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Reverse Engineering Web Pages For User-Centric Ubiquitous Learning

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ABSTRACT

The researcher had leveraged on the technological and social affordances of mobile phones in Nigeria and the reverse engineering of application software to enhance users education and learning by developing a user-centric ulearning model. This paper described the research experiences of designing a model of user interface adaptation to the individual user's situation. The author identified that migrating the user interface of a ubiquitous mobile learning system to another device is problematic because many programming languags, markup scritping languages aqnd computing platforms exist for different user interfaces and that each one of these also has its own set of constraints. Using the techniques of reverse engineering, the researcher obtained a presentation model of a ulearning system and renders same according to the individual user's situation.

Keywords: *Situational learning, static analysis, reverse engineering, user modeling*

1. INTRODUCTION

A ubiquitous mobile learning system enables learner takes advantage of the learning opportunities offered by mobile technologies, decreases limitation of learning location with the mobility of general portable devices, focuses on the mobility of the learner, interaction with portable technologies and is accessible from virtually anywhere, portable, collaborative; sharing is almost instantaneous among everyone using the same content. Users are also expected to time-slice through space. One major problem that has continuously plauged this system however is the lack of adaptivity to the individual user as different devices has different presentation models for the different user interfaces [1].

A ubiquitous learning environment is any setting in which students can become totally immersed in the learning process. It is a pervasive learning system where learning is happening all around the student but the student may not even be conscious of the learning process. Source data is present in the embedded objects and students do not have to do anything in order to learn [2].

This paper described a model of user interface adaptation to the individual user's situation in a ulearning system. The motivation for this work came from a similar research by [3] and the believe that a user-centred model is significant because migrating the user interface of a ubiquitous mobile learning system to another device is problematic since different many programming paradigms, markup scritping platforms and computing environments exist for different user interfaces. In addition, each one of these also has its own set of constraints.

2. REVIEW OF RELATED WORK

Ubiquitous user modelling (UbiqUM) describes ongoing modeling and exploitation of user behaviour with a variety of systems that share their user models. These shared user models can either be used for mutual or for individual adaptation goals. UbiqUM differs from generic user modelling by three additional concepts: ongoing modeling, ongoing sharing and ongoing exploitation. Systems that share their user models will improve the coverage, the level of detail, and the reliability of the integrated user models and thus allow better functions of adaptation. UbiqUM implies new challenges of interchangeability, scalability, scrutability and privacy [4].

Bomsdorf (2005) believed that ubiquitous learning is supported by ubiquitous computing and represents the next step in the field of e-learning. The goal is, that learning environments will be accessed increasingly in various contexts and situations. From this challenge, new questions arise concerning the adaptation of learning spaces to different contexts of use, so that they continue to enable and support learning processes. Her research paper introduced a first notion of a comprehensive definition of plasticity of digital learning spaces. It exemplified some of the facets affecting the plasticity and presented aspects of a first system prototype, which enabled to select learning materials depending on a given situation [5].

Zhao et al., (2010) discussed the issues on application of uLearning environment. Based on the research questions, they proposed an adaptive content delivery model for u-Learning environment, which may get original contents from e-learning system and recommend adaptive contents according to learning context awareness: device feature, learner's preferences. The adapted contents are created according to learning context awareness. The evaluation showed that the learners may get a better learning experience on the AubiLearn developed based on the adaptation content delivery mode. The specific research question concerning "types of contextual information and sources" using in u-Learning environment represented the

first and main open issue in future. It is still challenging works to define/reason different context (physical context, time context, learner context, resources context) and describe the learning environment (capabilities of ubiquitous device, characteristics network and learner) during mobility [6].

An approach to reduce the effort of building suitable user models and to ease the administration of cross-application data management was produced by Korth & Plumbaum, (2007). The authors introduced a centralized sophisticated multi-application user modeling and profile management framework with an integrated central identity management, called user modeling and personalization framework (UMP). The UMP enabled applications to collect and organize their data and extend their user knowledge through data inferences. The data was collected on one central server and the applications could share data among each other. Ubiquitous user models, which were the backbone for understanding the users' interests and demands were built by the UMP based on the data collected in different profiles. Also, adaptive software facilitated interaction for the user, e.g. by highlighting important functionality or omitting unnecessary information , based on the computed user models [7].

