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The interface as a space. The space as an interface.

Letizia Bollini

The book explores the transition from early models of human-computer interaction, based on two-dimensional graphical interfaces, to contemporary experiences rooted in 'phygital' spaces, where the physical and the digital converge. Interaction is no longer limited to the mediation of devices, but unfolds within environments where bodily experience, spatial contexts and sensory engagement play a central role, also in redesigning new relational paradigms.
This transformation challenges traditional design approaches, shifting the focus from mise-en-page to performative and choreographic paradigms. Through a historical, theoretical and critical perspective, supported by design case studies, the book examines this evolution and proposes the '3e model', a new interpretative framework.

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Letizia Bollini
The interface as a space. The space as an interface.

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No time, no space
Another race of vibrations
The sea of the simulation
Keep your feelings in memory
I love you, especially tonight

—Franco Battiato

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The choreographic paradigm

When, in 1991, Brenda Laurel proposed the *metaphor of the theatre* to describe the interactive relationship between people and digital technologies, the model was still applied primarily to two-dimensional interfaces displayed on a computer monitor or to those of simulated three-dimensional environments, typically found in video games based on virtual representations of space. In this conceptualisation, however, certain fundamental elements are already present, namely the role of users – human and otherwise – who are referred to as interactors, and thus an active part of the staged representation of what we might call, drawing on the artistic avant-garde of the early 20th century, the 'happening' – an event involving co-presence and participation – and of the 'blended' realm of interaction.

Over the years, the evolution and maturation of technologies, the cyclical resurgence of certain ideas such as virtual or immersive reality, the mobile revolution, the integration of electronic components into objects – the Internet of Things and smart objects – and subsequently into physical spaces – the smart environments – have transformed the relationship between people and digital technology.
The original 'zero posture' – a person sitting in front of a computer with a keyboard and mouse – is increasingly being replaced by our interaction within a space that has become hybrid, 'phigital' – a space in which the real and digital dimensions collapse, merge, and integrate into an experiential *continuum*.

Just as our experience of the world and our relationships is increasingly mediated and enhanced by digital technologies, so too must our perspective on design change and adapt in order to play a meaningful and ethical role in these transformations. This transition challenges us to re-examine many of the approaches, paradigms, and practices we have adopted so far for designing experiences, interfaces and interactions. In particular, we need to rethink and reinvent the concept of two-dimensional layout – the *mise-en-page* – which was previously applied to the flat surfaces of interfaces, screens and devices. We are, in fact, moving towards performative spatial interactions based on choreographic paradigms rather than compositional ones.

Design is called upon to stage interaction within a blended space, where people and technologies engage in dialogue with one another.

The book, *The interface as a space. The space as an interface*, seeks to summarise these concepts and developments and to explore them through a theoretical conceptualisation and a series of analysed and discussed case studies. They allow us to see how this relationship between the digital and the real, between people and technologies, is reconfigured in the light of a spatial, situated relationship. Here our corporeality and our sensoriality, once again, play a significant and strategic role in the interaction itself, and how this relationship between space and people can be interpreted, transformed, and invented.

The volume traces an evolutionary path that begins with *the interface dilemma*, the crisis currently facing design in this field.
The chapter seeks to focus precisely on this profoundly transformative moment regarding the design paradigms of interfaces and interaction, retracing in a historical-critical manner some of the inventions emerged since the late 1950s and early 1960s within the world of human-computer interaction.
The chapter also seeks to highlight a whole series of profoundly pioneering experiences, such as those of Douglas Engelbart, Ivan Sutherland and Ted Nelson, who were able to foresee potential technological developments long before the technologies themselves existed or had reached the necessary maturity to implement some of these pioneering visions.
From the theatrical metaphor for describing interaction, drawing on Aristotle's *Poetics* as proposed by Brenda Laurel, to Nelson's imaginative inventions of *hypertext* and *hypermedia*, from the experimental explorations of the *Visible Language Workshop* and Mariel Cooper's *Information Landscapes*, right up to the desktop metaphor of Apple's graphical interface, designed by Susan Kare, upon which we have shaped ourselves, the chapter traces the phenomena that foreshadowed possible visions – now a reality – in the evolution of the relationship between people and technological *prostheses*.

The second chapter, on the other hand, focuses on the 'phygital turn' – the transition we are currently undergoing. Digital technology, which

originated in the world of computing, is now finding its way into our pockets, into objects, into our surroundings and into the fabric of our daily lives. This implies to face and embrace the critical shift in the design paradigms of experience, interaction, and interface evolution.

It is the transition between concepts – borrowed from editorial design and mimicking the world they represent, such as layout and the composition of two-dimensional space – and those of *mise-en-scène*. In this paradigm, multidimensional space – which also includes time – becomes a variable, a defining parameter of our interactions. Here, physical and digital space merge, intertwine and blur, offering us a situated and embodied experience.

The third chapter explores the concept of the *interface as a space* that is shifting away from traditional two-dimensional forms – Graphical User Interfaces – towards new potential languages and models.
Interactions are becoming multimodal, gestures are more natural, and even our own kinetic-sensory dimension is becoming an asset to be explored and experimented with. People, data, artefacts and places enter into a dynamic dialogue mediated by digital technology, exploring new narrative and communicative forms.

The fourth chapter proposes a further elaboration of *The e3 model* as a possible framework within which three different possible modes of interaction between devices – which may be technological or our own bodies – the mode of interaction and the relationship with the physical-spatial dimension are summarised and synthesised. The three levels or three possible paradigms are *embodying*, *embedding* and *expanding*, which involve the use of the body, objects or space itself as mediators of interaction.

