# Screen Space: Depiction and the Space of Interactive Media

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**Abstract.** The spatial properties of digital interactive multimedia are analysed and contrasted with those of pictures, and of narrative feature films and factual television. These media have developed distinctive spatial methods and questions arise concerning the transferability of such methods to other, interactive, forms. A taxonomy is proposed which reflects existing practice in digital interactive media and indicates promising lines of enquiry for the future.

## 1. Introduction

We propose a taxonomy of types of pictorial representation relevant to interactive multimedia. There have been many classifications of static graphics [noted in 17, 23, 9]. Many are focused on visualisation, whereas our aim is to categorise interfaces which are pictorial.

It is rightly assumed when discussing visualisation that the task objectives are the principal influence on the design. We extend this assumption to pictorial systems. This might appear controversial, since it may seem that the purpose of picturing is simply to *resemble*. However, Benford *et al* [4] consider the *degree of resemblance* to real space to be subject to the requirements of the task, and it will become apparent here that the objectives to which imagery is put and the context in which it is used are as decisive for pictorial as for non-pictorial graphics.

The spatial practices of film and pictures have extensive literature, but the spaces of interactive media (and indeed factual television) have been neglected. Boyd Davis [6] has identified some significant differences between spatial representation in media. These call into question the transferability of spatial practices from one medium to another, such as from narrative film or television to interactive media. The demands of interactivity have a strong effect on spatial appearance, and we predict that new genres will appear, incorporating as yet unknown spatial practices.

Before proceeding, it should be noted that here we treat alike those pictures which depict a real scene and those in which the scene is imaginary. We describe a number of projects of which some are unpublished: these tend to take a more adventurous approach to spatial articulation than commercial counterparts, using spatial innovations in part to overcome the technological limitations of standard computer platforms.

## 2. Characteristics of spatial practice in interactive multimedia

Interactive digital media comprise technological support systems for diverse emergent genres. Spatial practices within interactive systems diverge greatly and are, we argue, immature: form fails to articulate meaning. We illustrate the taxonomy to show how the spaces of interactive media have not as yet acquired the expressivity of their more mature predecessors. This is partly because there is insufficient shared understanding between makers and users (which only time can produce), but partly because insufficient attention is paid to the special problems of interaction.

Two important influences on the spatiality of multimedia are: the desire to offer multiple representations, leading to a variety of composite displays [25, 24]; and the need to provide access to more information than can be displayed on screen at once, necessitating some kind of selection. The distortion-oriented presentation techniques intended to solve problems of detail and overview for visualisation [17] are more difficult to apply where the mode of representation is pictorial.

The book metaphor common in early interactive computing has been largely superseded by spaces derived from more fluid, image-rich technologies like film and television. Makers of interactive multimedia artefacts imitate apparent strengths of these other media. This may be counter-productive, taking insufficient account of differences in objectives and modes of use. The more freedom given to the user, the greater the difficulty of using the practices of spatial articulation exploited in film, since these are outcomes of authorial control. Boyd Davis and Athoussaki [6] and Persson [20] discuss ways in which spatial techniques of cinema could be repurposed for interactive systems through greater use of the variables of viewing such as selective focussing, but such borrowings lead to problems. For example, Hindmarsh *et al* [14] note the problems in making spaces coherent without the authorial control which narrative provides. The difficulties of such transfers are discussed in relation to particular examples below.

We read of media 'convergence' [18, 10], but integration of different spatial forms is elusive. Macromedia *Director* in conjunction with image manipulation tools such as Adobe *Photoshop* has given recent developers more ways of integrating media technologies, but this is not trivial even with such tools. Nevertheless, the combining of pictorial and other segments in single displays is now often taken further in interactive media than in film or television. Segments can be combined into seamless surfaces, often with multiple viewpoints, scales and modes of representation. Such amalgams go beyond mere configuration of parts and approach the status of pictures in their own right, pictures whose spatiality is designed in response to the demands of interaction.

