the fixed resources in conventional computer based instruction (CBI), Web-based instruction can be conveniently modified and redistributed, readily accessed, and quickly linked to related sources of knowledge, thus establishing a backbone for "anytime, anywhere" learning [2]. Another approach was put forward by Jose et al. [10]. They did put forth a Web-based intelligent tutoring system, which recommend learning goals, and generate appropriate reading sequences.

Research in the field of online learning indicates that developmental approaches to such systems lack certain vital functional entities. Chang et al.'s research [4] identified the lack of two important considerations needed for implementing Web-based learning applications. They stated that the learning systems lack the integration of the user interface design with instructional design and as well lacks the development of the evaluation framework to improve the overall quality of Web-based learning support environments. In this paper, we are addressing such design issues with an integrated approach that spans through a one-tier architecture to a three-tier architecture, and properly streamlined to bring out the functionality of a web based learning system at the level of implementation.

Design Issues

This section gives details of the design of the functionality aspect of the implementable architecture. It also presents the clarification of the design descriptive prototype and the evaluation of alternative solutions for the system development.

Design Alternatives

There are four major alternatives that were deployed in designing and developing the system [6]. They include: (i) The Static Client Design (ii) The Dynamic Client Design (iii) The Client Component Design (iv) The server side Design.

The Static Client Design: This design as shown in figure 1 is based on one-tier architecture. In this case the lessons are prepared using simple web pages, one page or more per lesson. When the remote student makes a request the browser sends the page.

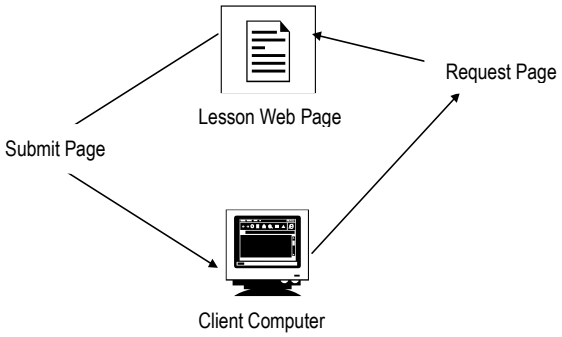

Figure 1: A One-tier Static Client Design

This method is quite simple and straight forward but assuming we have 1000 lessons the system need to make 1000 or more requests and we also need to create above 1000 different web pages**.** If we need to add more lessons we also need to create new pages. Web pages are static and this means that search cannot be made on the lessons except by an external search engine and interactivity and user computation is also lacking. Some Online tutors reviewed in chapter two used this method but it is grossly inefficient.

The Dynamic Client Design: This design method illustrated in figure 2 is also based on one-tier architecture but it inculcates client-side programming. Similarly the lessons are prepared using simple web pages, one page per lesson but in addition interactivity could be added using client side scripting languages. The scripts can make the web pages to be responsive to user interaction and to be dynamic. If a remote student makes a request the browser sends the page. The page script responds to other operational request made by the student. This reduces the number of pages that is actually needed in the development of the tutor. However the reduction is minimal since the lessons vary and their interaction may be only related to the lessons in question.

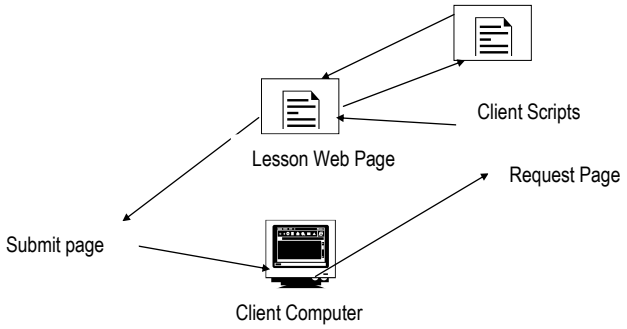

Figure 2: A One-tier Dynamic Client Design

This method has the setbacks of the first one, except the dynamic nature of the web pages. For each lesson a page or more must be created. If we need to add more lessons we also need to create new pages. However, in this method web pages are dynamic, user computation is available unlike the first case. The logic in the script is open, since all client side scripts are still open source hence users can have this proprietary scripts copied by unauthorized users. Vital information can be gotten from such scripts making security a very

big problem. This method does not permit much interactivity, and as such is inefficient and functionality is minimized.

