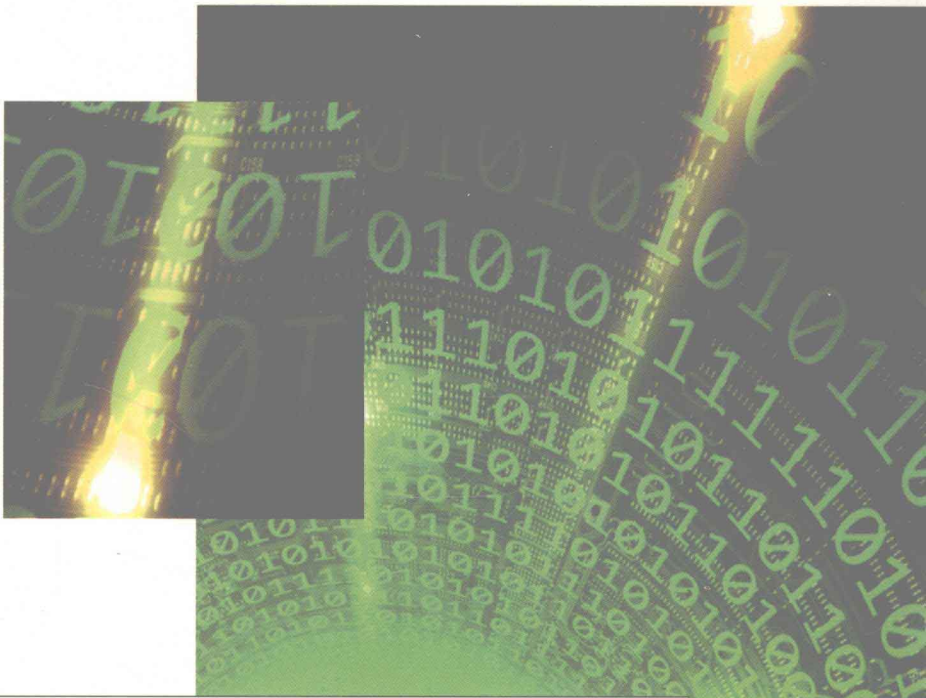
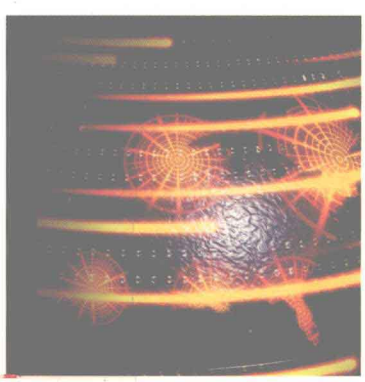
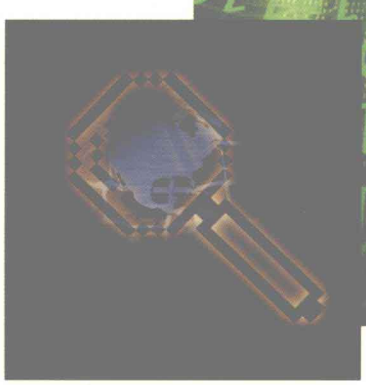


Principles of Interactive Multimedia

Mark Elsom-Cook





Mc Graw Hill

Mark Elsom-Cook

School of Computing & Mathematics
University of Northumbria
Newcastle Upon Tyne, UK

Principles of Interactive Multimedia

The McGraw-Hill Companies

London • Burr Ridge, IL • New York • St Louis • San Francisco • Auckland
Bogotá • Caracas • Lisbon • Madrid • Mexico • Milan • Montreal • New Delhi
Panama • Paris • San Juan • São Paulo • Singapore • Tokyo • Toronto

Published by
McGraw-Hill Publishing Company
SHOPPENHANGERS ROAD, MAIDENHEAD, BERKSHIRE, SL6 2QL, ENGLAND
Telephone: +44(0) 1628 502500
Fax: +44(0) 1628 770224
Web site: http://www.mcgraw-hill.co.uk

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN 007 709610 X

Library of Congress cataloguing in publication data
The LOC data for this book has been applied for and may be obtained from the Library of Congress, Washington, D.C.