Chapter five focuses in particular on the third parameter – *expanding* – understood as the potential for developing new design models.
Space itself becomes an interface and, in doing so, enhances and *augments* our ability to interact and to give meaning within the phygital worlds in which we find ourselves interacting and acting. The body, movement, gesturality, and position in relation to the context and other interactors are the new criteria of choreographic interfaces in which experience has become performative. A series of case studies illustrate in real terms, and in the light of design culture, how these different models of interaction and experience can be interpreted beyond their conceptual elaboration in the design practice.

The book concludes with open questions or with a possible reflection on the further digital revolution we are experiencing, namely that of Artificial Intelligence and its *agentic* role. In this regard, being situated in a specific context, of experiencing through our bodies and via our senses, in a contingent time – that is, the fact of being *empirical beings* – is precisely what still distinguishes our existence and interaction from AI: a specificity of ours that may enter into conflict or dialogue with these new actors of the phigital ecosphere.

Buona lettura!

Milano, Bologna, Bolzano, in the cloud, April 2026
Letizia Bollini

The interface dilemma. Information technologies have evolved from specialist *tools* into pervasive *media* that are integrated into everyday life, merging the material and symbolic dimensions into a *post-digital* experience in which the real and the virtual converge. Despite this evolution, interaction and interface design seems to remain anchored to the GUI paradigm, which emerged in the 1980s, based on visual metaphors and the 'zero posture', i.e. *person-keyboard-screen*. Whilst making things accessible, this model now limits new possibilities, even though visionaries such as Ted Nelson and Muriel Cooper had already anticipated and explored hypermedia, dynamic and multisensory scenarios. Today, there is a growing need to move beyond two-dimensionality and mimetic metaphors towards more embodied, immersive and situated interactions.

The interface dilemma

From their initial debut as 'prostheses' for automatic calculation and computation, limited to a narrow niche of uses and users, information technologies have become a constant, pervasive and inseparable part of our daily lives.
Their distinctive nature lies precisely in their dual status as *electronic-digital* artefacts that

combine a material component (consisting of their physical form) – which is essential for performing their intended functions – with a symbolic component (consisting of the names of their parts and functions, and the rules that govern their operation and enable their use) – which gives them meaning.

—De Michelis, 1998, pp. 8–9

The latter consists of software, whilst the hardware brings it into being. Both planes, which are inextricably linked, generate an experience that is no longer divided between the real and the virtual (Maldonado, 1992) – if indeed it ever was – but fused into a hybrid and, by now, post-digital dimension, where the concept of 'post' does not denote a temporal value, but rather a paradigm shift in which the distinction between the two planes no longer makes sense.

The most profound technologies are those that disappear.
They wave themselves into the fabric of everyday life until they are indistinguishable from it. Consider writing, perhaps the first information technology. The ability to represent spoken language symbolically for long-term storage freed information from the limits of individual memory. Today this technology is ubiquitous in industrialized countries.

The constant back¬ground presence of these products of "literacy technology" does not require active attention, but the information to be transmitted is ready for use at a glance. [...] *Such a disappearance is a fundamental consequence not of technology but of human psychology. When people learn something sufficiently well, they cease to be aware of it.* [...] *the philosopher Michael Polanyi calls it the "tacit dimension"; psychologist J. J. Gibson calls it "visual invariants"* [...] *only when things disappear in this way are we freed to use them without thinking and so to focus beyond them on new goals.*

—Weiser, 1991, p. 94

The transformation we are currently experiencing has deep roots that were already foreshadowed in the late 1990s, at the dawn of the Internet revolution and well before the mobile one, which coincided with the launch of the first iPhone in 2007.

Whilst Weiser was already discussing the pervasiveness of technology in our daily lives as early as 1991, Negroponte identified trends that we now see coming to fruition:

The computers as we know them today will a) be boring, and b) disappear into things that are first and foremost something else: smart nails, self-cleaning shirts, driverless cars, therapeutic Barbie dolls, intelligent doorknobs that let the Federal Express man in. [...] *Computers will be a sweeping yet invisible part of everyday lives: We'll live them, wear them, even eat them.*

—Negroponte, 1998

In the light of these transformations, design – in its various forms – interaction, experience, communication, interface and space – is faced with the need to reconfigure its role, processes and paradigms in relation to the project of these converging worlds (Jenkins, 2006): the *physical* and the *digital*.
This initial convergence is already articulated in the very definition of interaction design formulated in 1984:

There was an opportunity to create a new design discipline, dedicated to creating imaginative and attractive solutions in a virtual world, where one could design behaviors, animations, and sounds as well as shapes. This would be the equivalent of industrial design but in software rather than three-dimensional objects. [...] *I described it as "soft-face", thinking of a combination between software and user-interface design.* [...] *We went on thinking of possible names until I eventually settled on "interaction design" with the help of Bill Verplank.*

