MEME MEDIA AND MEME MARKET ARCHITECTURES
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In retrospect, the last three decades of computer systems can be summarized as follows. In the 1970s, we focused on the integrated management of enterprise or organization information. The relational model of databases proposed in 1970 provided a mathematical foundation for the discussion of the logical structure and operation of a database independent of its physical implementation and applications. It works as a pivot with various different candidates of implementation, and with various different applications. Such independence encouraged studies on its physical organization without considering its applications, and also studies on its applications and semantic data models without considering its physical organization. The former studies led to the development of high-performance relational database management systems, and the latter studies to the development of natural language interfaces and graphical user interfaces to databases, which led to the extension of queries toward object-orientation and logical inference. Integrated management of information increased data consistency and data integrity of enterprise and organization information, which information management using file systems could not achieve.

In the 1980s, we focused on the integrated environment of personal information processing and office information processing. The rapid development of personal computers and workstations that began in the late 1970s provided personal tools for writing documents, calculating tables, drawing pictures, and making charts. Their developers became interested in embedding figures, tables, and charts in document pages for printing. This is what we call desktop publishing. Then they became interested in directly editing such printed image of documents on the display screen and developed so-called WYSIWYG (what you see is what you get) systems. At the same time, developers became interested in keeping chart representations of data consistent with a table representations of the same data, which required a functional linkage between chart tools and table tools. Such functional linkages were also applied to the data consistency between these tools and a database, which led to the development of so-called integrated personal environment and of-
Office environment systems. These systems had to deal with functional linkages between different tools and different servers. They had to embed graphical representations of these different tools in document pages and manage these graphical objects to respond to user operations. They required a uniform way of treating different tools, their graphical representations, user events, and database servers as entities that react to given messages issued either from users or from other entities. The object-orientation studies that began in the mid-1970s and bloomed in the 1980s provided a solution to these requirements. The object orientation, together with integrated personal environment and office environment systems, led to the development of compound-document architectures, object-oriented GUI systems, visual programming environments, multimedia authoring tools, object-oriented languages, and object-oriented databases.

The last decade in 1990s can be easily characterized by the World-Wide Web (WWW) and its browsers. Although preceded by related visions like Xanadu, proposed in the 1960s, both the WWW and its browsers were developed in the 1990s. In the 1990s, we focused on publication and browsing of intellectual assets. People became liberated in publishing their intellectual assets. The WWW and its browsers have brought an enormous change to our social life. However, many of you will agree to the claim that this is just a beginning of a bigger change.

What will characterize this new decade of 2000? This book will answer this question. “Meme market” is the answer. “Meme” is a term coined by Richard Dawkins. He pointed out a similarity between genetic evolution of biological species and cultural evolution of knowledge and art, and used “meme” to denote the cultural counterpart of a biological gene. As biological genes are replicated, recombined, mutated, and naturally selected, ideas are replicated, recombined, modified with new fragments, and selected by people. The acceleration of memetic cultural evolution requires media to externalize memes, and to distribute them among people. Such media should allow people to reedit their knowledge content and redistribute them. Such media may be called meme media. They work as knowledge media for the reediting and redistribution of intellectual assets.

Although the WWW and browsers enabled us to publish and browse intellectual assets, they could not liberate these assets from the servers that store them. This situation is similar to that before Johann Gutenberg’s invention of printing technologies. Books in the library were secured by chains, and could not be taken out. After his invention, books became portable media that could be distributed among people, and became independent of the time and place of their publication, which significantly increased the chance of replication, recombination, mutation, and natural selection of memes published in books. The WWW and browsers do not enable people to reedit and redistribute memes published in meme media. When memes are liberated from their servers and distributed among people for their reediting and redistribution, they are accumulated by society to form a meme pool, which will work as a gene pool to bring a rapid evolution of intellectual assets shared by this society. This will cause an explosive increase of intellectual assets, similar to the flood of consumer products in our present consumer societies. The explosive increase of intellectual assets is not only inevitable, but also fundamental for their rapid evolution, since these increased intellectual assets form a sufficiently large meme pool and increase the chance and the variety of recombination. Meme media will bring us a consumer society and consumer culture of knowledge resources, which requires new services for distribution, management, and retrieval. The variety of consumer products was mainly brought about by business competition. Therefore, it is fundamental to introduce business activities into a meme pool, which will make it a meme market.
This book focuses on meme media: their potential for enabling technology, their software architecture, and their applications. It also focuses on meme pool and meme market architectures for the reediting and redistribution of memes without violating competitive business activities. The reader may download sample systems from the following Websites: http://ca.meme.hokudai.ac.jp/index.html, which is administered at Hokkaido University, and http://www.pads.or.jp/english/, which is administered by the IntelligentPad Consortium.

I started this research project in early 1987. My goal at that time was to develop a media toolkit architecture for the open integration of personal and office information processing environments. Then around 1992, I came across the concept of meme media. Since 1989 when my group finished the development of the first Smalltalk implementation of the system, our group has been living in the system and coevolving with it. We have learned a lot from the different versions of the system about in which direction to conduct the project. We are still opening new vistas for detailed study. This is one of the reasons why I have spent several years writing this book.

