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Editors

SMART INNOVATION, SYSTEMS AND TECHNOLOGIES ■ 2

Multimedia Services in Intelligent Environments

Software Development Challenges and Solutions

Springer

Multimedia Services in Intelligent Environments – Software Development Challenges and Solutions

Smart Innovation, Systems and Technologies 2

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Foreword

KES International (KES) is a worldwide organisation that provides a professional community and association for researchers, originally in the discipline of Knowledge Based and Intelligent Engineering Systems, but now extending into other related areas. Through this, KES provides its members with opportunities for publication and beneficial interaction.

The focus of KES is research and technology transfer in the area of Intelligent Systems, i.e. computer-based software systems that operate in a manner analogous to the human brain, in order to perform advanced tasks. Recently KES has started to extend its area of interest to encompass the contribution that intelligent systems can make to sustainability and renewable energy, and also the knowledge transfer, innovation and enterprise agenda.

Involving several thousand researchers, managers and engineers drawn from universities and companies world-wide, KES is in an excellent position to facilitate international research co-operation and generate synergy in the area of artificial intelligence applied to real-world 'Smart' systems and the underlying related theory.

The KES annual conference covers a broad spectrum of intelligent systems topics and attracts several hundred delegates from a range of countries round the world. KES also organises symposia on specific technical topics, for example, Agent and Multi Agent Systems, Intelligent Decision Technologies, Intelligent Interactive Multimedia Systems and Services, Sustainability in Energy and Buildings and Innovations through Knowledge Transfer. KES is responsible for two peer-reviewed journals, the International Journal of Knowledge based and Intelligent Engineering Systems, and Intelligent Decision Technologies: an International Journal.

KES supports a number of book series in partnership with major scientific publishers.

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The series covers systems that employ knowledge and intelligence in a broad sense. Its focus is systems having embedded knowledge and intelligence, which may be applied to the solution of world industrial, economic and environmental problems and the knowledge-transfer methodologies employed to make this happen effectively. The combination of intelligent systems tools and a broad range of applications introduces a need for a synergy of scientific and technological disciplines.

Examples of applicable areas to be covered by the series include intelligent decision support, smart robotics and mechatronics, knowledge engineering, intelligent multi-media, intelligent product design, intelligent medical systems, smart industrial products, smart alternative energy systems, and underpinning areas such as smart systems theory and practice, knowledge transfer, innovation and enterprise.

The series includes conference proceedings, edited collections, monographs, handbooks, reference books, and other relevant types of book in areas of science and technology where smart systems and technologies can offer innovative solutions.

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Editors

George A. Tsihrintzis received the Diploma of Electrical Engineer from the National Technical University of Athens, Greece (with honors) and the M.Sc. and Ph.D. degrees in Electrical Engineering from Northeastern University, Boston, Massachusetts, USA. He is currently a Professor in the Department of Informatics, The University of Piraeus, Greece. His current research interests include Pattern Recognition, Decision Theory, and Statistical Signal Processing and their applications in Multimedia Services, User Modeling, Intelligent Software Systems, Human-Computer Interaction and Information Retrieval. He has authored or co-authored over 200 research articles in these areas, which have appeared in international journals, book chapters, and conference proceedings, and has served as the principal investigator or co-investigator in several R\&D projects. He is the sole author of a book on *Image Analysis* (in Greek) and co-author of a book on *Principles and Applications of Signals and Systems* (in Greek) and an upcoming book on *Visual Affect Recognition* (IOS Press, 2010). He has served as a member of Program Committees and/or reviewer of International journals and conferences. He was the founding general and program co-chair of the **2008 International Symposium on Intelligent Interactive Multimedia Systems and Services (KES-IIMSS 2008)**, organized jointly by the Department of Informatics of the University of Piraeus and KES International. He was the honorary co-chair of the **2009 International Symposium on Intelligent Interactive Multimedia Systems and Services (KES-IIMSS 2009)**, Venice, Italy, July 16–17, 2009. He is the general and program co-chair of the **2010 International Joint Conference on e-Business and Telecommunications (ICETE 2010)**, Piraeus, Greece, July 26-28, 2010. He is the founding general co-chair of the **2010 International Multi-Conference on Innovative Developments in Information Communication Technologies (INNOV 2010)**, Piraeus, Greece, July 29-31, 2010. He is the general and program co-chair of the **2010 International Symposium on Intelligent Interactive Multimedia Systems and Services (KES-IIMSS 2010)**, Baltimore, USA, July 28-30, 2010. He has co-edited the following books: (1) *Multimedia Services in Intelligent Environments - Advanced Tools and Methodologies*, volume 120 in Studies in Computational Intelligence (SCI) Book Series, Springer 2008, (2) *Computational Intelligence Paradigms - Innovative Applications*, volume 137 in Studies in Computational Intelligence (SCI) Book Series, Springer 2008, (3) *New Directions in Intelligent Interactive Multimedia*, volume 142 in Studies in Computational Intelligence (SCI)