Web site address: http://www.mcgraw-hill.co.uk/textbooks/elsom-cook

Publisher:	David Hatter
Page design:	Mike Cotterell
Typesetting:	Mouse Nous
Illustration origination:	Fin McMorran
Production:	Steven Gardiner Ltd
Cover:	Hybert Design

The McGraw-Hill Companies

Printed in Great Britain by Bell & Bain Ltd. Glasgow
3 5 BB 4 3 2 1

Principles of Interactive Multimedia

For Tamsin

Preface

What is *Interactive Multimedia*? This is the question that should be in your mind when you first pick up this book. I am not going to tell you, because I don't know; indeed, I don't believe that anyone knows, although many of us have ideas about what it can and will mean. This book will help you explore those ideas, discover for yourself, and develop your own understanding of the terms. It will do this by examining the broad range of contributory disciplines which feed into the area and showing how they relate to practice and potential future developments. This is exciting because *Interactive Multimedia* is a field in its infancy, and it is people such as ourselves who are in the process of creating the specialism of research, design and development. It is a major revolution in computing which is inevitable but, despite what some people may think, hasn't happened yet. So far, what we see described as *Interactive Multimedia* is a collection of toys and exploratory systems.

Let me expand upon that. Multimedia has been around for a long time. It has origins far older than computers. Books which used words and pictures are, by one definition, multimedia. The Open University in the 1970s pioneered multimedia teaching-using text books and study guides, television, radio programmes, cassette tapes and video tapes. There wasn't a computer in sight, but it was still a multimedia system. It was not *Interactive Multimedia* however, since the interactions were provided by people

By enabling us to combine and control various technologies from a single box, *computers* have enabled us to integrate these media more closely, but they have not taken our thinking beyond the things that we could do with these older technologies. They have made it easier and more accessible, but not novel and innovative. In the same way that early support for text enabled authors to put books on-screen, but didn't lead them to think about the advantages or otherwise of such a strategy, *multimedia* is an enabling technology, but not a guiding one.

In the late 1980s I was visiting Apple Computer with a group of academics and, for the first time, we were given a demonstration of how you could take a running piece of video and paste it into a spreadsheet. 'Very interesting' was our reaction, 'but what is it *for*?' The Apple response was 'We make it possible. *You* tell *us* what it is *for*.'

In a sense, this book is an approach to answering that question. It assumes the technology of multimedia and invites the reader to think differently about what to do with it. This is achieved through taking an alternative perspective on *multimedia*, and through examining the nature of interactions more closely. This book will not teach you how to use authoring tools or how to produce graphical effects. It will not tell you much about how to program or how to integrate video. What it will do is introduce you to a different way of thinking that will enable you to radically reorient your approach to the use of the computer in the future, breaking away from current practice and examining just what we could do with a computer (or several) and what they could do for us.

To this end, there are two main strands to the book. The first requires one to realize that the various media are not, of themselves, new. They have a long history and the processes of creation and interpretation of a medium in the past cannot be ignored. It is painfully apparent when a developer utilizes a medium without being aware of its history and meaning. The result is almost invariably crude and stilted. A parallel can be found in the uses of the early Apple Macintosh:

Before the Mac, computers had *a* screen which had *a* font. This was normally a fixed width, typewriter style font. You could not change size, colour, face or emphasis. The only people who used fonts were those who worked in the areas of typography, and they did not use computers. With the advent of the Mac, there were suddenly, for the first time, hundreds of fonts available in many different formats and everybody wanted to use them. Consequently, there was a huge upsurge in the use of fonts by people who had no idea about why fonts evolved, how they work, what effects they have on the reader, or whether they are even readable. Often you would find 20 fonts on one page with every possible effect applied to them. It was horrendous. You could tell a Mac tyro a mile away by looking at anything they printed and counting the fonts – 'Oh yes, you must be a Mac user.'