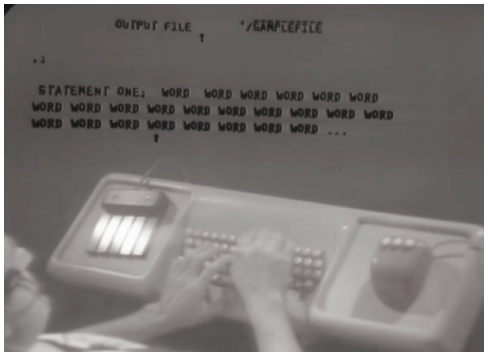
—Moggridge, 2006

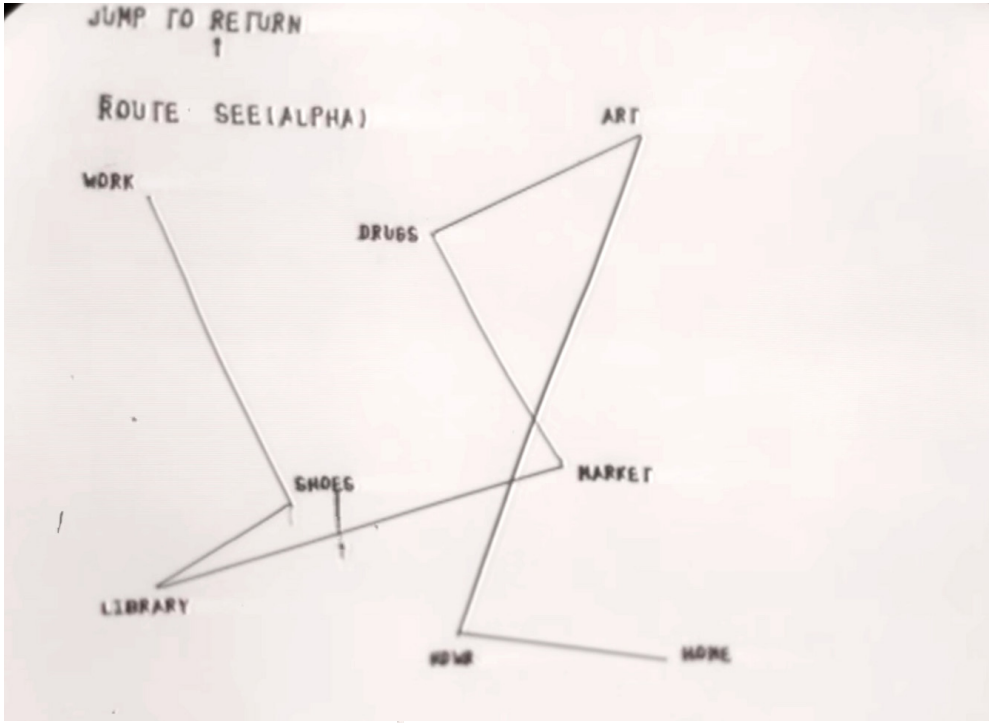
In this context, however, design and technology are moving at different speeds.

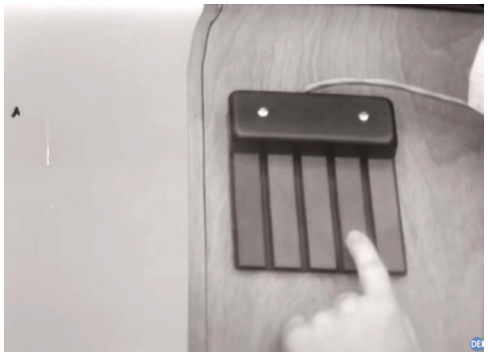
In the beginning, there were GUIs

In the field of interface and interaction design, we are still operating within the paradigm of GUIs (*Graphical User Interfaces*), which emerged in the 1980s, despite the profound transformations the sector has undergone in recent decades and years.
Several factors have facilitated the transition from text-based to graphical interfaces (Raskin, 1994). The most significant is the reversal of the relationship between the computer and people, in a way that favours the latter. Instead of learning the language of the machine, people find themselves operating within a mimetic metaphorical sce-

1—Douglas Engelbart, 9.12.1968
The mother of all demos
Association for Computing Machinery
Institute of Electrical and Electronics
Engineers (ACM/IEEE)
Computer Society's Fall Joint Computer
Conference in San Francisco

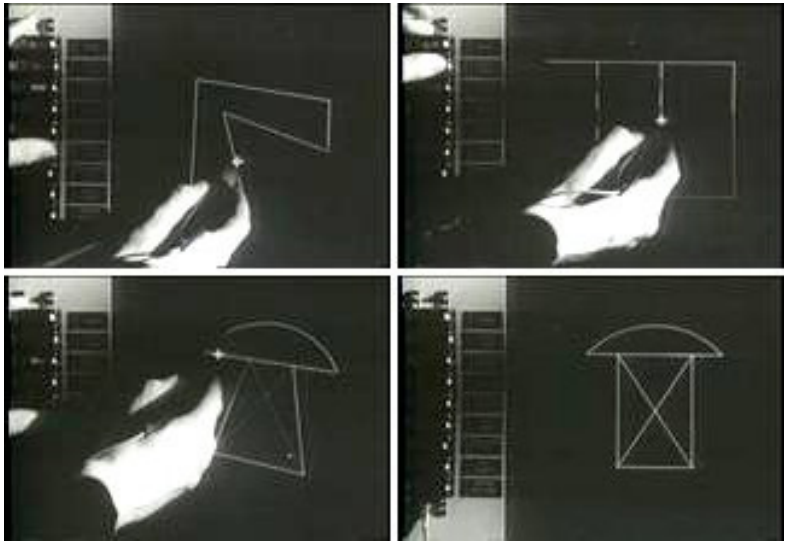






nario (Bollini, 2016) that is familiar and easily interpretable, making the computer a mass-market and accessible object.
This conceptual shift is accompanied by a series of technical inventions that form its practical foundation. On the one hand, the introduction of the mouse, conceived by Douglas Engelbart and developed in collaboration with Bill English from 1963 onwards (Edwards, 2008), is the essential step towards enabling direct manipulation on the display surface (Shneiderman, 1986) On the other hand, explorations such as the Sketchpad developed by Ivan Sutherland in 1963 open up a new perspective regarding the possibility of visual interaction, which lies at the very foundation of graphical user interfaces.