The Client Component Design: This design method is still based on one-tier architecture also but it inculcates client-side components such as ActiveX Objects and Java Applets instead of simple client scripts. The logic in the Objects [12], are Closed, since the object are executable with binary or byte codes users can have their proprietary codes protected from unauthorized users. Vital information can hardly be gotten from such components making a security gain unlike the dynamic client script design. Like the second method the lessons are prepared using simple web pages, one addition interactivity could be added using components. The components can make the web pages to be responsive to user interaction and to be dynamic. The Component code responds to other operational request made by the student. See figure 3 below

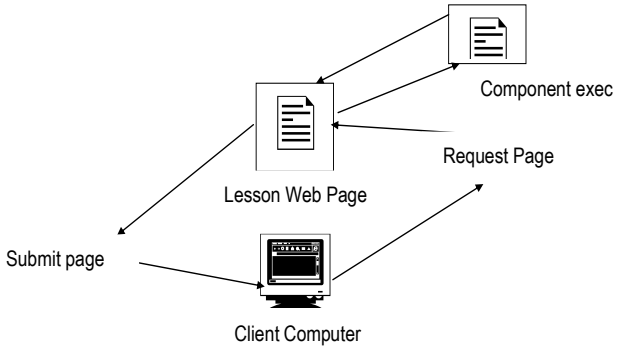

Figure 3: One-tier Component exec Client

The components are embedded into the web pages, and can contain malicious elements such as Trojan Horses, Viruses and Worms. These elements can cause destruction to the client machine. In the case of Java applet, Sun Microsystems restricted the component to the browser so that it will not have access to the client files. But this also creates another problem restricting the capability of the applet component. In the case of ActiveX components, it is allowed to have access to client system using a third party certificate authority and with the permission of the user. This tends to have solved the problem of malicious components, but hackers can pose as authentic components senders by faking the certificate authority of genuine companies. This is a major setback on this solution method. These method substitutes the risk of copying a proprietary script with the risk of allowing suspicious executable to run on the client which may have more destructive effect on the client. In lesson creation and addition this method remain similar to the second one, since if we need to add more lessons we also need to create new pages. This method is inefficient due to the risks and setbacks inherent in the system.

The Functionality Model

This approach to showcasing the functionality components that were capable of fostering interactivity in a web based learning system has two possible methods: (a) Server Side and (b) Server Side with Databases [11].

(a)The Server Side Only: This is a client server only methodology based on two-tier architecture where the tutor logic is defined and processed by the server side program. The lessons are prepared using simple web pages, one page or more per lesson but in addition interactivity could be added using the server side scripting languages. The server side scripts can make the web pages to be responsive to user interaction and to be dynamic. If a remote student makes a request the browser sends the page. The server script responds to other operational request made by the student. This makes the entire logic to be based only on the server. The logics in the script are not sent to the client rather the processed result in form of simple web page HTML are sent to the client. Hence proprietary codes are not available to unauthorized users. Vital information can be hidden and there are no security problems or risks resulting from sending components to client machine. The dynamism provided by the component code can also be handled by the server side program, making the system to still have the benefits accruing from such components. This method is good but inefficient due to bandwidth problem. These problems arise due to round-tripping between the web server and the client browser.