Book Series, Springer 2008, (4) *Multimedia Services in Intelligent Environments - Software Development Challenges and Solutions*, in Studies in Computational Intelligence (SCI) Book Series, Springer 2010, and (5) *Multimedia Services in Intelligent Environments - Integrated Systems*, in Studies in Computational Intelligence (SCI) Book Series, Springer 2010. He was a guest co-editor of the special issue on "Intelligent Modelling and Data Analysis Techniques" of the *International Journal of Intelligent Defence Support Systems* (Inderscience, 2009). He was a guest co-editor of the special issues on "Knowledge-based Modes of Human-Computer Interaction" and "Knowledge-based Environments and Services in Human-Computer Interaction" of the *Intelligent Decision Technologies Journal* (IOS Press, 2010). He won the Best Poster Paper Award of the 5th International Conference on Information Technology: New Generations, Las Vegas, USA, April 7-9, 2008, for co-authoring a paper titled: "Evaluation of a Middleware System for Accessing Digital Music Libraries in Mobile Services." He also won one of the Best Applications Papers Award of the 29th Annual International Conference of the British Computer Society Specialist Group on Artificial Intelligence, Cambridge, UK, December 15-17, 2009, for co-authoring a paper titled: "On Assisting a Visual-Facial Affect Recognition System with Keyboard-Stroke Pattern Information." He can be reached at geoatsi@unipi.gr.

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the general and program co-chair of the **2010 International Conference on Software and Data Technologies (ICSOFT 2010)**, Piraeus, Greece, July 22-24, 2010. She is the founding general co-chair of the **2010 International Multi-Conference on Innovative Developments in Information Communication Technologies (INNOV 2010)**, Piraeus, Greece, July 29-31, 2010. She is the general and program co-chair of the **2010 International Symposium on Intelligent Interactive Multimedia Systems and Services (KES-IIMSS 2010)**, Baltimore, USA, July 28-30, 2010. She is a co-editor of the following volumes in the Studies in Computational Intelligence (SCI) Book Series, Springer: (1) vol. 104: *Intelligent Interactive Systems in Knowledge-based Environments* 2008, (2) vol. 137: *Computational Intelligence Paradigms-Innovative Applications*, 2008, (3) vol. 142: *New Directions in Intelligent Interactive Multimedia*, 2008, and (4) *Multimedia Services in Intelligent Environments - Software Development Challenges and Solutions*, 2010. She was a guest co-editor of the special issues on "Knowledge-based Modes of Human-Computer Interaction" and "Knowledge-based Environments and Services in Human-Computer Interaction" of the *Intelligent Decision Technologies Journal* (IOS Press, 2010). She won one of the Best Applications Papers Award of the 29th Annual International Conference of the British Computer Society Specialist Group on Artificial Intelligence, Cambridge, UK, December 15-17, 2009, for co-authoring a paper titled: "On Assisting a Visual-Facial Affect Recognition System with Keyboard-Stroke Pattern Information." Her research interests are in the areas of web-based information systems, knowledge-based human-computer interaction, personalization systems, software engineering, e-learning, e-services and m-services. She can be reached at mvirvou@unipi.gr.

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Preface

Multimedia services are widely used by humans in their daily lives. Society is increasingly demanding convenient access to the wealth of information that is available, in a friendly environment.

This book is a continuation of previous volumes providing various perspectives on multimedia services in intelligent environments [1-3].

It includes eleven chapters on various aspects of the challenges encountered when developing multimedia services and related solutions, such as software life-cycle framework, distributed multimedia data management, monitoring and tracing techniques, ontological software architectures, quality engineering of services, pervasive computing and context-aware services, host discovery, swarm intelligence, intelligent system behaviour under risk, and cindynics.

Each chapter in the book was reviewed by two independent reviewers for quality, novelty and clarity of the research presented in it. We are grateful to the authors and the reviewers for their excellent contributions and visionary ideas. This research book is directed to professors, researchers, application engineers and students of all disciplines.

We wish to express our appreciation to the KES Community for supporting KES International and taking part in the events related to their areas of interests. Thanks are due to Springer-Verlag for their excellent support to KES international.