2—Douglas Engelbart, 1963
Engelbart's prototype of a computer mouse, as designed by Bill English from Engelbart's sketches



3—Ivan Sutherland, 1987
Ivan Sutherland demonstrating Sketchpad, frames from the video Alan Kay: Doing with Images Makes Symbols

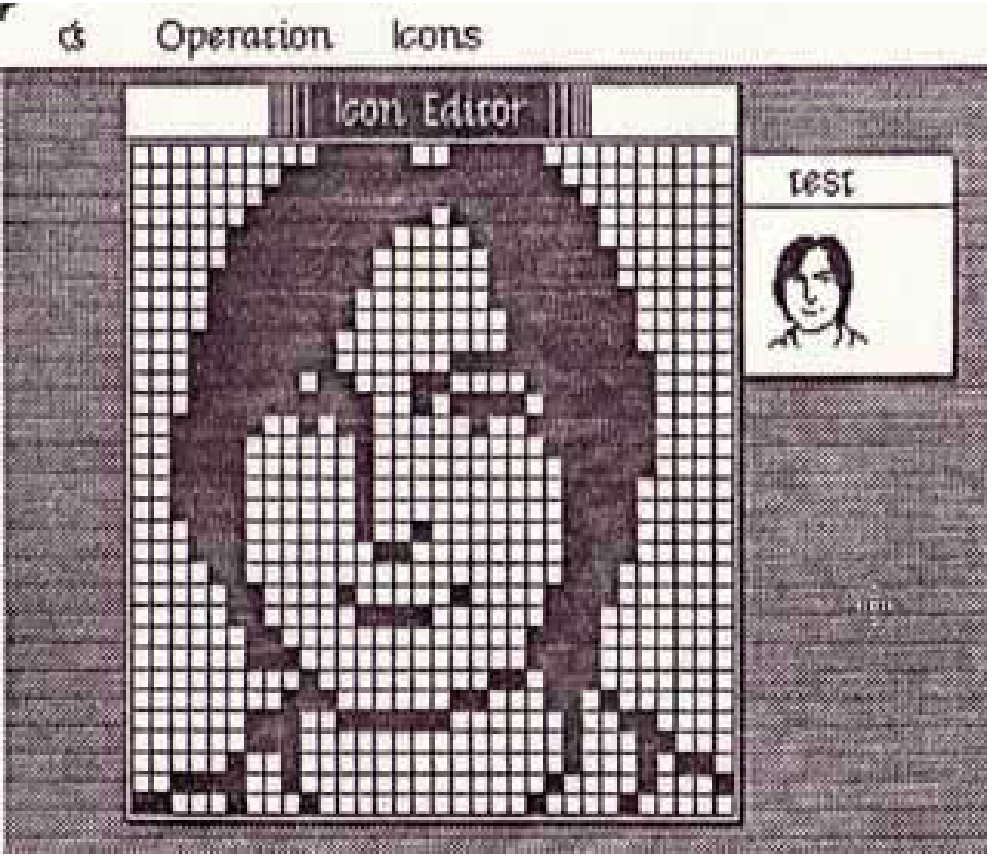
As early as the 1968 event organised by Engelbart and members of his team at the Stanford Research Institute, we see a possible synthesis of all these hardware and software tools and, above all, their potential interactions. During the demonstration, many of the paradigms theorised previously were synthesised into a working experience.
From the new way of thinking theorised by Vannevar Bush (1945), to the mouse itself, from the vision of future media and the global village (the internet!) advocated by McLuhan (McLuhan & Fiore, 1968), to the non-linear notation conceptualised by Landow (Landow & Delany, 1993), from the sketchpad to Ted Nelson's (1965) hypertext and hypermedia, the manifold possibilities for interaction offered by the 'dreaming machine' are clearly visible and already foreshadow the possibility of remote collaboration and the integration of the real and the virtual.

The *Visual Operating System Interfaces* developed in the Xerox Park laboratories for the Xerox Star System by the pioneers of the digital revolution, including Alan Kay and Adele Goldberg (Malone, 2024), represent the first experimental exploration of the visual-metaphorical language that underpins GUIs.
The desktop metaphor, the concept of icons and windows (already present in the 1968 demo) were definitively established through the visual design work of Susan Kare (Malone, 2024). Her icons and typefaces, designed pixel by pixel to recreate the quality of traditional graphics in a low-resolution world, became the paradigm that still dominates our digital experience today, mediated by the two-dimensionality of screens.

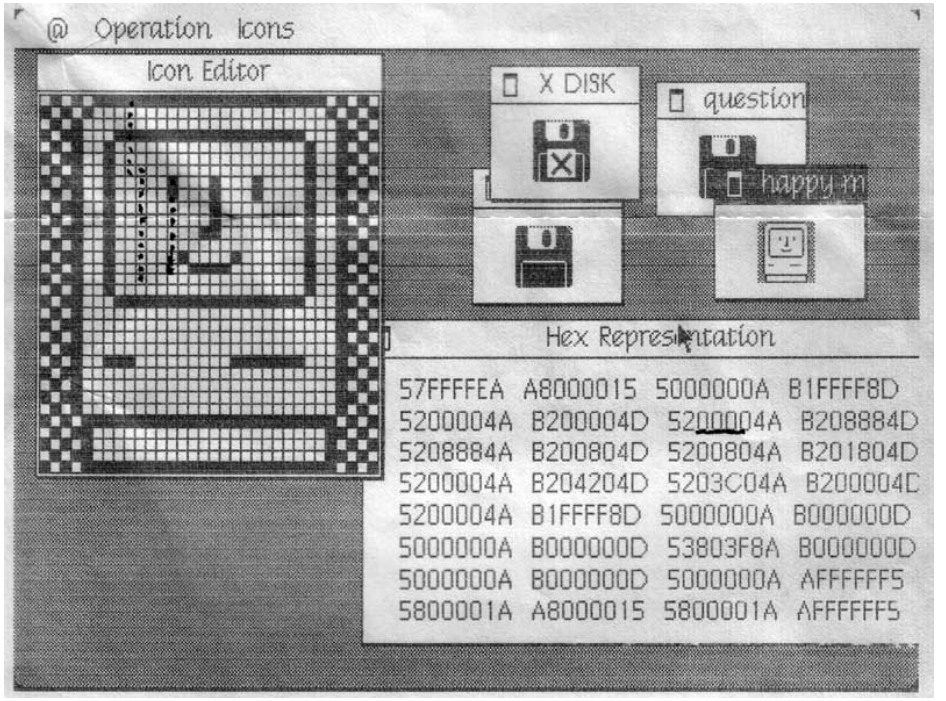
In February 1983, I worked on putting together an icon editor for Susan Kare to use to create icons for the Finder. Susan started working on icons for the Finder, but she also would draw lots of other images as well, for practice or just for fun, usually reflecting her whimsical sense of humor. One day, I came over to her cubicle to see what she was working on, and I was surprised to see her laboring over a tiny icon portrait of Steve Jobs.