Barely 15 years on, such typographic aberrations are thankfully rare. Once the novelty wore off and people started to learn or discover about typography, a general improvement in document layout and readability occurred. This happened because the basic typographic knowledge has disseminated far beyond the original restricted, specialized audience and into the community at large. If you fail to take account of typeface and readability in your software designs these days you are laughed at. If that can happen with typography, what about Art, graphic design, film, video, sound – all areas in which the general public already has a much

higher awareness than they did with typography. Multimedia developers may share this public awareness of the personal effect of these media upon them, but are often lacking in the historical knowledge and expertise to design with these media. Consequently, if we wish to avoid repeating the errors of over-simplicity and naivety we cannot move ourselves forward in multimedia until we have understood the background of these contributing fields.

The second major strand of the book is *Interaction*. As you will find out, 'interacting' with computers is much more recent than the development of computers themselves, and our ideas about what is and is not possible, or useful, are still evolving. Computers are still not fully 'interactive' in the sense that will be introduced here, and the term is often badly misused elsewhere. By drawing on models of interaction from a variety of disciplines we will ground our thinking about interactions in a much richer context.

If all this sounds far too theoretical,

Don't panic.

The book leads you through these areas in a comfortable manner (I hope!), with pointers to places where you can find out more about the things that interest you, and suggestions for how you might incorporate some of these ideas into your own work. It leads towards an integration in which a design process is outlined that takes account of the various needs. There are plenty of examples and anecdotes around to lighten the tone of things.

Bear in mind that developing an *Interactive Multimedia* system is not a one person process. Because of the complexity involved you will inevitably work as part of a team. Between them, the team needs to understand all the issues raised in this book thoroughly, but one individual needs only some awareness of all the areas, and can focus in the particular one that interests them. Whether you are a developer, a programmer, a designer, a manager or a user, there are parts of this book that are for you. Don't feel you have to read the whole thing, but you really should if you want to get the big picture. Remember that our objectives are not about how to use the tools of multimedia, but are about what to do with them. It is like the difference between a course that teaches you how to use water colours and a course which helps you develop into a painter.

Structure of the book

The book is divided into three sections. The first addresses the fundamental issues that we need to think about in the design of an *Interactive Multimedia* system before we even consider the nature of the media that we might use. Chapter 1 clarifies and, to some extent, defines

Contents

	Preface	xi
1	**What is interactive multimedia?**	1
1.1	Introduction	1
1.2	Multimedia	2
1.3	Interaction	8
1.4	A brief history of computers and multimedia	12
1.5	A brief history of computers and interaction	17
1.6	So – what is IMM?	28
1.7	Exercises	29
1.8	Further reading	30
2	**Communicative interaction**	31
2.1	Introduction	31
2.2	Objects and agents	32
2.3	Channels of communication	35
2.4	Artificial languages	37
2.5	'Natural' communication	43
2.6	Meta-languages	49
2.7	Components of interactive multimedia systems	50
2.8	Exercises	52
2.9	Further reading	52
3	**Knowledge**	55
3.1	Introduction	55
3.2	Why does knowledge matter?	55
3.3	The basic idea of knowledge	57
3.4	A working definition	61
3.5	Techniques of knowledge representation	63
3.6	Techniques of knowledge elicitation	74
3.7	Summary	78
3.8	Exercises	79
3.9	Further reading	80