Muller & Wittig (2003) showed how to exploit raw speech data togain higher level information about the user in a mobile context. They introduced an approach for the estimation of age and gender using well known machine learning techniques and classified the relevant speech features into three levels of abstraction each implying their own characteristics with regard to extraction costs and expressiveness. The researchers introduced the architecture of the M3I project, which coped with the limited resources of the mobile scenario by distributing services between mobiles devices and a server. The age and gender estimation component that was described in their publication was integrated into this architecture. Application scenarios within the M3I included a mobile pedestrian navigation system with a multi-modal interface. Such an application benefited from the advanced user modeling by the facility adapting the interface with regard to the special needs of a particular user group and the improved speech recognition quality using specific acoustic models [8].

A complete framework to realize the newly defined concept of ubiquitous user modeling was developed by Heckmann, (2005). The researcher developed a set of tools that covered methods for the uniform exchange and the semantic integration of partial user models. They also accounted for the extended needs for privacy and the right of every human for introspection and control of their collected data. A multilevel conflict resolution method, which handles the problem of contradictory statements, was implemented together with a web-based user model service, such that the road capability and the scalability can be proven with this approach [9].

3. MATERIALS AND METHODS

A software reverse engineering methodology based on questions, information selection, and transformation alternatives was deployed in this research work. This methodology recovers the presentation model of the individual web pages in a ubiquitou learning system using some mapping rules between the scripts or tags and presentation elements.

The API for the resulting ubiquitous system were of two folds; the client programming tool and the server programming tool. A version of Java for mobile devices; the Java Micro edition (J2ME); was deployed for the client side programming. The J2ME contains a specialized Java interpreter for devices with limited memory; the K Virtual Machine (KVM) and the programming interface for wireless applications is the Connected Limited Device Configuration (CLDC) [10]. The Mobile Information Device Profile (MIDP) provides support for a graphical interface, networking and storage.

The mobile learning application server side programming was done using Java servlet, a Java technology for creating server side application in response to client requests. Widely used for Web processing, servlets are designed to handle HTTP requests (get, post, etc.) and are the standard Java replacement for a variety of other methods, including CGI scripts, Active Server Pages (ASPs) and proprietary C/C++ plug-ins for specific Web servers (ISAPI, NSAPI) [11]. Because they are written in Java, servlets are portable between servers and operating systems. The servlet programming interface (Java Servlet API) is a standard part of the J2EE platform.

The MYSQL, a very popular open source, relational DBMS for both Web and embedded applications from MySQL AB, Uppsala, Sweden, was deployed as the database tool [12]. Our choice of this tool was hinged on its provision of support for applications written in PHP, Perl, Python, Ruby, Java, C/C++, C# and Visual Basic- the development tools for mobile system.

4. RESULT DISCUSSION AND CONCLUSION

The author had described a reverse engineering process in this work using the static analysis paradigm. This paradigm is applied to the HTML elements from the source model of a learning content web page and then map these tags into elements of a presentation model (Fig. 1). The static analysis was applied to a uLearning content written in hypertex tag or any mobile programming paradigm and it simply involves scanning the tags or code elements to

understand them based on certain rendering criteria and filtering criteria specified by the page authors.

With the mobile content as the source model, a presentation model resulting from the reverse engineering process is the target model. This is a representation of all the web application's static and dynamic tokens presented to the user by the interface. This is rendered according to the users ubiquitous situation, therebye adapting the learning content to the user's situation.

This work leveraged on the technological and social affordances of mobile phones in Nigeria and the reverse engineering of application software to enhance users education and learning by developing a user-centric ulearning model. The work acknowledge that the ubiquitous content interactivity was programmed in different complex paradigms, Scripts, PHP, CGI, Java, etc; giving rise to a need to adjust to students changing circumstances. Therefore there is the need to see how the presentation model of a web page (learning system) can be adapted to the learners individual situations.

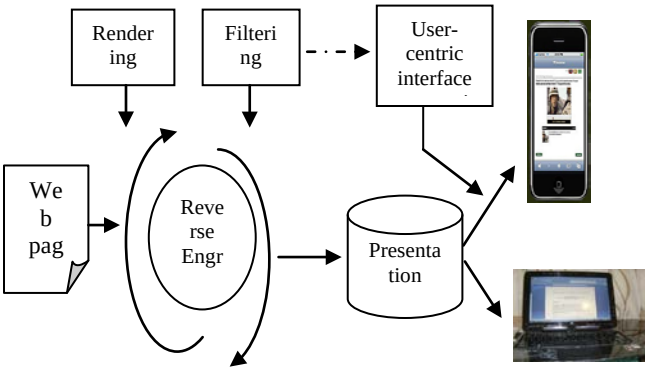

Fig 1: The user-centric ubiquitous learning model

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$$C = \{S_1, S_2, S_3, S_4\} \quad (1.1)$$