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Efthimios Alepis
Maria Virvou

Object-Oriented User Interfaces for Personalized Mobile Learning

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Foreword

Efthimios Alepis and Maria Virvou have investigated two recent related areas that attracted the attention of the scientific community, namely mobile learning and interfaces. The motivation arose from the fact that, when integrating these technologies, we obtain personalized educational software that meets the prerequisites of modern mobile learning software that has become very popular worldwide in recent years. These two technologies have made significant advances recently and have become hot disciplines with increasing research projects around the world in both academia and industry.

Demand for mobile learning is growing at a remarkable rate; however, there seems to be a shortfall in software development to meet this fast-growing demand and associated challenges.

This book is a significant addition to this field and an excellent effort to address these challenges and trends. The authors employ an interesting approach that utilizes the Object-Oriented (OO) method in order to find answers for these issues and difficulties. They chose to follow the object-oriented scheme so as to embrace the basic concepts and traits in order to offer a very flexible, vigorous, and extendable structure for the devised framework.

Specifically, in the book, the authors develop a broad paradigm built using the OO approach. I found that each chapter concentrates on the structure of a particular section of the paradigm; however, it puts all of these together in a nice way.

I believe that the authors have done a good job at addressing the tackled issues. I consider the book a good addition to the areas of mobile learning and user interfaces. It definitely will help software developers to build better state-of-the-art personalized software aiming at mobile education, while maintaining a high level of adaptivity and user-friendliness within individualized-mobile interfaces.

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Prof. Mohammad S. Obaidat

Preface

This book covers two very important and quite recent scientific fields, namely that of mobile learning and the other, advanced user interfaces. These two scientific fields' successful combination can result in personalized educational software that meets the requirements of state-of-the-art mobile learning software. Both mobile learning and user-personalized interfaces have grown over the last decade from minor research fields to a large set of significant projects in universities, schools, workplaces, museums, and cities around the world. According to a report in 2013, "the market for Mobile Learning products and services has been growing at a five-year compounded annual growth rate of more than 25 %." Benefits by using and/or incorporating these technologies in software engineering include social, economic, and educational gains. However, the swift growth of new software technologies and their corresponding services keeps in pace with new challenges in these scientific fields. As a result, new approaches try to resolve the resulting problems and at the same time give more potential and robustness to the next generation of software applications.

In this book, the authors try to provide a framework that is capable of incorporating the aforementioned software technologies, exploiting a wide range of their current advances and additionally investigates ways to go even further by providing potential solutions to future challenges. Our proposed approach uses the well-known Object-Oriented method in order to address these challenges. By using the OO approach, we adopt its fundamental concepts and features for the purposes of providing a highly adjustable, dynamic, and extendable architecture for our proposed framework. Throughout this book, a general model is constructed using Object-Oriented Architecture. Each chapter focuses on the construction of a specific part of this model, while in the conclusion these parts are unified. We believe that this book will help software engineers build more sophisticated personalized software that targets in mobile education, while at the same time retaining a high level of adaptivity and user-friendliness within human-mobile interaction.

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Chapter 1

Introduction

Abstract In the first chapter of this book the authors present a short introduction on the scientific topics that are covered. To this end, this chapter includes introductory sections for the scientific fields of mobile education, multimodal mobile interfaces and the Object Oriented paradigm which, to a large extent, is followed throughout this book. Both mobile education and mobile multimodal user interfaces are quite recent and are rapidly growing fields in the broader areas of information technology. Their use is expected to grow at a serious rate in the foreseeable future, not only by technical, but also by software means of evolution. The introductory chapter also reveals the authors' motives for writing a book in the aforementioned domains while the rest of the book covers Object Oriented mobile projects, coupled by software evaluations and empirical studies.

1.1 Mobile Education

Over the last decade, both educators and educational institutions have recognized the importance of distance learning educational software. Some important assets of distance learning applications include platform, hardware and facilities independence and also the actual facility offered to students as distant learners of learning something at any time and at any place, away from the settings of a real classroom. In many situations this means that learning may take place at home or some other site, supervised remotely, synchronously or asynchronously, by human instructors as educators. In these cases the interaction is achieved between humans and computers through computer assisted learning or e-learning.