## 3. The importance of interactivity

Interactivity is not just an additional layer imposed on existing forms of spatial articulation, but fundamentally influences deployment of those forms. The user must be provided with objects with which to interact by pointing. The tools of interaction such as joysticks, joypads, mice and keyboards, have been described as 'curiously

alienating devices' [21], and pointer-based interaction significantly constrains spatiality, since pointing requires the presence of an object whenever the user may wish to interact with it, a requirement quite unlike that of film or television where objects previously seen are assumed by the viewer to remain 'present' when no longer on screen. This can also be seen as a major difference between graphical user interfaces and the command line interfaces that preceded them which had no need to display a representation of objects. Multimodal interaction, allowing the user to interact using a mode such as speech [8, 19], could radically affect this spatial characteristic of interactive multimedia since users could then address items not currently visible. Grasso *et al* [11] list comparisons between graphical and multimodal user interfaces, but omit this important fact that graphical interfaces need to visually represent all available objects. This will be seen to be a fundamental problem for most of the artefacts under discussion.

## 4. Towards a taxonomy

We make a distinction between pre-pictorial and pictorial spaces, borrowing from the approach of synthetic computer graphics in which it is normal to conceptualise two sets of decisions in the design of a picture: one involving the geometry and attributes of the model—that which is to be depicted—while the other relates to the visualisation of the model necessary to its display, including such factors as projection system, mode of rendering, point of view, framing and so forth. It is instructive to consider this framework in relation to other pictorial forms. In the case of a photograph, there may or may not be opportunities to manipulate the pre-pictorial or model space, but there will certainly be opportunities to control many aspects of the picture (above all, point of view and framing). In the case of painting, the pictorial freedoms are far greater, even involving the use of inconsistent projective geometries and of course the depiction of scenes which have never existed. A range of pictorial means has evolved (over centuries in the case of painting) which enable the picture-maker or film-maker to produce certain effects in the viewer [3, 12]. In both cases, the author is sovereign since the user of the picture never sees any more than the author permits. These are essentially pictorial media.

Film might be thought analogous to a virtual environment, since in film there is a scene to be depicted and a depiction. However, this is not a useful characterisation, since it overlooks the fact that the filmmaker decides what should be seen in every shot at every moment. This pictorial character is highlighted by two factors. In fiction film, many 'scenes' are in fact sets, which are designed entirely in the light of how they will be seen by the camera. And scenes often comprise footage from different places and times [5,15] so that the apparently unitary pre-pictorial space does not in fact exist. This contrasts with the space of a virtual environment, in which to a large extent the user may look anywhere. Most current virtual environments are thus—by our definition—far less strongly pictorial than film, though, as we indicate below, the user's freedom of viewing is not complete.

We use the proposed taxonomy to argue that the displays of interactive digital media can productively be considered as a form of picture-making.

## 5. A spatial classification of pictorial interactive media

We divide the uses of space in interactive multimedia into seven categories:
1. simple assembly
2. two-dimensional pre-pictorial space
3. three-dimensional pre-pictorial space
4. pseudofilmic space
5. hybrid space
6. integrated spaces combining pre-pictorial and pictorial space
7. pictorially dominated space

These range from simple assembly of pictorial components in the plane and in (shallow) depth, through to new pictorial forms designed to support the demands of interaction within the limitations of the technology. Not surprisingly, these new forms are largely derived from inherited practices reinterpreted to meet new objectives. The categories proposed bring out different relations between the design of pre-pictorial models and the pictorial views by which they are presented to the user. These are related to modes of interactivity. We discuss examples illustrating the seven categories.

### 5.1 Spatial configuration: simple assembly

There is a need to place multiple elements in a single space to make them accessible to vision and interaction. This can lead to segmented spaces like those of the television news broadcast, using juxtaposition and layering of related elements. The spatial organisation of software applications tools such as Adobe Photoshop offers interface objects in discrete areas. The relationship between them is not articulated, so it is not generally apparent which objects control which until the user becomes accustomed to each application.