4	**Understanding users**	83
4.1	Why are users important?	83
4.2	Things you might know about a user	85
4.3	How to apply user knowledge	97
4.4	How to acquire user knowledge	105
4.5	Techniques: user profiling	109
4.6	Techniques: user modelling	112
4.7	Summary	119
4.8	Exercises	119
4.9	Further reading	120
5	**Interaction and the interface**	121
5.1	Introduction	121
5.2	Traditional HCI	123
5.3	Modalities and the interface	132
5.4	Channels of communication and the interface	134
5.5	Functionality and usability	144
5.6	Visual appearance and graphic design	151
5.7	Summary	154
5.8	Exercises	154
5.9	Further reading	155
6	**Semiotics**	157
6.1	Multimedia content	157
6.2	What is semiotics?	158
6.3	The idea of a sign	159
6.4	More complex signs	168
6.5	Semiotics and media	169
6.6	Exercises	170
6.7	Further reading	171
7	**Text**	173
7.1	Visual perception of text	173
7.2	Images on a page	177
7.3	Meaning and text	192
7.4	The concept of readability	195
7.5	Text and the screen	198
7.6	Exercises	199
7.7	Further reading	200
8	**Sound**	201
8.1	Introduction	201
8.2	The modality	201
8.3	Primary channels of communication	212
8.4	Combining sound channels	216
8.5	The technology of sound	220

8.6	Exercises	224
8.7	Further reading	224
9	**Still Images**	225
9.1	Psychology of vision	225
9.2	The diagram	226
9.3	Representational images	229
9.4	Juxtaposition of images	244
9.5	Exercises	246
9.6	Further reading	246
10	**Moving Images**	249
10.1	Perception of motion	249
10.2	A brief history of the film	250
10.3	Constructing a shot	251
10.4	Shots into narrative	257
10.5	Modern languages of film and television	261
10.6	Exercises	263
10.7	Further reading	264
11	**Stakeholders and teamworking**	265
11.1	Teamwork	265
11.2	Players	277
11.3	Communication	284
11.4	Exercises	287
11.5	Further reading	287
12	**Product design processes**	289
12.1	Standard design processes	289
12.2	Issues for multimedia	290
12.3	Categories of multimedia systems	293
12.4	An integrated design process for interactive multimedia	319
12.5	Exercises	333
12.6	Further reading	333
13	**Project design and management**	335
13.1	Why?	335
13.2	General approach	337
13.3	Planning for ...	343
13.4	Management	352
13.5	Evaluation	353
13.6	Documentation	355
13.7	Deployment and acceptance	356
13.8	Exercises	357
13.9	Further reading	358

14	**Future trends**	359
14.1	Conceptual	360
14.2	Cultural	363
14.3	Technological	365
14.4	Hot topics	367
14.5	Conclusion	368
	Glossary	369
	Bibliography	375
	Index	379

Colour Plates **following page 178**

1. Clearway and a few red bordered circles.
2. Black and white no entry.
3. Yield sign.
4. Train, quayside.
5. One-way signs.

1

What is interactive multimedia?

1.1 Introduction

If you have read the Preface, you will be aware that this book is seeking to determine specifically what is meant by *Interactive Multimedia*. It is not possible (or desirable) to give a precise definition, but the objective is to provide readers with sufficient understanding of various areas to develop their own model and to understand why *Interactive Multimedia* is quite clearly distinct from *multimedia*. This understanding will only be achieved once you have mastered the various areas covered by the book, but in this chapter we will seek to motivate that discovery and to give a feel for what we mean by *Interactive Multimedia*.

We will do this by examining each of the components in detail. To begin with we will explore what *multimedia* means to the person on the street and introduce some key concepts and questions about what *multimedia* might be. We will then turn to examining *interaction* and try and clarify what we intend the term to embrace. This is particularly interesting because there are many views of what interaction is, which are not in day-to-day usage. Having explored these issues in general, we turn to their specific relationship with computers: first examining the history of computers and multimedia, and then turning to the history of computers and interaction. The chapter is concluded by two sections of a more practical nature. The first describes some examples of multimedia systems to give us a feel for what these packages encompass. The second comes as close as we will get to offering a definition of *Interactive Multimedia* as an alternative to multimedia.

