Journal of Zhejiang University-SCIENCE C (Computers & Electronics)
ISSN 1869-1951 (Print); ISSN 1869-196X (Online)
www.zju.edu.cn/jzus; www.springerlink.com
E-mail: jzus@zju.edu.cn

Perspective:

Societally connected multimedia across cultures

Zhongfei ZHANG[†§1], Zhengyou ZHANG[2], Ramesh JAIN[3], Yueting ZHUANG[4], Noshir CONTRACTOR[5], Alexander G. HAUPTMANN[6], Alejandro (Alex) JAIMES[7], Wanqing LI[8], Alexander C. LOUI[9], Tao MEI[10], Nicu SEBE[11], Yonghong TIAN[12], Vincent S. TSENG[13], Qing WANG[14], Changsheng XU[15], Huimin YU[1], Shiwen YU[12]

([1]*Department of Information Science & Electronic Engineering, Zhejiang University, Hangzhou 310027, China*)
([2]*Microsoft Research, Redmond, WA, USA*)
([3]*Department of Computer Science, University of California, Irvine, CA, USA*)
([4]*College of Computer Science and Technology, Zhejiang University, Hangzhou 310027, China*)
([5]*School of Communication, Northwestern University, Evanston, IL, USA*)
([6]*Informedia Group, CMU, Pittsburgh, PA*)
([7]*Yahoo! Research, Spain*)
([8]*School of Computer Science and Software Engineering, University of Wollongong, NSW, Australia*)
([9]*Kodak Research Labs, USA*)
([10]*Microsoft Research Asia, China*)
([11]*Department of Information Engineering and Computer Science, University of Trento, Italy*)
([12]*Institute of Computational Linguistics, Peking University, Beijing 100871, China*)
([13]*Institute of Computer Science and Information, National Cheng Kung University, Taiwan 701, Tainan*)
([14]*School of Computer Science, Northwestern Polytechnical University, Xi'an 710129, China*)
([15]*Institute of Automation, Chinese Academy of Sciences, Beijing 100080, China*)
[†]E-mail: zhongfei@zju.edu.cn

doi:10.1631/jzus.C1200279

The advance of the Internet in the past decade has radically changed the way people communicate and collaborate with each other. Physical distance is no more a barrier in online social networks, but cultural differences (at the individual, community, as well as societal levels) still govern human-human interactions and must be considered and leveraged in the online world. The rapid deployment of high-speed Internet allows humans to interact using a rich set of multimedia data such as texts, pictures, and videos. This position paper proposes to define a new research area called 'connected multimedia', which is the study of a collection of research issues of the super-area social media that receive little attention in the literature. By connected multimedia, we mean the study of the social and technical interactions among users, multimedia data, and devices across cultures and explicitly exploiting the cultural differences. We justify why it is necessary to bring attention to this new research area and what benefits of this new research area may bring to the broader scientific research community and the humanity.

Key words: Connected multimedia, Social media, Social-cultural constraint

1 What is connected multimedia?

Social media (Agichtein *et al*., 2008) has received extensive attention recently and has become a very popular research area due to its wide spectrum of applications. We note that even though the whole area of social media is very popular in the literature, there are a group of research issues that are related to the social-cultural constraints in the social media study that have not yet received sufficient attention. In this context, we group all these issues together under the umbrella of a new sub-area of social media that we call 'connected multimedia'. This is a position paper in which we propose and define the area of connected multimedia. Multimedia and social media research, in particular, media content and connection research, has been around for a while. However, many research problems still remain open. Instead of continuing the research effort in the broad social media or multimedia area, we attempt to focus on connected multimedia with the hope to solve real-world problems in this new area that will lead to technology development with substantial societal impacts.