**Fig. 1**. Maltez, Bennett and Cova 1997: Interactive Documentary 'Contact'. The user chooses between the main video narrative sequence and supplementary narratives which appears when appropriate in the space. Choosing is done by simply pointing at the item of interest.

A typical device in interactive systems is the opaque overlay which occludes underlying material. Lack of visual semantic relations between windows in the pile,

and the fact that windows the user needs to access may be obscured by others, reportedly lead to poor user performance compared with configurations which preserve the visibility of every item [16].

Another approach based on juxtaposition is adopted in *Contact* (Maltez, Bennett and Cova 1997), a prototype interactive documentary, which more resembles factual television (Fig. 1). The user may advance or step back in separate narratives by interacting at any time; ancillary information is offered at predetermined points in narratives, and the user can interrogate individual components of the interface, though authorial control is strongly maintained within each narrative strand.

There is clearly work to be done in considering how simple assembly styles may be more fully articulated to assist the user in understanding the relations between segments.

### 5.2 Two-dimensional pre-pictorial spaces

We define as pre-pictorial those spaces which can usefully be considered to exist independently of any particular view. In the simplest cases such spaces are two-dimensional but extend beyond the boundaries of any single view. For example *Britain in Brief* (Foreign and Commonwealth Office 1997) offers a six-by-five array of iconic pictures based on photographs. Clicking one of the pictures leads to other screens. The user is never permitted to see all thirty pictures at once since only about four fit the display (Fig. 2.) and there is no facility to zoom-out for a broader view (nor, as a Web-user might expect, to alter the frame of the window). This is clearly deliberate, since there would be sufficient space to exhibit thirty such images at a usable size in a single screen.

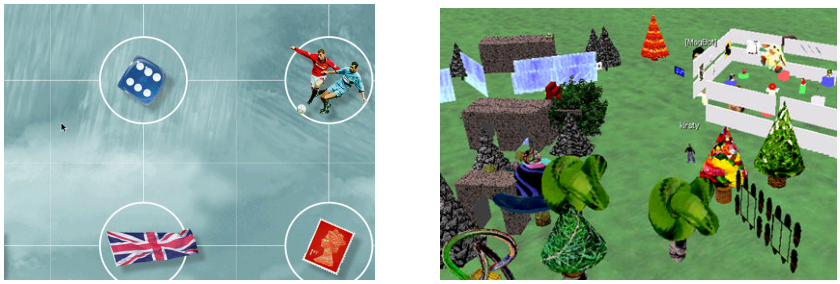

**Fig. 2.** Examples of 2D and 3D pre-pictorial spaces in Britain in Brief and the VERTEX environment built by young school children Bailey and Moar (2001) in ActiveWorlds.

The character of the space used in this particular product is indicative of some special issues associated with digital media. The user might expect the boundary of the scrolling model-space to be reached, as when scrolling in a word-processor or Web browser, but attempts to scroll horizontally or vertically reach no boundary: the space wraps back on itself. This topography could be conceived as drawn on a torus, but there is no visual evidence of curvature; the graphic suggests the model lies in a plane surface. As with film, it is experience of the visuals over time which constructs

this ‘space’, as much as any single view of it, but in this case the single view and the aggregation of views offer contradictory evidence. Such indeterminate or contradictory spaces are particularly facilitated by digital media.

The window renders in unmediated fashion the view of the ‘model’ beyond. No aspect of the view is altered in response to what is viewed, unlike in painting for example where it is normal for a picture to *re*-present the observed scene—to create a space—rather than simply to open a frame upon it. Here by contrast the window really is just a window.