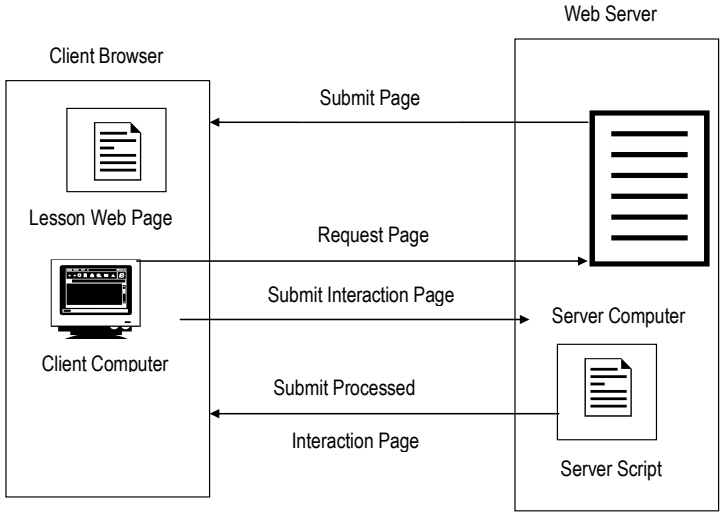

Figure 4: A two-tier Server Side Only Design

The round-tripping as illustrated in figure 4, involve the process of the student requesting a page and the server submitting one and then the student interacting with the page and the server processing the interaction and returning the processed result. Assuming there are 1000 pages and 5 interactions per page the server need to send 1000 pages at the request and 5000 processed interaction. Hence a total of 6000 pages are needed. This consumes large bandwidth and the cost of bandwidth is high. This method promotes functionality in a web based tutor but its utilization is not full because of its inefficiency in bandwidth management [8].

(b)The Server Side with databases: This is based on the three-tier architecture where the tutor logic is defined and processed by the server side program and the lessons are prepared and stored in server side database using a Database Server such as MySQL, MS

SQL server X, Postgre etc. Interactivity is also provided using the server side scripting languages. The server side scripts can make the web pages to be responsive to user interaction and to be dynamic. If a remote student makes a request the server uses a query to fetch the result and send to the browser. The server script responds to other operational request made by the student. The makes the entire logic to be based on the server and the database. The code in the server are not sent to the client rather the processed result in form of simple web page HTML are sent to the client. Hence proprietary codes are not available to unauthorized users. Vital information can be hidden and there are no security problems or risks resulting from sending components to client machine. The server side program provides dynamism, making the system to still have the benefits accruing from components use without the risks. This method is better than the client-server only method because it reduces the number of simple HTML pages needed to be created in the server. Only one set of pure HTML code is actually created as an output, the rest is a set of it and the logic that manipulates it before it can be send to the browser. The processing power required from the server could be less since some code are processed once and reused as the need arise. There is significant reduction on the size of content fetched in each trip to the server since many objects are sent once and the once lacking in the database are then sent at subsequent requests.

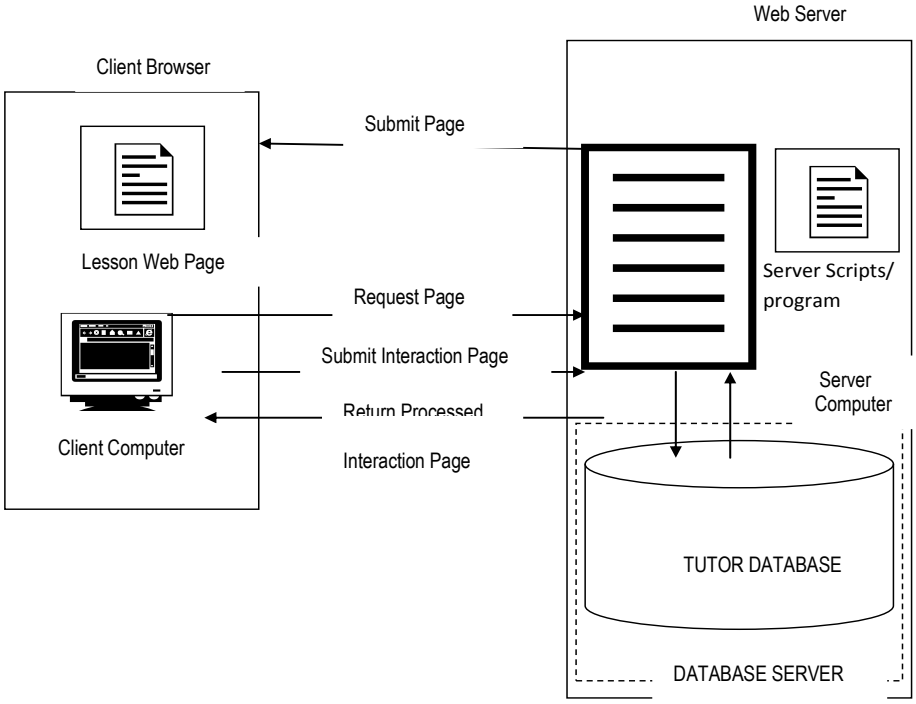

Figure 5: Three-tier Server Side with Database Server Design

Server Computer Client Computer Interaction Page

In figure 5, the server script communicates with the database server using SQL queries. The lessons stored in the databases are fetched and processed for sending to the browser. Instead of sending everything as it is the case in the two-tier architecture, only the lessons

requested are sent reducing the bandwidth used by the system. This method actually gives a combined functionality model that provides the tutorial system with flexibility, interactivity, and feedback capabilities.