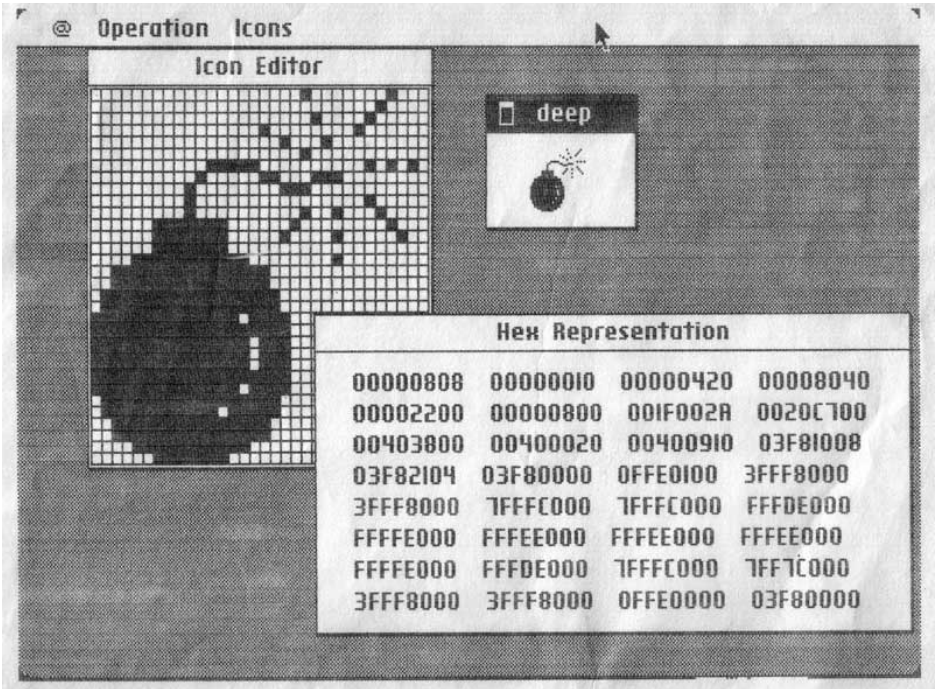
Icons were only 32 by 32 black or white pixels, 1024 dots in total, and I didn't think it was possible to do a very good portrait in that tiny a space, but somehow Susan had succeeded in crafting an instantly recognizable likeness with a mischevious grin that captured a lot of Steve's personality.

—Hertzfeld, 1983



4—Susan Kare, 1983
Steve Jobs' icon in the Icon Editor





5 / 6—Susan Kare, 1983
The "Happy Mac" icon
and the Mac ROM source code

The "bomb" icon and the Mac
ROM source code

7— Susan Kare
Original Mac fonts

Susan Kare herself reflects on her experience, discussing her work – now part of the collection at MoMA in New York – in an audio interview available on the museum's website:

It was my first pen to paper thinking about how do you create symbols using a small number of monochromatic pixels. Because I didn't have a computer at the time (!).
When I got to Apple there was a tremendous focus on designing the Macintosh so that it would be, as the ad said, "the computer for the rest of us." And a big part of that was using visual design to communicate. [...] *Little pictures and symbols made that computer accessible. So I think in that way design did, and can, serve as a bridge to be a great equalizer.*

—Kare, n.d.

And explaining the role of icons within the metaphorical world of interfaces:

Simple images can communicate with wide audiences over time. Icon design is like solving a puzzle, trying to marry an image and idea that, ideally, will be easy for people to understand and remember.