George A. Tsihrintzis, Greece
Maria Virvou, Greece
Lakhmi C. Jain, Australia

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Chapter 1

Advances in Multimedia Services in Intelligent Environments – Software Development Challenges and Solutions

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1 Introduction

Multimedia services is the term chosen to describe services which rely on the coordinated and secure storage, processing, transmission, and retrieval of information which exists in various forms [1]. The term refers to the several levels of data processing. It includes application areas, such as digital libraries, e-learning, e-government, e-commerce, e-entertainment, e-health, and e-legal services. In our earlier book [2], we covered aspects of low level data processing of multimedia services in intelligent environments, including storage, recognition, classification, transmission, retrieval, and securing of information. Four additional chapters in [2] considered systems developed to support intermediate level multimedia processing services. These included noise and hearing monitoring, and measurement, augmented reality, and automated lecture rooms. In addition rights management and licensing were included. The final chapter in [2] was devoted to a high-level intelligent recommender service in scientific digital libraries.

The book at hand presents various software development challenges and related solutions that are faced when attempting to accommodate multimedia services in intelligent environments. In addition to this chapter, the present book includes ten additional chapters. Chapters 2 to 8, cover various aspects of the challenges encountered when developing multimedia services and related solutions. Specifically, Chapter 2 by Savvopoulos and Virvou is on "Evaluating the generality of a life-cycle framework for incorporating clustering algorithms in adaptive systems." Chapter 3 is by Chatterjee, Sadjadi and Shu-Ching Chen and deals with "A Distributed Multimedia Data Management over the Grid." Chapter 4 is authored by Pirzadeh and Hamou-Lhadj and covers "A View of Monitoring and Tracing Techniques and their Application to Service-based Environments." Chapter 5 by Bucci, Sandrucci, and Vicario is devoted to "An ontological SW architecture supporting the contribution and retrieval of Service and Process models." Chapter 6 by D'Ambrogio deals with "Model-driven Quality Engineering of Service-based Systems." Chapter 7 by Katsiri, Serrano, and Serat

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deals with "Application of Logic Models for Pervasive Computing Environments and Context-Aware Services Support." Chapter 8 by Patsakis and Alexandris covers "Intelligent Host Discovery from malicious software."

The final three chapters consider new theoretical results, development methodologies and tools which hold promise to be useful in the development of future systems supporting multimedia services in intelligent environments. Specifically, Chapter 9 by Fountas deals with "Swarm Intelligence: The Ant Paradigm," while Chapter 10 by Artikis deals with "Formulating Discrete Geometric Random Sums for Facilitating Intelligent Behaviour of a Complex System under a condition of Major Risk." Finally, Chapter 11 by Artikis deals with "Incorporating a Discrete Renewal Random Sum in Computational Intelligence and Cindynics."

2 Conclusions

As multimedia services for intelligent environments become increasingly more demanding, new challenges appear which require even more sophisticated tools, development methodologies, and systems to solve them. Coincidently, the application areas of multimedia services continue to expand at a very high rate. As a result, the entire field of multimedia services in intelligent environments cannot effectively be covered in one or two volumes. It may be expected that future volumes on other aspects of multimedia services in intelligent environments will continue to appear.

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Chapter 2

Evaluating the Generality of a Life-Cycle Framework for Incorporating Clustering Algorithms in Adaptive Systems

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Abstract. There are many applications incorporating recommendation techniques in order to help users in a personalized way. But very few address software life-cycle issues. In this paper we evaluate the generality of the RUP technique by applying the software life-cycle process in a different medium. We apply this technique in order to incorporate a new clustering algorithm in an interactive tv application. We compare this research to our previous work, which is an adaptive application that sells mobiles phones and tries to help its users with personalized help and recommendations. Our research shows that the Life-Cycle Framework we proposed can be easily applied to different domains without changing its basic steps. The different medium used didn't compromise the procedure at all and tendency towards help. The different medium only changed few procedure steps on a low technical level as their aim remains the same.

1 Introduction

Recommendation techniques are a very common way of achieving personalization in applications. An interesting approach in the field of recommendation has been made in WindOwls [4]. WindOwls is a recommending system that uses user modeling techniques to propose products to individual users. WindOwls uses association rules to calculate weights in order to group acquired tastes together. In contrast, in our system we use a clustering algorithm to group users according to their tastes. Another interesting approach has been made by Choi, et al. [2]. They chose a multi-attribute decision making method to find similar products. In their system, the customer must first order a product in order for the system to propose a similar one. Another recommending system that uses clustering techniques in order to group products is the system proposed by Guan et al. [3]. In their system they use an explicit method of ranking to acquire generic attributes from products and then cluster new attributes into the different groups of generic attributes using the k-NN algorithm.