[§] On leave from Computer Science Department, State University of New York at Binghamton, USA

While it is still evolving, we here first give a working definition of connected multimedia. By connected multimedia, we mean the study of the social and technical interactions among users, multimedia data, and devices across cultures and the explicit exploitation of cultural differences. Consequently, connected multimedia involves three elements—users, data, and devices—with two perspectives—social focus and cultural focus. In short, connected multimedia is about multimedia content and connection across community and cultural boundaries. In comparison with those existing research areas including social media as its super-area and human centered computing (Jaimes and Dimitrova, 2006), we here emphasize that connected multimedia pays more attention to cultural difference. The definition of the social side is broader than just national cultures; it possibly includes cultures of groups, disciplines, organizations, communities, ethnicities, religions, and nations. This emphasis distinguishes connected multimedia from all other existing areas, which may claim to include some of these aspects, among many others. Fig. 1 illustrates conceptually what connected multimedia is.

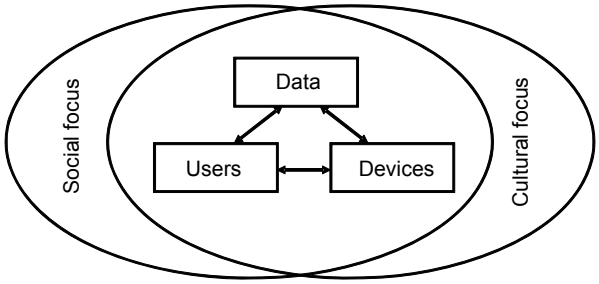

Fig. 1 A conceptual illustration of the elements and foci of connected multimedia

Therefore, in connected multimedia, we attempt to address the same media content and connection problem with two perspectives. The first is to incorporate and exploit cultural constraints into consideration. There are many successful examples in the literature in which standard solutions fail whereas specialized solutions that incorporate and exploit local cultural constraints into consideration succeed when the standard problem is considered under a specific local culture. One of such examples is the Defense Advanced Research Projects Agency (DARPA)'s 40-year anniversary of Internet contest on locating 10 weather balloons nationwide (Hesse, 2009), where 10 red weather balloons were placed at 10 different locations across US and a fast solution to locating the exact positions of the balloons can be obtained only through exploiting locality-related cultures across the nation along with the social networks obtained from Facebook and Twitter. Another such example is Yahoo! Answers, where the best answers are typically obtained by incorporating and exploiting local cultures into the answers.

The second is to incorporate and exploit social constraints into consideration. In recent years it has become a hot research direction where people attempt to use social contextual information to deliver more effective solutions in media content and connection understanding and/or to use multimedia technologies to further promote social or environmental interactions, such as folk computing (Jain, 2003a), experiential computing (Jain, 2003b), and social computing (http://www.socialcomputing.org/) with many emerging, specially dedicated organizations or products such as Facebook, Flickr, and Pipes. The DARPA's 40-year anniversary of Internet contest on locating 10 weather balloons nationwide (Hesse, 2009) once again is a good example of developing a solution with an emphasis on the social perspective in which the social networks discovered through the solution development contribute to fast locating where a balloon is about either through computing facilities or through manual search. This example once again demonstrates the power of collective human interactions to computing facilities as the wisdom of crowds obtained through social networks.

We argue that it is important and necessary to bring attention to connected multimedia research and related dedicated research community at this time. Though there are related areas including social media as its super-area, none of them explicitly addresses the cultural differences across communities when a solution is developed. Creating the culture or community-based niche for this new area's research is what distinguishes this area from all other related areas. When we say culture, we take a very broad meaning, not just for cultures of different ethnics, but also including cultures of different disciplines, different groups, different societies, etc., such as Chinese vs. American,

young people vs. old people, and computer science vs. social science. In general, we mean the cultures of communities. Through explicitly addressing cultural differences, connected multimedia may lead to many important implications with real-world societal impacts that are difficult to obtain in any of the related areas. For example, we may use media to make the bridge with other research areas as well as to build up connections among different communities. As another example, with connected multimedia we are able to study the communicative behavior (media and methods of communication) within specific groups and more interestingly, across communities; one such example is the Bus Uncle video in YouTube, an example of cultural differences where a video is funny to some but not to others. Connected multimedia is proposed in this context.