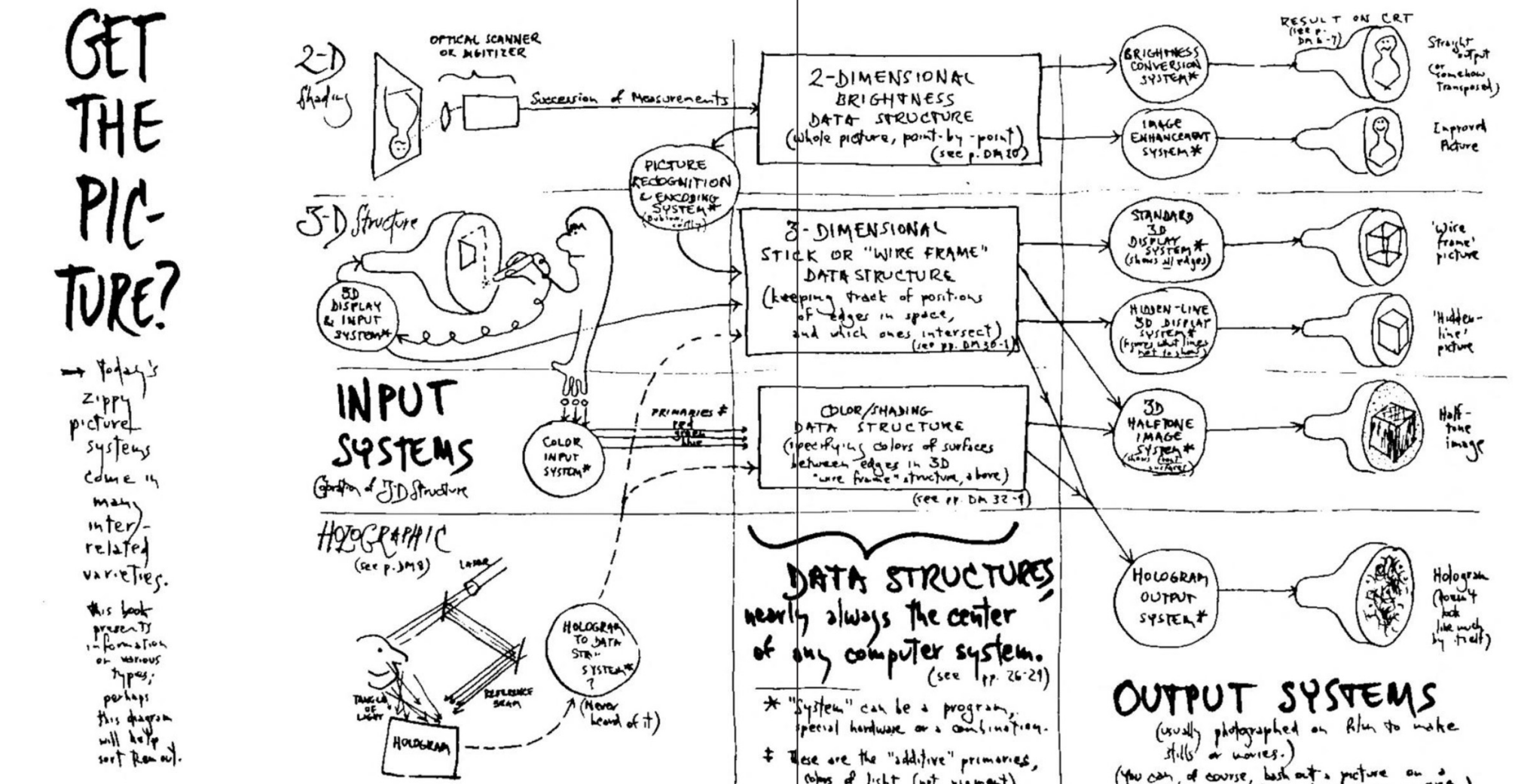
—Campblee, 2019

Such an effective, efficient and comfortable design solution, however, blinds us to a range of conceptual issues.
Posture Zero: the projective space of the interface.
Adopting the Posture Zero perspective developed by Baricco (2018), we observe that GUIs require a specific setup based on the person-keyboard-screen triad.

Can you feel the shift? [...] *the shifting of the centre of gravity* [...] *the swapping of places between your abilities, your potential, your sensations, your emotions. The changing nature of the experience.* [...] *A revolutionary physical and mental posture, incredibly concise and brutally summarising* [...] *man* (sic!), *keys, screen. Commands given with the fingers, results verifiable with the eyes on the screen.*

—Baricco, 2018, pp. 40, 42

A fixed and rigid posture, both physical and mental, which defines the way of relating to and interacting with the world and with digital technology typical of the last century. A pioneering historical period, populated by digital migrants, early adopters and the first digital natives, in which technology was still confined to a screen, often a fixed one: the space and setting for digital doing.
Although we now view this twentieth-century model as a somewhat



8—Ted Nelson, 1974
Computer Lib/Dream Machines, p. 23

naive phase, it was during this period that many of the inventions, the intuitions, and possibilities were first envisaged, which we are only now actively exploring.

During the great era of experimental incubation in the 1960s and 1970s, visionary authors were indeed able to foresee possibilities that were still beyond reach. Ted Nelson, amongst many concepts and neologisms, introduced and popularised a new way of viewing what were then known as the new media, long before any operational technology existed. Hypercard, one of the first software programmes to implement hypertext, developed by Bill Atkins (principal designer and developer of the GUI at Apple), was not released until 1987, as was MacroMind Director (an evolution of VideoWorks launched in 1985), a multimedia design software (Bollini, 2023).

But as early as 1965, Nelson spoke of *hypermedia*, that is, the possibility of combining multiple communication and media channels within the same experience – text, images, sounds, video – according to a model of interaction rich in stimuli and perceptual suggestions that transcends the mechanical nature of the input/output exchange of computers. And it is precisely the concept of hypermedia that transforms machines designed for computation into media (Bollini, 2001), that is, into spaces of communication, which will undergo a definitive transformation with the Internet revolution.
Whilst it is true that the computer can be regarded as a "metamedium capable of simulating others" (Kay and Goldenberg, 1977), it is equally true – and probably more relevant today –that "its essence [the computer's] is universality, its power the capacity for simulation" (Papert, 1980), then the computer is not so much a medium as a tool, that is, the field of action for the designer who devises "the ways in which the user accesses/uses information." (Polillo, 1992).