However, there are many cases where it would be extremely useful to have such facilities in portable handheld devices, rather than desktop or laptop computers so that users could use the educational software on a device that they can carry anywhere they go. Handheld devices may render the software usable on every occasion, even when people are waiting in a queue or even moving rather than when they are sitting on a chair inside their office. However, among handheld

devices, which include palm or pocket PCs and mobile phones, mobile phones provide the additional very important asset of computer-device independence for users. Unlike mobile phones, palm-top PCs have to be bought by a person for the special purposes of computer use. On the other hand, mobile phones are very widespread devices, which are primarily used for human–human communication purposes. However, a large number of mobile devices can also be used as computers. Thus, prospective users of handheld devices are not required to spend money for extra computer equipment since they can use their mobile phone, which they would buy and carry with them anyway. In this sense, using the mobile phone as a handheld computer is a very cost-effective solution that provides many assets. Two of the most important assets are users' device independence as well as independence with respect to time and place in comparison with web-based or desktop-based education using standard PCs. Indeed, there are situations where both students and instructors could benefit by using their spare time constructively to complete homework exercises and electronic lesson authoring respectively in situations where no computer may be available. Such situations may occur in taxis, public buses and coaches while commuting, in long queues while waiting or more generally in situations where unexpected spare time comes up. In the fast pace of modern life where time is precious such situations can be very frequent. Mobile technology in general can provide services to most computer-based applications including educational applications. Mobile features can be of great assistance to educational procedures since they offer mobility to students and/or teachers.

In view of these compelling needs, the research work described in this book has dealt partially with the problem of enriching existing educational software technology with mobile aspects. In particular, in this chapter we focus on the incorporation of mobile educating and authoring tools into the field of Intelligent Tutoring Systems (ITSs). The work that is described in this chapter also resulted in the development of an authoring tool prototype that can generate ITSs of multiple domains. This authoring tool is called Mobile Author (Virvou and Alepis 2005). Mobile Author allows instructors to create and administer data-bases concerning characteristics of students, of the domain to be taught and of tests and homework. The creation and administration of these data-bases can be carried out through a user-friendly interface from any computer or mobile phone. In this way the creation of mobile ITSs is facilitated enormously and a high degree of reusability is ensured.

Authoring tools in general are meant to be used by human instructors (prospective e-learning authors) to build intelligent computerized tutors in a wide range of domains, including customer service, mathematics, equipment maintenance, and public policy; these tutors have been targeted toward a wide range of students, from grade school children to corporate trainees (Murray 1999). More specifically, authoring tools that specialize in ITSs aim at providing environments for cost-effective development of tutoring systems that can be intelligent and adaptive to individual students. The main goal of ITSs, as compared to other educational technologies, is to provide highly individualized guidance to students.

It is simple logic whose response, individualized to a particular student, must be based on some information about that student; in ITS technology this realization led to learner modeling, which became a core or even defining issue for the field (Cumming and McDougall 2000).

Similarly, in the resulting tutoring applications, students can answer test questions and can read parts of the theory from any computer or mobile phone. The underlying reasoning of the tutoring systems is based on the student modeling component of the resulting educational applications. The student modeling component monitors the students' actions while they use the educational system and tries to diagnose possible problems, recognize goals, record permanent habits and errors that are made repeatedly. The inferences made by the system concerning the students' characteristics are recorded in their student model that is used by the system to offer advice adapted to the needs of individual students. Moreover, the students' characteristics can be accessed by human instructors who may wish to see their students' progress and educational skills.

Despite the fact that computer-based mobile technology is quite recent, it is growing very rapidly and there have already been quite a few research attempts that aim at the incorporation of mobile features in education. As an example, Ketamo (2003) has developed an adaptive geometry game for handheld devices. Another approach is described in the system called KleOS (Vavoula and Sharples 2002). This system allows users to organize and manage their learning experiences and resources as a visual timeline in both desktop computers and mobile devices. An interesting application of mobile services in computer assisted education is the proposal of Wang et al. (2003). This proposal consists of three kinds of information awareness mechanisms using mobile devices to assist students in promoting their learning performances. Aiming at providing a more generalized framework, Leung and Chan (2003) introduce a framework of mobile learning that consists of mobile learning applications, mobile user infrastructure, mobile protocols and mobile network infrastructure. A common issue in all of the above systems is the fact that these systems aim primarily at assisting students in their learning process. However, there is also one important part of the educational process which refers to that part that teachers are involved in the educational processes and deals with creating and managing their courses and/or related educational material. Looking at this view, of computer assisted education, there are noticeable fewer attempts so far. For example (Chan et al. 2003) have made an attempt to address this issue. Their system aims at assisting teachers to create and manage their computer-based lessons.

In any case, it remains to be investigated quite thoroughly what the extent of the appreciation of these mobile features is within the educational community. Mobile features show a great potential to provide time, place and computer-equipment independence. On the other hand, mobile phones have more restricted interaction channels with users due to the limited space of memory capacity of the devices. This may not be a problem for simple uses of mobile phones but it may be a problem for the mobile use of more sophisticated computer-based applications such as educational applications. In view of these, in this book we also focus on