### 5.3 Three-dimensional pre-pictorial space

Many three-dimensional digital spaces are also essentially pre-pictorial; users can look where they wish in the space and no accommodation is made in the view. For example, most *virtual worlds*, such as ActiveWorlds (Fig. 2) allow the user largely unconstrained and unarticulated views of the model. The geometry and other attributes of this world exist independently of any particular view, and there are none of the opportunities to engineer a particular pictorial outcome in order to fulfil particular objectives which are inherent in authored picture-making. Nevertheless there are limitations on viewing. The focal length of the virtual lens is fixed and certain viewing angles are forbidden; the viewpoint may not pass in an arc through the vertical. In addition, since the user is by definition an inhabitant of such shared spaces, the viewpoint is always either through the user’s eyes or over the avatar’s shoulder (a clear borrowing from film).

The viewpoint typically does not respond to the kinds of scenes or action depicted as it would do in film. However, work by He *at al* [13] and by Tan *et al* [22] begins to apply cinematic approaches to depicting virtual worlds, as does the design of some computer games, in which for example crashing one’s car triggers the display of an aerial view of the scene. This is a move towards considering the presentation of such worlds as a depictive process.

### 5.4 Pseudofilmic space

Pseudofilmic spaces are pictorial in a similar sense to film since, though the user may move about the space to a certain extent, every view is chosen by the maker. Exploration games in which a user’s chosen trajectory is responded to by pre-rendered views fall into this category. The user infers that there is one consistent pre-pictorial model of which views are scenes. This approach was originally adopted to cope with performance limitations in the delivery of 3D scenes, but some of its benefits may not be abandoned even when this is not a consideration.

Many artefacts in this category involve some degree of entertainment, such as CD-ROM ‘edutainment’ titles, adventure and strategy games. They try to make the space immersive by eliminating counter-cues such as the paraphernalia of the everyday computer screen, or at least to subordinate such items as far as possible. In this they aspire to the apparently unmediated qualities of the fiction film. Unfortunately, given the visual constraints from interaction noted earlier, this immersive quality is often

interrupted, for example by dialogs and floating tools which exist in an awkward visual relation to the main scene.

An aid to a sense of continuity is the use of environmental sound which is uninterrupted by changes of view. This technique, noted by Persson [20], is an important means by which film conceals its intermittent visual nature, but is outside the scope of this paper.

### 5.5 Hybrid space

Hybrid spaces combine some of the characteristics of simple assembly with those of three-dimensional worlds, reflecting the combined demands of presentation and of interaction. Such juxtaposition of spatial methods might be disconcerting, but in practice for involved users these spatial hybrids have become acceptable, partly through the efforts of designers to disguise incongruities. It is possible that this impression of incongruity is itself a temporary phenomenon arising from the relative unfamiliarity of these spatial configurations, and that in future they will come to be seen as transparent and natural.


**Fig. 3.** Chung et al. 2000: Virtual Office, a project visualising a shared virtual work environment. Translucence is used to integrate components with different spatial modes.

A prototype shared workspace tool is given as an example of hybrid space (Fig. 3). Many computer and console games similarly offer central pictorial views with an accretion of supplementary views and tools in the periphery of the display. In Fig. 3, translucence is exploited (a characteristically digital trait) in an effort to integrate pictorial and other components. The axonometric views also have the effect of allowing the overlaid textual and iconic elements to be seen as more tightly integrated than if convergent perspective were used.

The position and visual integration of the chat window give it the character of a speech bubble in a cartoon (cartoons are a rich area of multimodal representation deserving study as spatial artefacts), so it seems part of the space while still being accessible to the user. Like a head-up display for a pilot it also ensures the user may encompass diverse stimuli within a narrow visual field. Use is made in this project of techniques derived from film to bind together separate spaces which are juxtaposed only in time and not in the display: a user seen leaving the room by the lift is next

shown emerging from the lift in another space. No other visual information is needed for users accustomed to film techniques.