In Nelson's visionary imagination, we can already see a wealth of communicative and experiential approaches that would be explored from 2002 onwards in the second generation of the Internet, Web 2.0. Macromedia introduced the concept of 'rich interfaces' (Mullet, 2003), referring primarily to the potential offered first by Director and then by Flash, the software and plug-in that promised a significant shift in interaction models through the introduction of animations, time-based interactions, video and audio – in other words, that hypermedia potential that had been heralded but not yet realised on the web.
This promise was definitively shattered by Adobe, which, following the acquisition of its competitor, finally discontinued the plugin at the

end of 2020 (Lawson, 2017), condemning a vast body of experimental work to erasure and oblivion (McKat, 2017).

Baricco comments on this flattening of the posture zero as follows:

Instead of creating lots of beautiful and diverse worlds, spend your time devising a single setting into which all existing worlds can be incorporated.

—Baricco, 2018, p. 44

The two-dimensional space of the interface, which seemed to offer infinite depth, appears to become a flat, limited surface.
Even the process of direct manipulation and its mimicry of the real world reveal conceptual limitations. As Laurel (2013) points out, referring to Shneiderman's work (1982), direct manipulation

employs a psychologist's knowledge of how people relate to objects in the real world in the belief that they can carry that knowledge across to the manipulation of virtual objects that represent computational entities and processes.

—Laurel, 2014, p. 12

In which the three principles of 1) *continuous representation*, 2) *physical actions* and 3) *immediate visibility* generate and ensure the persuasiveness of the representation.
However, the coupling between the projective vertical surface of a monitor and the displaced movement of a mouse on a horizontal surface or keyboard, following the mobile revolution, no longer seems at all so direct and natural. In this evolutionary context, the interface's

design paradigms– originally intended as the contact surface between the person, the task, and the tools (Bonsiepe, 1995) – change profoundly. Whilst traditional interaction models – based on the separation between the body, the tool, and the cognitive prosthesis – allow for a staging within fixed, pre-established spaces, the experience remains symbolic, narrative, and sequential. The current frontiers, on the other hand, operate according to an analogical approach, in which the place of interaction and representation merges, and gestures are no longer projective or metaphorical. The somatic approach (Höök, 2018) – which simulates the physical experience and has been explored by art and design – emerges as one of the design variables to be considered. Technology becomes increasingly transparent, involving people in meta-narratives: a possible layering of perceptual experiences that atomise and recompose units of meaning coordinated by a unifying directing act.

Muriel Cooper was already moving in this direction in the 1970s, when she began to explore different paradigms of representation as part of the pioneering *Visible Language Workshop* (1974–1984) with the designer Ron MacNeil at MIT, which merged into the MIT Media Lab in 1985 together with MIT Architecture Machine Group, and the Center for Advanced Visual Studies (CAVS). The first course – entitled *Messages and Means* – invited students to explore the world of graphic design by generating new languages aligned with the transformations taking place in the communication ecosystem (Reinfurt & Wiesenberger, 2014). The course, a sort of foundation of communication design, integrated reproduction tools into the thinking process and aimed to bridge the gap between process and product. This early experiment already featured some of the themes that would later be explored in greater depth, such as the use of 'rotations' of planes, transparency and the layering of information.
Based on a strong interdisciplinary approach, the VLW explored both the visual and verbal aspects of communication and, from the 1980 edition onwards – *Turning a copy machine into a medium* – the course was divided into three areas: typo-graphics, photo-graphics, and electro-graphics, in light of the transformations that the electronic revolution was bringing to the sector.
Muriel Cooper freely explored with her students the new space for experimentation offered by computers, albeit still limited by the two-dimensionality of the screen. While describing the "new graphic language" in the liminal essay *Computers and Graphics* (Cooper, 1989), she faces this new sense of reality that reconfigures itself according to the technological dimension, which draws on what is already known in terms of language:

The shift from a mechanical to an information society demands new communication processes, new visual and verbal languages, and new relationships of education, practice, and production. [...] In each period of our history, design and communication have evolved synchronously with the technology of the time. Each new medium has extended our sense of reality and each has looked to its predecessor for language and conventions, referencing and adapting its characteristics until its unique capabilities can be explored and codified.

—Cooper, 1989, p. 4

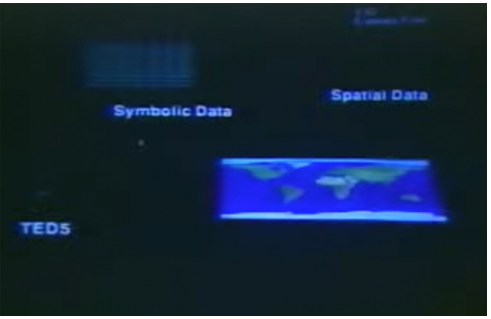
The explorations undertaken in the various editions have led not only to significant experimentation in terms of reconfiguring visual paradigms, but also to a profound reflection on the challenges posed by new digital media within design culture.
On the one hand, Cooper emphasises that the figurative and iconic world of GUIs, however effective, is transitory. The simulation of the real world, the metaphor of the desktop, which derives its meaning from mimesis, will be superseded the moment the

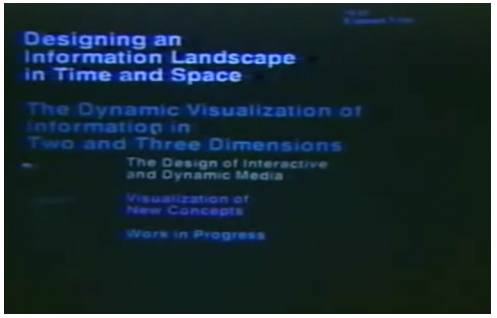
user understand that the computer is a medium different from the physical world, one that offers the power of abstraction.