Implementation

In this paper, the functionality architecture and the evaluation method are implemented in a new support system, a combination of Internet Information Service server and Apache web server that have both PHP and MySQL in their configuration to test the system. The system was able to fetch data from the database to populate the web page using the lesson hyperlink and the answer hyperlink. The search hyperlink also uses the search term to search the database and to produce correct results which are also displayed on the web page. The lesson was followed in the normal way an online user is expected to follow it using the appropriate link. The system use the user interface to display all the result of its operation instead of keeping specific HTML file or Link as a given result or link to a given click event. This makes the system to manage the content of the tutorial system dynamically.

In the interactive section of the program, as shown in figure 6, the implementation was done using the client side scripting language JavaScript. The script run on the client and was able to respond directly to math operations required by the user.

Figure 6: Interactive Operations

The home program file shown in figure 7 is then processed by the PHP server engine and the result returned to the client machine as simple HTML code. This code is then rendered by the client browser and viewed by the student using the online tutor as a simple web page. In the interactivity, the PHP server engine process the code and send the forms for the math operations to the client browser as illustrated in our design in figure 5. The user fills the forms and clicks an operation, Add for instance, the system uses the post method of the form to send the inputs to the client script for processing instead of sending it to the server.

Figure 7: Home Program File

Figure 8 shows a typical add function operation. In the Add function of the JavaScript file ***fact*** used in the implementation, the code clearly show the operation on the client side. The cmdAdd() has no parameter passed to it but it was called by the on click method of the page form. When the call is made function is executed.

function cmdAdd()

```
{
        a = document.mathint.numl.value;
        b = document.mathint.num2.value;
        e = new Number(a);
        f = new Number(b);
        c = e+f;
        alert( a +' + ' + b + ' Answer =' + c);
}
```

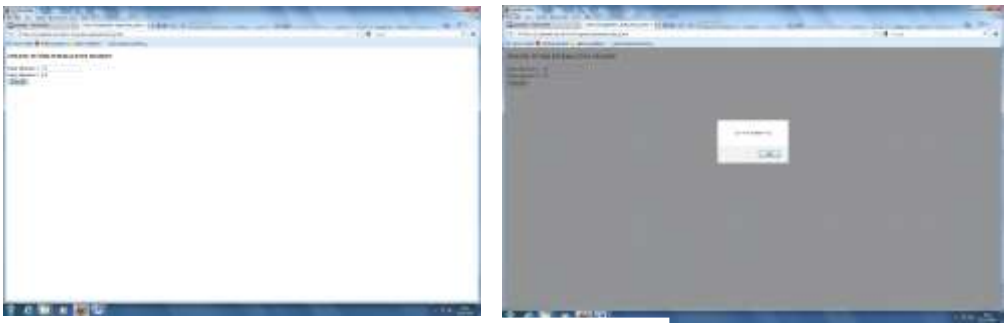

Figure 8: Typical Add Function Operation

In the function, the form text box variable value in numl and num2 are sent as string objects to mathint and the function uses the document method to invoke the value as document.mathint.numl.value; and then assign them to a and b the new method is used to create a new instance of a and b which we assign to e and f we now use e and **f** to form add (e+f) and return the value using an alert statement. This is also done for other maths operations by creating new functions each for the operations. The detail of the code and the result of the operations are shown in the appendix of the project.

CONCLUSION AND RECOMMENDATION

In this paper, the issue of functionality of online tutors was addressed. A review was done on other similar methods. We also looked at the salient areas of improvement. This we found in areas of technology used, the design implemented in the system process and the architecture used in the implementation of the system. This made us to look at various design alternatives that can be deployed in the development of the system. In each design case we looked at the benefit and the pitfalls of their implementation. Finally we designed

our own system that combined features of the dynamic client (one-tier) and the three-tier alternative design techniques to bring out the functionality metrics of a web based tutor. Our future work is directed to the use of AI methods to achieve learner communication along a distributed platform.

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