### 5.6 Integrated spaces: combining pre-pictorial and pictorial space

In the pre-pictorial and hybrid spaces discussed above it is possible to separate the model from the view so that a coherent pre-pictorial space can be imagined, but in some artefacts the depiction undermines the distinction between view and model.
An example, *Upholstery Weekend* (Eberle 1996), is an animated narrative and is not interactive, and this indicates important aspects of the relationship between film practice, digital space and interactivity. The artefact draws attention to the process of representation for ironic purposes. This is not a unique characteristic of digital animation: traditional animators have also made media-conscious jokes of this kind (for example, a character climbs out of a hole, then picks up the black oval representing the hole). The pre-pictorial 'space' is defined only by the relationships between a small number of objects which are displayed without backgrounds. As in classical film, optimal views from varying viewpoints are exploited to afford the best possible view of an event or situation as well as to create visual interest and engagement. For example, an armchair threateningly approaches a small toy. Next, the victim appears significantly smaller; the approach of the predatory armchair is more easily assessed. There is a brief cut-away to an extreme close-up point-of-view shot of the front of the armchair before the armchair crushes the toy.

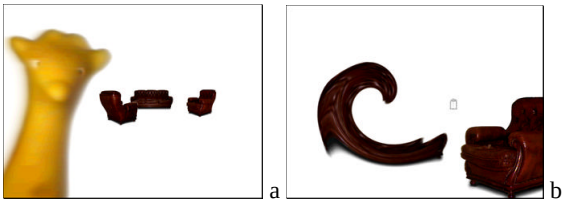


**Fig. 4.** Eberle 1996: *Upholstery Weekend*. In ***a***, focus is used to create distance and increase the drama of a near object. The evocation of a pre-pictorial space is abandoned in ***b*** by severe distortion of a sofa, forcing the user to 'see' the representation for what it is.

Later defocusing (almost entirely neglected in digital media outside high-budget feature films) gives extreme depth to the 'shot' (Fig. 4). The impression that a second small toy is in the near foreground is a visual joke, since it turns out that this is in fact a giant toy seeking revenge. This seems only a witty exercise in pre-pictorial space, but subsequently the coherence of the pre-pictorial space is subverted when a sofa is transformed in a wholly pictorial way which has nothing to do with the space which it seemed to occupy.

This animated narrative apparently constructs, but then undermines, a pre-pictorial spatial environment. Its strengths arise precisely because it is a wholly authored experience. Far from representing a solution to the difficulties of pictorial interactive media, it confirms them, by underlining the expressivity of authored depictions of

space in which the maker decides exactly what shall be seen, from where and when. Every shot is designed in the known context of what precedes and follows it.

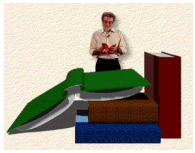

**Fig. 5.** Donald Norman 1994: *Donald A Norman—defending human attributes in the age of the machine*, CD-ROM 1994. Integrated components dissociated from their original photographic contexts, and recombined into a new form of picture.

Similar recombination of photographic and quasi-photographic elements into new 'pictures' has however also been used in interactive media. In a Voyager CD-ROM of 1994 an animate Don Norman is inserted into a new space at a new scale and with shadows which belong to the environment of the virtual page rather than to the real environment in which filming took place (Fig. 5). Such practices are pictorial: the designer *makes space* rather than simply opening a view upon it. Often there is a resemblance to pre-Renaissance forms of picture-making where each component has its own optimal view (and therefore perspective geometry) largely independent of the other components, but all are nevertheless organised into a unitary composition.

### 5.7 Pictorially dominated space

Differentiated from the previous category not in kind but by the degree of pictorial arbitrariness, the final class of pictorial space takes further the possibilities of recombining dissociated graphical elements into new spaces. Such integrated digital spaces have antecedents in traditional media, such as photomontage which combines fragments taken from their original contexts and assembles them in a unified composition with a conventional underlying pictorial structure; numerous examples are given by Ades [1]. However, we suggest that interaction differentiates the case of digital media from that of static photomontage. Whereas we have previously presented interaction as something of a problem, here we emphasise its beneficial effects on pictorial coherence.

