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Special Issue on

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Guest Editor

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The Multimedia - Processing and Applications (MMAP) Symposium within the framework FEDERATED CONFERENCE ON COMPUTER SCIENCE AND INFORMATION SYSTEMS (FedCSIS) addressed several themes related to theory and practice within multimedia domain.

In the 1993 first edition of Multimedia: "Making It Work", Tay Vaughan declared "Multimedia is any combination of text, graphic art, sound, animation, and video that is delivered by computer. When you allow the user – the viewer of the project – to control what and when these elements are delivered, it is interactive multimedia. When you provide a structure of linked elements through which the user can navigate, interactive multimedia becomes hypermedia." In common usage, multimedia refers to an electronically delivered combination of media including video, still images, audio, and text in such a way that can be accessed interactively. Much of the content on the web today falls within this definition as understood by millions. Some computers which were marketed in the 1990s were called "multimedia" computers because they incorporated a CD-ROM drive, which allowed for the delivery of several hundred megabytes of video, picture, and audio data. That era saw also a boost in the production of educational multimedia CD-ROMs. Multimedia finds its application in various areas including, but not limited to, advertisements, art, education, entertainment, engineering, medicine, mathematics, business, scientific research and spatial temporal applications.

The enormous interest in multimedia from many activity areas (medicine, digital government, e-commerce, public safety, entertainment, education, advertising) led researchers and industry to make a continuous effort to create new, innovative multimedia algorithms and applications. From papers that were accepted at MMAP 2017 we selected and invited many articles and the best 6 extended papers are for publication in this special issue.

Although future networks will have more capabilities and capacities, the amount of multimedia content online will also increase. We must foster innovation in this domain to develop intelligent apps and APIs, as well as multimedia standards (but take care not to over-standardize). This issue is certainly not an exhaustive discussion of these topics. Please add your views and feedback in the comments section below. The majority of multimedia Internet traffic will be transmitted wirelessly in coming years, and quality issues will become increasingly important as user expectations rise. Most of today's Internet users have at least two personal devices that they use to create, share, and consume multimedia content anywhere and anytime. Both the amount of content and the amount of time people spend viewing it have increased significantly in recent years. It's estimated that by 2019 it would take a viewer more than 5 million years to view all the Internet videos that will be generated each month! In the coming years, the majority of multimedia Internet traffic will be transmitted wirelessly. Quality issues will become increasingly important as user expectations rise. To address these and other demands from an application perspective, intelligent apps and APIs must reduce complexities for developers and designers. Multimedia standards must also allow for basic interoperability.

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The concept of multimedia from the traditional idea of ‘multi-mediums’ such as text, photographs, sides, video and audio tapes (analogue) is being redefined by the use of new computer concepts to integrate the digitized information to include text, graphics, sound, animation and full-motion. The dreams of multimedia technologists have come true and today we are able to store, transport, access and manipulate digitized multimedia information by simple drag and drop actions or export/import information to and from distant locations. The proliferation of image capturing devices and their diverse applications have enabled multimedia technology to contribute in the advancement of almost every aspect of human life. Multimedia research has evolved at tremendous speed in the last few decades to capitalize on the breadth of such applications, ranging from image/video coding and processing to multimedia communications to the analysis of human behavior to medical diagnostics. Most of these topics involve techniques from artificial intelligence, computer vision, and multimedia, but also human computer interaction, educational science, and psychology.

Multimedia technologies have achieved impressive results in the last years and they may be the key for a revolution in the cultural heritage area. These new technologies in fact can now make available for the public huge amounts of heterogeneous data creating unbelievable opportunities of study and capitalization of the cultural items. For example, e-Learning theory in the past decade has expanded dramatically because of the introduction of multimedia. Several lines of research have evolved, e.g. cognitive load and multimedia learning. The idea of multimedia convergence is also becoming a major factor in education, particularly higher education. Defined as separate technologies such as voice (and telephony features), data (and productivity applications) and video that now share resources and interact with each other, media convergence is rapidly changing the curriculum in universities all over the world. Multimedia provides students with an alternate means of acquiring knowledge designed to enhance teaching and learning through various mediums and platforms. Multimedia is a robust education and research methodology within the social work context. The five different multimedia which supports the education process are narrative media, interactive media, communicative media, adaptive media, and productive media. Contrary to long-standing belief, multimedia technology in social work education existed before the prevalence of the internet. It takes the form of images, audio, and video into the curriculum.

The goal in designing a real-time multimedia system is to achieve high perceptual quality under every possible operating condition, where perceptual quality is the result of a subjective assessment by system users. Achieving high perceptual quality requires making tradeoffs between the multiple quality metrics observed by users, and translating those tradeoffs into analytical data that can be used to tune control inputs at run time. This translation is difficult because the relation among control inputs, quality metrics, and perceptual quality is complex and unknown, especially under resource constraints such as limited network bandwidth. In a virtual reality system with a head-mounted display, the processing time before displaying a virtual scene is a control input that affects perceptual quality. A longer processing time will lead to smoother graphics when rendering changes in a scene but will incur longer delays before the changes are perceived. Interaction has long been an important theme for pervasive display researchers, and it’s now commonplace for deployments to support some form of user interaction.