To further bring attention to this new research area, we organized an international workshop on the topic of connected multimedia in Hangzhou, China, on October 24 and 25, 2009. This workshop was sponsored in part by US National Science Foundation (NSF) and College of Computer Science and Technology of Zhejiang University, China. We dedicated the whole workshop to brainstorming discussions on the foundation of this new area, the practical problems we must solve in this new area in the real world, the development goals of this new research discipline, the relationships and the contributions the development of this new area can make to other scientific disciplines, as well as the specific approaches we must take to maintain and grow this new research discipline. This effort was continued when we organized a follow-up workshop on October 29, 2010, in Florence, Italy, where discussions on the further development of this area were carried out to a broader scope with an open participation from academics and industries through public call for papers and the resulting selected paper presentations, in addition to another round of brainstorming discussions among the participants in the workshop.

In the rest of this paper, we outline the practical problems in the real world identified in connected multimedia research, the research goals for connected multimedia, the relationships and contributions connected multimedia research may make to other disciplines, and the approaches we may take to maintain and grow this new area.

2 Practical problems identified in connected multimedia research

According to the working definition of connected multimedia given in Section 1, it is clear that there is a wide spectrum of practical problems that we may address in the area of connected multimedia. Here we list a few typical important problems with specific real-world application examples.

1. Distributed work force collaborations/virtual organizations

Examples include recognizing the cultural difference in user behavior, automatic meeting facilitations, and sign/body language translation.

2. Virtual environments

Examples include revealing the honest/true signal, accurate representation of social presence, and turn taking.

3. Healthcare informatics

Examples include discovery of effective medical treatment from different sources such as sharing the benefits between western medicine and Chinese medicine, continuous monitoring of health status across media with ubiquitous sensors such as those wearable and/or mobile, and specialized medical information retrieval and treatment (e.g., ethnicity specific).

4. Emergency response

Examples include multi-disciplinary response teams, coordinating across diverse stake-holders, and effective preparation for hazards that may impact areas with residents from multiple cultural backgrounds.

5. Tourism

Examples include search/route design before travel, recommendation On-site, and summarization/sharing of experiences and geotagging.

6. Facilitating mutual understanding and accessibility across cultures (e.g., culturally aware of users and data interaction)

Examples include highlighting media bias and reducing/mitigating polarization.

7. Personalized storytelling

Examples include how to utilize and leverage social media and third-party content to enhance the overall storytelling and media sharing experience. In addition, we need to consider how to effectively incorporate cultural aspects (e.g., cultural festivals and

regional customs) into the storytelling process to further personalize the final products or output.

8. Cross-media learning

Examples include cross-data modality learning such as imagery/video annotation, real-world event tracking, and prediction from cyber-space learning.

Note that some of the problems listed above may be solved only under connected multimedia, such as the problem of emergency response, while others may also be solved in the study of other areas such as social media or multimedia.

3 Goals of connected multimedia research

As a newly formed research area, we strive to succeed through achieving the following four development goals.

1. Defining our community

Since the community of connected multimedia is still in its infant stage, it is critical to carefully and continuously define and grow this community. Given the wide spectrum of the applications that connected multimedia research may lead to, it is important to incorporate all the relevant people working in these applications into our research community. Consequently, we anticipate a fairly large community as a result of the development of connected multimedia. Furthermore, as both social sciences and multimedia research develop and evolve, the definition and scope of connected multimedia will also dynamically evolve.

2. Modeling integral interactions

By the current working definition of connected multimedia, the key component of this study is the understanding and promotion of the social and technical influences and interactions among users, data, and devices across cultures. Consequently, effectively modeling the integral interactions and influences among the users, data, and devices across cultures has become critical to the success of this research community. It is essential for the success of the development of connected multimedia to have a whole suite of theory for correctly modeling these integral interactions and/or influences such that effective solutions may be developed to practical problems. For example, for the social side, the exemplar work was conducted by Kleinberg (2008) and Contractor (2009). They argued for the convergence of social and technological networks, and employed the principles of human social interaction to study the dynamic behavior of individuals and the evolution of the structure of social networks.

3. Developing tools to support the research in connected multimedia

To appropriately address all the research issues as well as to develop the related technologies in connected multimedia, it is also necessary to develop the tools to support connected multimedia. Typical tools include data management tools, data mining and analysis tools, virtualization tools, search and retrieval tools, communication tools, as well as public domain databases.