1.2 Multimedia

In any technical or scientific field there is a tendency to define specialist terms. Sometimes this appears to be purely for the purpose of obfuscation, but often the reason for such terms is to allow workers in that field to talk precisely and concisely about what they are doing in a meaningful way. In typography, for example, there is talk about *fonts*, *faces*, *kerning*, and *serifs*. Some of the terms do not arise in everyday language, and have meanings that are only understood within that community (e.g. kerning). Some of the terms refer to words that do exist in everyday language, but provides those words with entirely different meanings (e.g. face). Sometimes the technical term has a meaning which is very similar to its day-to-day usage, but which has been made more precise in the specialized usage of the field.

Given this situation, and the comparative youth of the field of *Interactive Multimedia*, we are still in a position where there is a confusion over terms. Different people may use the same words to mean different things or to provide different levels of specificity. We will therefore try to clarify what we mean by multimedia as precisely as possible.

An obvious starting point is to examine what multimedia means to the general public. This awareness has grown up since the late 1980s. In common usage people will typically describe a multimedia experience as one involving pictures, sound, and video. They tend to think of it as a combination of stimuli such as this, often taking place in a specialized area (such as a 'multimedia experience' at a theme park or gallery). Individuals who use computers also commonly equate multimedia with CDs. In neither of these areas is interaction a key aspect of the term. People have tended to see themselves as recipients of a multimedia experience – passive observers of the time-based experiences that unfold before them.

However, this view of multimedia is limited by the fact that it is based upon the experience of what is commonly available now, rather than being informed by what will become available in the future. There is little reference to tactile or olfactory multimedia, for example. Equally, there is a tendency to ignore the more obvious multimedia systems. A television programme might well use moving pictures, subtitles, spoken words, music, and sound effects. This would certainly appear to qualify as a multimedia experience, but it is not perceived as such by the general public. We therefore need to go beyond this intuitive idea if we are to arrive at a description of what multimedia is that is suitable for us to work with as designers and developers.

Our definition will depend upon an understanding of three interrelated terms: the *modality*, *channel*, and *medium*. We will explore each term in detail before bringing them together into multimedia.

1.2.1 Modalities

There is one clear-cut way of dividing up the components of a multimedia activity: the sensory system through which that activity occurs (*modality*). We can determine unambiguously whether something is communicated through our sense of sight, hearing, touch, taste, or smell. This applies to both communications of which we are the recipient and communications of which we are the initiator. Music, speech, and sound effects are all received by us through the auditory modality (hearing). The keyboard, mouse, and touch screen are all communications that we would make through the tactile modality. If there is a speech input system for a computer then communication through an auditory modality to the machine is possible. From these observations we will therefore assert that the first (and easiest) question to ask about a multimedia system is which modalities it can or does utilize. Remember the formal names for the five modalities:

- tactile – touch;
- gustatory – taste;
- visual – sight;
- auditory – hearing;
- olfactory – smell.

1.2.2 Channels

While the division of multimedia activity into modalities is clear, it is obviously not sufficient for us to be able to distinguish adequately between different sorts of multimedia artefact. If we consider the auditory modality, for example, there is something fundamentally different about receiving spoken communication, hearing noises, or listening to music. Yet they all operate within the same modality. We need to introduce something more sophisticated.

This additional concept is the idea of a *channel* of communication. A channel of communication exists within a single modality, but one modality may contain many channels of communication. We can regard a channel as something like a form of encoding of the information within a particular modality. This has a number of implications.

- The first implication is that for there to be an encoding there must exist an encoder and we, as the recipient of the multimedia input must be able to operate as a decoder for the particular channel that we are receiving. This can be simply illustrated. At the moment you, the reader of this book, are receiving a communication through your visual modality (that is, you are reading this page). Within that

modality you are using a channel which is encoded as printed text in English. I can safely assume that you have a decoder for this channel inside your head since you have got this far into the book. However, 如果我開始寫中文,大多數的讀者們將不會明白我的意思.