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As interaction has emerged as a more prominent feature of pervasive display deployments, there has been a clear shift from relatively static information presentation to highly interactive systems. While early interactive systems relied on touch-screens and dedicated input devices (such as mice, data gloves, and joysticks), many now feature interaction with the display via smart-phones or through direct physical manipulation. The ability to interact with data can help transform a pervasive information display from a simple ambient awareness tool to a sophisticated data-access point for viewers that enables browsing and potential experimentation with the data being visualized, leading to new insights. The production of interactive data visualizations on media facades in urban settings is particularly interesting, because it poses significant new challenges. In some cases, a display might be visible by hundreds or thousands of nearby citizens, so providing interactivity for both the large scale of the physical display and its large user base will require significant innovation. More generally though, trends across all technologies indicate that, in the near future, most pervasive displays will support interaction, and viewers will assume an ability to explore, control, and interact with the information presented to them.

Software engineers may use multimedia in computer simulations for anything from entertainment to training such as military or industrial training. Multimedia for software interfaces are often done as a collaboration between creative professionals and software engineers.
In mathematical and scientific research, multimedia is mainly used for modeling and simulation. For example, a scientist can look at a molecular model of a particular substance and manipulate it to arrive at a new substance. In medicine, doctors can get trained by looking at a virtual surgery or they can simulate how the human body is affected by diseases spread by viruses and bacteria and then develop techniques to prevent it. Multimedia applications such as virtual surgeries also help doctors to get practical training.

Early information presentation applications of pervasive displays were largely focused on supporting the workplace. More recently, news and advertising information have become commonplace. However, with the trend toward situated displays, and a wide user base, new applications have started to emerge. Perhaps the most common of these are applications for behavior change in which visualization of previously unseen data is used to try and encourage viewers to modify their current behavior—often for health or sustainability reasons. Although the potential for behavior change applications is clear, there remains a question as to the long-term effectiveness of such interventions.

Therefore, the extent to which they will become widely deployed is not obvious. However, we do expect new applications for data visualization to develop as new display technologies emerge. A further trend is the growing set of varied users encountering information displays. Embedded in research environments, many early displays had limited accessibility for the general population, but the growing accessibility of displays has led researchers to accommodate a diverse viewer audience. The biggest of these challenges is improving the scale and resolution of physical display hardware.

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While progress is being made in both the research and commercial sectors, as with traditional displays, the "price per pixel" will reduce as technology develops and demand increases. Such higher resolution shape-displays will both better represent the required data and allow significantly larger datasets to be rendered. In the meantime, combinations of display technologies can provide an intermediate step for this hardware development.

Runtime conditions (like network bandwidth and losses) or information needed by the control inputs might be outdated. Such information might be too large to be collected, or there might be a delay in its collection. Optimization using outdated information might not lead to high perceptual quality. Human perception is not well understood, and there is no well-defined relation between perceptual quality and control inputs. Some previous approaches have developed approximate analytic models for measuring perceptual quality. For instance, quality metrics can be simplified using linear relations or heuristics to allow online measurements and closed form mappings from control inputs to perceptual quality. However, such models usually cannot capture the complex relations between control inputs and perceptual quality. Other analytic models might be more accurate for evaluating the perceptual quality of a given application but not applicable in online measurements because the process is computationally expensive. In short, the perceptual quality of real-time multimedia systems is hard to optimize because it lacks well-defined analytic models for relating perceptual quality to control inputs and to the available quality metrics.

Multimedia is increasingly becoming the "biggest big data" as the most important and valuable source for insights and information. It covers from everyone's experiences to everything happening in the world. There will be lots of multimedia big data—surveillance video, entertainment and social media, medical images, consumer images, voice and video, to name a few, only if their volumes grow to the extent that the traditional multimedia processing and analysis systems cannot handle effectively. Consequently, multimedia big data is spurring on tremendous amounts of research and development of related technologies and applications. As an active and interdisciplinary research field, multimedia big data also presents a great opportunity for multimedia computing in the big data era. The challenges and opportunities highlighted in this field will foster some interesting future developments in the multimedia research and applications. Recent advances in computing, networking, storage, and information technology have enabled the collection and distribution of vast amounts of multimedia data in a variety of applications such as entertainment, education, environmental protection, e-commerce, public safety, digital government, homeland security, and manufacturing. Today, there are lots of heterogeneous and homogeneous media data from multiple sources, such as news media websites, micro-blog, mobile phone, social networking websites, and photo/video sharing websites. Integrated together, these media data represent different aspects of the real-world and help document the evolution of the world. Consequently, it is impossible to correctly conceive and to appropriately understand the world without exploiting the data available on these different sources of rich multimedia content simultaneously and synergistically.

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Based on the articles, we can conclude that providing the right form of authoring tools for non-professionals is still a non-trivial task. We hope these papers are a valuable resource for scholars and practitioners who want to better understand the state of the art and the upcoming challenges in this fascinating field.

Quality of experiences and user experience are important aspects of future multimedia services. The perceptual quality of a multimedia system with multiple quality metrics is the combined quality perceived by subjects when using the system's user interface. There have been several previous studies on developing a general method for optimizing the perceptual quality of multimedia systems. Researchers conducted studies to combine existing quality metrics with metric selection using offline psychophysical measurements or using a heuristic method, such as evolutionary algorithms. However, these approaches are limited in that they depend on existing quality metrics and just provide a framework for combining them. There have also been approaches that use a black-box method to optimize multimedia systems without well-modeled metrics.

Dumitru Dan BURDESCU

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