An important field in recommendation that has a large affinity with interactive TV is TV programs recommendation. Important steps have been made in this field too, e.g. [7,5]. Their aim is to help users find a program of interest to them. Marbury's et. al [5]

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work applies a user model based on keywords and named entities in every user's query for a tv program and in this way provides the user with personalized results based on this specific user's interests. On the other hand, O'Sullivan [7] proposes the use of data mining techniques as a way of supplementing merge ratings-based profile knowledge with additional item-similarity knowledge that can be automatically discovered by mining user profiles. They argue that this new similarity knowledge can significantly enhance the performance of a recommender system in even the sparsest of profile spaces.

On the field of systems that try to help elderly users or users physically impaired, there is significant on-going research work too. In [6], a multimodal navigational system is presented that learns from the cognitive load of users and then categorizes them into two different stereotypes: elderly and average aged adults. Another system that helps the elderly is made by Zhao and Tyugu [9]. Their system has a personalized web browser that helps older people browse the web. The browser adapts its presentation according to the users' behavior. In [8], a system called Unified User Interface is presented. That system is a framework that can adapt to users depending on their age and kind of incapability by creating polymorphic user interfaces. In their work they apply the Unified User Interface on a health application scenario, namely the MediBridge C-Care web-based EHR system. The polymorphic interfaces are produced through rules of the "tasks" of the user performances.

Despite the fact that all of the above applications of adaptive methods are innovative and gave users results concerning adaptive help to every specific user, none of them addressed software life-cycle issues. In adaptive applications like the ones mentioned above it's very difficult to apply the traditional software life cycle techniques. A very useful tool in software life-cycle is the Rational Unified Process (RUP). RUP is an object-oriented process that advocates multiple iterations of the software development process. It divides the development cycle in four consecutive phases: the inception, the elaboration, the construction, and the transition phase. Each phase is divided into four procedural steps, namely, requirements capture, analysis and design, implementation, and testing. The phases are sequential in time but the procedural steps are not. Moreover, one important advantage of RUP is the highly iterative nature of the development process. For the above reasons, RUP can be selected as the basis for presenting adaptive systems too.

In [12] we presented an RUP based software life cycle on how to incorporate a clustering algorithm on a prototype e-shopping system. The process has four major steps. First, designing and building the prototype system that does not include any clustering techniques. Second, evaluating the system and through this process obtaining data for the clustering algorithms. Third, comparing several clustering algorithms with the above data as input and choosing the most efficient algorithm. Fourth, incorporating the clustering algorithm into the system and building stereotypes based on this algorithm. In this paper we evaluate the generality of the RUP built in our previous work. We show that the same steps are followed as before but this time the clustering algorithms are different. We will also use an entirely different medium for our built system witch is interactive tv and at last our test bed system will not only try to make recommendations about the product that sells but

also, try to personalize its behavior in order to help people with special needs use the system more effectively.

2 The Software Life Cycle

The life – cycle framework is based on RUP and is presented in the table below. RUP gives a framework of a software life-cycle that is based on iterations. However, RUP neither specifies what sort of requirements analysis has to take place for adaptive systems nor what kind of prototype has to be produced during each phase or procedural step. In this table, we have maintained the phases and procedural steps of RUP. Based on this, we have specified what prototype has to be constructed and what kind of experiment has to be conducted. Therefore, this table represents our solution to this problem which was built in our previous research [13]. Here we will how this procedure can be generalized and be applied in an entirely different domain.

Table 1. RUP Life Cycle Process

Procedural Steps/Phases	Inception	Elaboration				Construction	Transition
Requirements Capture	Requirements of a prototype adaptive recommender system without clustering.					The most efficient clustering algorithm.	
Analysis & Design	Analysis and Design of the prototype adaptive recommender system without clustering.	Computing the resemblance coefficients for the data set and developing the clustering algorithm.				Designing double stereotypes resulted from the selected clustering algorithm.(of users and products)	
Implementation	Building the prototype adaptive recommender system without clustering.	Execute the clustering method for the prototype.				Building the user modeling component based on the stereotypes and incorporating them into the system.	Dynamically improving system performance while used by real users.
Testing	Evaluating the system and obtaining the data set for the clustering techniques.	Evaluating the Results of the clustering algorithm used in the prototype.				Comparing the results provided with those of the prototype system.	
Iterations	Iter #1	Iter #2	Iter #3		Iter #n	Iter #n+1	Iter #n+2

3 Inception

3.1 Defining Requirements for the Prototype System and Analysis and Design of the Prototype Adaptive Recommender System

As with our previous research [13] we used the UML technique in order visualize our system initial requirements. UML helped to understand what where the true requirements of our system. A use case diagram is presented below.