Intelligent and Pervasive Multimedia Systems

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Recent advances in pervasive computers, networks, telecommunication, and information technology, along with the proliferation of multimedia-capable mobile devices, such as laptops, portable media players, personal digital assistants, and cellular telephones, have stimulated the development of intelligent and pervasive multimedia applications. The new multimedia standards (for example, MPEG-21) facilitate the seamless integration of multiple modalities into interoperable multimedia frameworks, transforming the way people work and interact with multimedia data. These key technologies and multimedia solutions interact and collaborate with each other in increasingly effective ways, contributing to the multimedia revolution and having a significant impact across a wide spectrum of consumer, business, healthcare, education, and governmental domains.

With the rapid increase in the penetration rate of pervasive multimedia services, coupled with the imminent deployment of 3G wireless infrastructure, users are more ready than ever to enjoy those services. What is really revolutionary here is that, we not only can enjoy these services in a passive way (for example, watching videos), but also can customize services by deciding what information we want to receive and how it's delivered.

The six articles selected for this special issue provide excellent coverage of the areas we've outlined, and deal with interactive multimedia education, quality of service (QoS) control in multimedia content delivery, multimedia service personalization, peer-to-peer multimedia streaming, mobile TV, and VoIP systems.

Articles in this issue

In seeking to merge pervasive multimedia computing and education, Cheng, Basu, and Goebel, in "Interactive Multimedia for Adaptive Online Education," propose an innovative Computer Reinforced Online Multimedia Education framework. Crome integrates multimedia computing in the main components of online education, including learning, teaching, and testing, and facilitates both adaptive testing and student modeling. In addition, Crome features support for drag-and-drop design, logical-mathematical items, multimedia educational games, as well as the use of multimedia computing in improving and evaluating students' cognitive skills.

QoS poses new research challenges for global quality assurance for Web services and multimedia streaming. In "A Framework for Using Web Services to Enhance QoS for Content Delivery," Buccafurri et al. propose an integrated approach for quality definition, monitoring, and fault prediction. The approach is based on a two-layer structure for multimedia service delivery—service composition and real-time, multimedia content delivery—and exploits the unique advantages offered by data-mining techniques. Moreover, it includes a module for predicting QoS faults and a module for possible adaptation and recovery through a machine-learning approach. The approach represents a unique contribution to prior work because, although there have been extensive studies on network-based multimedia services, a large-scale implementation to study guaranteed QoS control is still unavailable.

In "Multimedia Service Provisioning and Personalization on Grid-Based Infrastructures: Now and the Future," Li, Veeravalli, and Li provide a survey on the demands of multimedia services over scalable systems as well as a wide range of challenging issues in this field.

The article identifies key technology components for multimedia service provisioning over grid-based infrastructures, and shows that promoting personalization and interactive service can improve the network-client population.

While two of the previous articles focus on QoS control and provisioning for multimedia services, the article entitled "Analyzing Voice Quality in Popular VoIP Applications" by Sat and Wah focuses on a general method for evaluating the quality of systems that provide a special kind of multimedia service: VoIP. In particular, the authors propose an objective evaluation method and use it to compare the conversational quality of four VoIP systems in repeatable network and conversational conditions. The results show that none of them attain the best quality under all conditions.

Among the wide range of multimedia services, mobile TV is perceived as an emerging service that enhances TV experience by bringing traditional TV services and on-demand audiovisual content to mobile devices. In "Digital Television for Mobile Devices," Zhou et al. present a survey of recent advances in mobile TV technologies and standards. In particular, the authors compare and contrast those technologies and identify future trends in mobile TV.

Finally, in "Deployment Issues in Scalable Island Multicast for Peer-to-Peer Streaming," Jin et al. propose the Scalable Island Multicast (SIM) protocol for peer-to-peer media streaming through integrating IP multicast and overlay delivery. The authors study various practical deployment issues related to SIM, including fault tolerance and the impact of a network address translator. The authors show, through simulations, that SIM can achieve higher delivery efficiency and a lower loss rate compared to existing overlay protocols.

Final thoughts

While these articles cover a collection of recent techniques and novel applications in the area of intelligent and pervasive multimedia systems, several issues related to multimedia modeling, specification, analysis, and design of these systems still remain challenging. One appealing research challenge, for example, is the efficient indexing, mining, and retrieval of multimedia data in a pervasive environment. Another interesting issue is related to the development of human-friendly user interfaces and the related standards and user-interaction models. Yet another issue is how to design the distributed multimedia system architecture so users are guaranteed full services without being aware of the underlying communications and computing techniques. **MM**

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