*Eclipse (*Holley *et al.* 1998*)* constructs a space from such dissociated graphics, coercing disparate elements into a pictorial ensemble which, when interacted with, operates as an integrated system. This is not simple graphical assembly but neither is it a depiction of apparently pre-pictorial space. For example, an astronomical device is brought into direct connection with the heavens which it surveys, pictorially uniting disparate elements. It facilitates mixed modes of presentation, so it does not seem incongruous to see spatial coordinates presented as text which alters and moves as the space changes. Actions on one part affect the behaviour of the whole display, creating a coherence which exceeds any purely pictorial unity. There is an analogy here with the acceptability of editing in film which is unlike natural vision but is nevertheless

perceived as in some sense ‘natural’ and has through custom become almost invisible to the film viewer.

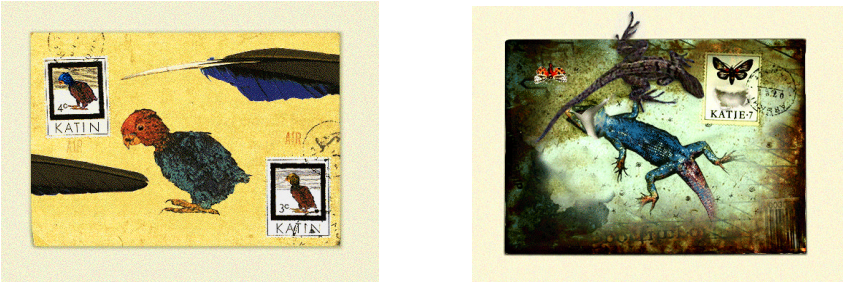


**Fig. 6.** Mayhew 1997: Ceremony of Innocence. This CD-ROM explores the boundaries between levels of representation.

A final example is *Ceremony of Innocence* (Mayhew 1997), an interactive narrative about a surreal postcard correspondence that makes visual puns on the nature of representation. The narrative suggests that one of the correspondents may have invented the other, so ambiguity and self-reference of representation and of space are appropriate. By representing picture postcards, everything seen is already depictive to at least one degree (Fig. 8). The user interacts with graphic elements in ways which fluctuate between interacting with the scene depicted and with the depiction itself. The bird is also depicted in stamps on the card, confirming its pictorial status, yet it moves, squawks and eats when coaxed by the pointer. The cursor, normally the user’s ‘property’ is often captured by, or becomes part of, the representations with which it interacts.

The point of this paper is to elucidate different spatial forms which have emerged to serve differing requirements. The spatiality of *Ceremony of Innocence* does not offer a paradigm for other kinds of interactive media. Its objectives are relatively simple, to allow the user to progress through a narrative by means of interaction, whereas many of the problems of devising expressive spatial organisation in interactive media arise from the competing demands of widely varying functions.

## 6. Conclusions

We distinguished seven classes of spatiality in pictorial interactive media. Particularly relevant to interactive media is the situation when the parameters of viewing and picturing are authorially determined, but specific views and pictures are not. While the spatialities of pictures, of film and of television seem to have a high degree of fit with their objectives, the spaces of pictorial interactive multimedia are, with rare exceptions, awkward amalgams of the spatial practices of antecedent media. In general these spaces not only fail individually to serve the functions (both affective and utilitarian) of the artefact but when combined together fail to operate together in a coherent way. We have argued that some of these problems could be solved by a

greater consideration of how existing pictorial media work. However, we have shown that it is not a matter of simply transferring existing spatial practices to the newer medium, but of developing new means of achieving similar ends. There is a need to rethink inherited pictorial and spatial practices to suit the demands made on the artefact. It is useful to remember ways in which digital interactive media are unlike their antecedents: they require (at least currently) the display of everything with which the user may interact; the visual experience is only partly authored, reducing the maker's control over viewing and picturing at any moment; for the same reason, there are fewer narrative possibilities for structuring the user's experience over time. These differences affect the spatiality of the medium, and the different genres which the medium supports, fundamentally.

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