4. Promoting awareness of culture diversity through connected multimedia experiences and workshops

An important aspect of connected multimedia is the cultural considerations in addressing the research issues as well as the development of the community of connected multimedia (Nisbett, 2003). Consequently, we must promote the awareness of cultural diversity. This can be achieved through the research and development experiences in this community as well as the educational components in the community reach-out activities.

4 Relationships and contributions to other disciplines

Connected multimedia is a direct product of the integration between multimedia and social sciences. In addition, connected multimedia is related to other scientific disciplines including but not necessarily limited to not only several well-established disciplines such as mathematics, statistics, computer science, signal processing, communication, and robotics, but also emerging areas such as the Internet of things and cyber-physical systems. Needless to say, the development of connected multimedia will further help promote the development of these related scientific disciplines. Below we list the specific contributions to further promoting the understandings in social sciences and multimedia and the benefits to the development of the Internet of things and cyber-physical systems.

Specific contributions to social sciences include promoting the understanding beyond human-human interactions (e.g., the understanding of the motivation why humans are connected to non-human resources such as devices and multimedia data), developing novel theories for processing and understanding large-scale digital traces such as emails and blogs, developing multimedia tools to harvest the large-scale digital traces, developing insights of how human individuals interact with an ensemble of media instead of single media, developing methodologies for large-scale validations of social science theories, and developing tools to increase and enhance global understanding (Lazer *et al*., 2009).

Specific contributions to multimedia include using cultural study and/or social networks to assist media content analysis and link analysis, using cultural study and/or social network for diverse but relevant recommendations such as novelty recommendations, using social network analysis methods to connect to various resources, using cultural study and/or social network to harvest more accurate labeled data, helping exploit cultural knowledge to better interpret and understand media (e.g., social distance to event understanding), and using social network and/or cultural information to target multimedia resources to users.

Specifically, from the list of the typical practical problems identified in connected multimedia research in Section 2, it is clear that the research in this new area directly provides solutions to many of the problems in the Internet of things and in cyber-physical systems research, facilitating and benefiting the further development in these emerging areas.

5 Approaches to maintaining and growing this community

To aggressively maintain and grow this research community, we list several appropriate approaches as follows.

1. Disseminate and advertise connected multimedia research

We must aggressively disseminate and advertise the knowledge generated from the research in this community, including organizing conferences or workshops, panel discussions, tutorials, special sessions, and special journal issues. As a follow-up effort after the workshop in Florence in 2010, we have organized a special issue on connected multimedia in *Journal of Multimedia* (Zhang *et al*., 2012) early this year. We will also aggressively use social media and multimedia technologies and tools such as Web pages and blogs to disseminate the connected multimedia research. When the community has been developed into a certain stage, we shall consider establishing a new journal dedicated to this community. We will make the research data public so that people either within or outside the community are able to use our datasets to benchmark their research. For published research results, in particular for the research results published at the beginning stages, we will ensure that they are significant and noticeable to the whole scientific research community such that sufficient attention and impact will be generated to receive the support from the broader community to help establish this research community.

2. Look for active collaborations

Like all other research communities, an effective approach to aggressively growing this research community is to seek active collaborations not only among the individual researchers, engineers, as well as other professionals within this community, but more importantly also among organizations within this community and between this community and other research communities such as social sciences, Web science, network science, multimedia, statistics, the Internet of things, and cyber-physical systems. Active collaborations, in particular active collaborations between different research communities, will help generate novel ideas and lead to a breakthrough as a non-traditional approach to solving problems in this research community. We encourage our community members to actively seek such collaborations in order to aggressively grow our research community.

6 Conclusions

This is a position paper in which we have proposed and defined a new research area that we call connected multimedia, which is a collection of those research issues of social media involving social-cultural perspectives. We have argued why it is important and necessary to establish this new research

area as well as the relevant research community, and have identified practical problems. This new area is well-poised to generate solutions to these problems, thereby generating important societal impacts. Finally, we have identified the strategies and the relationships we will forge to nurture and grow this new research community.