So, what went wrong there? Nothing, for some readers, but most of us would suddenly find that communication was no longer happening. This is because I switched to a channel coded as printed text in Chinese. If you, as a reader, do not have a decoder for that channel then you cannot understand it. I would be a very poor author if I relied upon channels that I cannot expect my audience to be able to use. Note that I remained very firmly in the same modality while switching channels.

- The next key concept that we must consider is that of *bandwidth*. As we shall see in a subsequent chapter, bandwidth is a strict mathematical idea that indicates how much information can be carried by a certain encoding. It is quite common to talk about the bandwidth of different modalities: for example, to indicate that the visual modality has a much higher bandwidth than the auditory modality. In fact, while there are such absolute limits on the bandwidth of given modalities, most people who make such comments are talking about the bandwidth of specific channels. One can suggest, for example, that we can read words at the rate of 100 words per minute, whereas we can listen to words at the rate of 500 words per minute. This is not a comparison of the visual modality with the auditory modality, but a comparison of the printed text channel in the visual modality with the spoken text channel in the auditory modality. This is a very different thing.

  A further point to remember about bandwidth is that it is a theoretical maximum level at which information can be transferred through a channel. It is something that we are rarely likely to reach in practice.

- The reason that the bandwidth indicates a level that we are unlikely to see is that it assumes the perfect encoder and decoder. These are processes which are unambiguous and take zero time, so that the only constraint is movement of information along the channel. When we are dealing with humans this is unlikely to be the case. In particular, later chapters of this book will demonstrate that this decoding process is very much dependent on the individual. We will emphasize the importance of the psychology of interpretation as it applies to different individuals and different channels. A thorough understanding of the psychology of your intended audience and the subject knowledge that you are trying to communicate to them will allow the selection of appropriate channels and is key to the design of a successful multimedia artefact.

1.2.3 Medium

We can build upon these ideas to arrive at a description of what we mean by a *medium* (i.e. the singular of media). In general usage, something like a television is referred to as a medium. How can we usefully encompass that within our set of definitions? It is apparent that a television programme uses multiple modalities (auditory and visual) and multiple channels (moving picture, written text, spoken word, music, etc.). So what is it that makes it a single entity? We will define a medium to mean:

> A set of co-ordinated channels spanning one or more modality which have come, by convention, to be referred to as a unitary whole, and which possess a cross-channel language of interpretation.

Our definition makes several important points.

- Our medium must contain at least one channel or no communication happens. Spoken word radio is an example of a one-channel medium. The captionless cartoon (i.e. drawn not animated) is another example. Typically, however, we will expect there to be more than one channel in our medium. Radio is a medium which includes spoken word, music, and sound effects, on the channels which it encompasses. These channels are all in one modality, but our example of a television (above) shows a medium which has several channels operating across several modalities.
- Where we are dealing with more than one channel in a medium, our definition states that the channels are *co-ordinated* and that there is a *cross-channel language of interpretation*. These two properties are interconnected. The first means that a true medium must display some form of relationship between the channels. If you are watching pictures on television with the sound turned down while your partner is berating you for failing to do the washing up then this combination of channels is *not* a medium. This is because the channels are not co-ordinated: There is no intention for them to interrelate and indeed they are in competition.
- The *cross-channel language* indicates that this co-ordination of the channels adds an additional communicative feature which can only be understood through a combination of the individual channels. If I hear a character say 'Let me take that plate for you' followed by a breaking noise, then I know that a plate has been broken by combining the information from the two channels used. If I heard either alone, I would not realize its significance. This is an example of co-ordinated channels with a language of interpretation additional to that of either channel alone.
- The final important point in our definition is that this medium comes into being by *convention*. Television, a book, a radio, a newspaper, a