My collaborators and I established a consortium in 1993 for the promotion of system architectures. Since then, I have worked with many collaborators in industry and academia. They became fascinated by the system concept and/or system architecture, and dedicated themselves to work as system developers, application developers, evangelists, or managers. These people include Toshifumi Murata of Softfront, Jun-ichi Fujiwara of Sapporo Electronics Center, Tatezumi Furukawa, Nobuyuki Makimura, Taiji Okamoto of Fujitsu, Yasushi Miyaoka, Masafumi Shimoda, Kazuyuki Tanaka of Hitachi Software, Kazushige Oikawa of K-Plex Inc., Yui Miyawaki of Fuji Xerox, Katsuhiko Sakaguchi of Canon (now with Softfront), Nobuya Kawachi of Kanganrde, Takeshi Mori of NEC, John Cheuck of Metrowerks, Jiro Yamada of C’s Lab, Seigo Matsuoka of Editorial Engineering Laboratory, Yoshimitsu Hirai of JIPDEC, Takafumi Noguchi of Kushiro Technical Collage, Takeshi Sunaga of Tama Art Collage, Shin Nitoguri of Tokyo Gakugei University, Yoshiaki Yanagisawa of National Language Research Institute, Kazuhiro Sato and Masaki Chiba of Sapporo Gakuin Collage, Mina Akaishi, Akihiro Yamamoto, Makoto Haraguchi, Kiyoshi Kato of Hokkaido University, and Yoshihiro Okada of Kyushu University. The people who contributed to the research and development of IntelligentPad/IntelligentBox and their applications are too numerous to list. Some of them influence the direction of my research. Kazushige Oikawa introduced me to Xerox PARC’s views on object-oriented paradigms in early 1980s. Seigo Matsuoka enlarged my research vision toward media as cultural infrastructures. Ryoichi Mori, who proposed “superdistribution” in 1983, encouraged me to integrate meme media and meme pool architectures with the idea of superdistribution. I was also encouraged and supported by many other people. They include Setsuo Ohsuga of Waseda University, Makoto Nagao of Kyoto University, Yasushi Takeda of Hitachi, Tsutomu Sato of Hitachi Software, Iwao Toda of Fujitsu, Yukio Mizuno of NEC, and Tohru Takahashi of Canon. Marvin Minsky, Donald Knuth, Doug Engelbart, Ted Nelson, and Bill Atkinson privately encouraged me and supported my project.

With the support of these people, I have continuously obtained significant support from the Agency for Science and Technologies and Ministry of Education (Japan). From 1991 to 1995, I conducted a project under the support from Agencies for Science and Technologies. In 1995, I won a three-year Grant in Aid for Specially Promoted Research from the Ministry of Education. In the same year, the ministry set up the Meme Media Laboratory for my research. In 1999, the ministry selected me to conduct a new five-year
project on “intuitive human interface for the organization and access of intellectual assets” based on meme media and meme pool architectures. This book will cover most of the research achievements of these projects. In the Meme Media Laboratory, I started collaborations with Klaus Jantke of the German Research Center for Artificial Intelligence (DFKI), and Nicolas Spyrratos of the University of Paris South. They and their colleagues are now helping me to distribute the concept and architecture of meme media in Europe.

I would like to express my thanks to all these people. Without their help, I could not have written this book. The project is still in progress. I had to omit many new ideas in this book only because they are not implemented in any version. Furthermore, the systems are still opening new vistas for detailed study.

I also would like to thank my former students involved in IntelligentPad or IntelligentBox projects. Takamoto Imataki and Akira Nagasaki worked on the development of IntelligentPad, while Yoshihiro Okada worked on IntelligentBox. Akira Nagasaki also studied the FieldPad architecture for event sharing, while Mina Akaishi studied the StagePad architecture for scripting user operations. Mitsunori Nakagawa studied workflow applications, while Ryota Hirano studied the decomposability and composability of specifications based on the meme media architecture. My present students are also making significant contributions to meme media and meme pool architectures. They include Kimi-ihito Ito working on the Web application linkage, Makato Ohigashi and Tsuyoshi Sugibuchi on database visualization, and Jun Fujima on Topica framework. In writing this book, Aran Lunzer and Bruce Darling of the Meme Media Laboratory helped improve the draft of the book.

I would like to thank Hokkaido University and the Graduate School of Engineering for providing me a comfortable research environment, and, especially, Ryozaburo Tagawa for the pleasure of conducting research projects in Sapporo.

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YUZURU TANAKA

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CHAPTER 1

OVERVIEW AND INTRODUCTION

This book examines meme media architectures and their application frameworks developed by the author and his colleagues for allowing people to reedit and redistribute intellectual resources over the Internet just through direct manipulation. Intellectual resources denote not only multimedia documents, but also application tools and services provided by local or remote servers. They cannot be simply classified as information content since they also include tools and services.

Media used to externalize some of our knowledge as intellectual resources and to distribute them among people are generally defined as knowledge media. Some people may use the term “information media” to denote a similar type of media. Whereas information media denote those media that externalize information content, knowledge media are used to externalize not only information content but also tools and services, and, furthermore, to distribute them among people. Some knowledge media that provide direct manipulation operations for people to reedit and redistribute their content are called meme media. Chapters 2 and 3 discuss the details of these definitions. This chapter shows why we need meme media, and how meme media change the environment of publishing, reediting, and redistributing intellectual resources for their further reuse by other people.

1.1 WHY MEME MEDIA?

During the last decade, we observed the rapid accumulation of intellectual resources on the Web. These intellectual resources include not only multimedia documents, but also application tools running on the client side, and services provided by remote servers. Today, from the Web, you can almost obtain whatever information items, application tools, or services you may think of. You can just access some search engine and type in appropriate keywords that characterize the intellectual resource you want to access. Then the search engine returns an address list of candidate Web pages. In this list, you will probably find more than one appropriate Web page including the intellectual resource you want to get.