Acknowledgements

This paper is based on the discussions contributed by all the participants of the 2009 Connected Multimedia Workshop listed as the co-authors of this paper as a result of the collective wisdom. The workshop is supported in part by US National Science Foundation through grant IIS-0956924 and College of Computer Science and Technology of Zhejiang University, China. The follow-up workshop in 2010 held in Florence was supported in part by ACM and Microsoft Research. We are also grateful to Dr. Jie YANG of US NSF for his strong support to this effort as well as his insightful advice. Zhongfei ZHANG is also supported in part by the National Basic Research Program of China (No. 2012CB316400), ZJU–Alibaba Financial Joint Lab, Zhejiang Provincial Engineering Center on Media Data Cloud Processing and Analysis, and US NSF (Nos. IIS-0812114 and CCF-1017828).

References

Agichtein, E., Castillo, C., Donato, D., Gionis, A., Mishne, G., 2008. Finding High-Quality Content in Social Media. Proc. Int. Conf. on Web Search and Web Data Mining, p.183-194. [doi:10.1145/1341531.1341557]

Contractor, N., 2009. The emergence of multidimensional networks. *J. Comput.-Mediat. Commun.*, **14**(3):743-747. [doi:10.1111/j.1083-6101.2009.01465.x]

Hesse, M., 2009. Spy vs. Spy on Facebook. The Washington Post.

Jaimes, A., Dimitrova, N., 2006. Human-centered multimedia: culture, deployment, and access. *IEEE Multimedia*, **13**(1):12-19. [doi:10.1109/MMUL.2006.8]

Jain, R., 2003a. Folk computing. *Commun. ACM*, **46**(4):27-29. [doi:10.1145/641205.641223]

Jain, R., 2003b. Experiential computing. *Commun. ACM*, **46**(7):48-55. [doi:10.1145/792704.792729]

Kleinberg, J., 2008. The convergence of social and technological networks. *Commun. ACM*, **51**(11):66-72. [doi:10.1145/1400214.1400232]

Lazer, D., Pentland, A., Adamic, L., Aral, S., Barabasi, A.L., Brewer, D., Christakis, N., Contractor, N., Fowler, J., Gutman, M., *et al*., 2009. Computational social science. *Science*, **323**(5915):721-723. [doi:10.1126/science.1167742]

Nisbett, R., 2003. The Geography of Thought. Free Press.

Zhang, Z., Zhang, Z., Jain, R., Zhuang, Y., 2012. Guest editors' introduction: special section on connected multimedia. *J. Multimedia*, **7**(1):1. [doi:10.4304/jmm.7.1.1-1]

Introducing editorial board member: Zhongfei ZHANG is a Qiushi Professor at Department of Information Science and Electronic Engineering, Zhejiang University, China. He is on leave from State University of New York (SUNY) at Binghamton, USA, where he is a professor of computer science, and director of the Multimedia Research Laboratory. He received a B.S. in Electronics Engineering (with Honors), an M.S. in Information Sciences, both from Zhejiang University, China, and a Ph.D. in Computer Science from the University of Massachusetts at Amherst, USA. He was on the faculty of Computer Science and Engineering Department, and a research scientist at the Center of Excellence for Document Analysis and Recognition, both at SUNY Buffalo, before he joined the faculty of computer science at SUNY Binghamton. His research focuses on data mining and knowledge discovery, specifically on multimedia data mining (e.g., concept discovery from large-scale imagery/video data) and relational data mining (e.g., community discovery from large-scale relational data), as well as general pattern recognition. He is the author of the very first monograph on multimedia data mining and the very first monograph on relational data clustering. His research has been funded by a number of government agencies including US NSF, US AFOSR, US AFRL, French CNRS, Japanese JSPS, and Chinese Ministry of Science and Technology as well as industry research labs including Kodak Research and Microsoft Research. He holds more than 10 inventions, has served as a reviewer/PC member for many conferences and journals every year, has held the positions as regular grant review panelists for federal government funding agencies (NSF and NASA), New York State government funding agencies, and private funding agencies, and is currently in the editorial boards for several journals, including *Journal of Zhejiang University-SCIENCE C (Computers & Electronics)*. He has also served as a technical consultant for a number of industrial and governmental organizations.