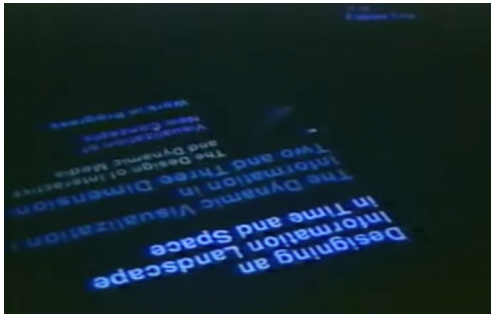
—Cooper, 1989, p. 17

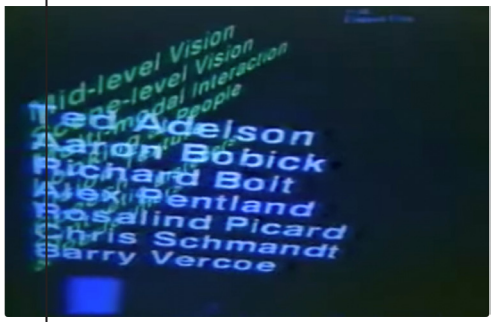
New potential metaphors, the construction of three-dimensional typographic worlds, the deconstruction of the editorial grid in favour of multi-layered perceptual structures, and the ability to visualise data and relationships contextually through spatial arrangement are all well illustrated by the demo *The Information Landscapes*, which Muriel Cooper presented at the 5th TED Conference in Monterey, California, in 1994, in conversation with Richard Saulå Wurman.

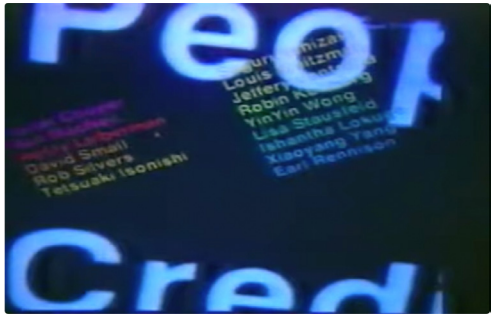
It is within this dynamic flow of information that we can already glimpse a new relationship between the two-dimensional projective space of the interface and the new possibilities for representing a 'new' experiential and dynamic language.

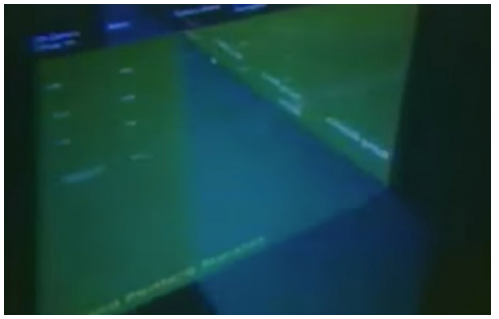












9—Muriel Cooper, 1994
Cooper presents *The Information Landscapes* at the TED5 Conference, Monterey, CA

The 'phygital turn' is the transformation in which the physical and digital worlds merge through technological innovations, particularly the mobile, virtual, and blended reality revolutions. This evolution breaks with the traditional model in favour of physical, sensory and immersive experiences, expanding our perception of reality. Interfaces are no longer tools but interactive and narrative environments, akin to performance spaces, in which the inter-actor becomes the protagonist. The two-dimensional layout is superseded by a dynamic *mise-en-scène* based on time, relationship and action, in which design thus assumes a directing role.

The phygital turn

Just as Mitchell (2017) speaks of the pictorial turn to describe the epistemological shift that places the study of images on an equal footing with that of language, today we can speak of the phygital turn to describe the transformation driven by the continuous succession of 'waves' of technological innovation, which are becoming ever more frequent and ever faster.
In its simplicity, the term 'phygital' allows us to encompass a range of phenomena – some of which are very diverse – that lie at the intersection of these two worlds. The neologism, a portmanteau of physical and digital (cited in Wired, 2004, according to some sources), is attributed to Chris Weil, CEO of the Australian marketing agency Momentum, as early as 2007 (from 2010, according to Treccani), who claimed copyright over it in 2013.

Beyond vague definitions or its predominant use in Retail 4.0, the hybrid reality where the physical and digital worlds converge is a phenomenon driven and facilitated by various factors, primarily linked to the proliferation of new devices and the maturation of technologies.
At the heart of the phygital turn, in fact, lies first and foremost the mobile revolution: the shift from mobile phones to smartphones with the launch of the first iPhone in late 2007 and, subsequently, with tablets in 2011, as well as the introduction of ubiquitous, wearable and widespread technologies and, now, artificial intelligence.

Whether new or revamped – as in the case of VR, first experimented with by Sutherland in 1968 with the 'Sword of Damocles' and revived intermittently by the Metaverses in recent years – these developments have generated accelerated and disruptive innovation, which is pushing boundaries and raising new questions.

One of the first effects has been to break the 'zero posture': the coupling between the projective surface of a monitor and the displaced movement of a mouse on a horizontal surface or on a keyboard, in favour of interactions enacted by our gestures and body, situated in space and time at a material level, activating the emotional – or rather, the visceral side of experience, according to Norman (2005) – filtered by our sensory perceptions and cognitive expectations.

Eventually, the phygital turn implies "an extension of our sense of reality", quoting Muriel Cooper describing the new graphic language of the graphic computers:

Natural visual and aural languages were gradually translated into message making conventions that coupled intuitive understanding of human perception with the organization of images and words into two dimensions. Reality was filtered and organized through the limitations of the media, modifying the way we think. [But] *Multi-image or audio-visual design is very close to theatre and performance* [...] *it depends heavily on three-dimensional space and does not translate well into film or videotape.* [...] *The idea of visualizing and modelling the physical environment as a metaphor in the computer is transitional.* [...] *At that point the user understands that the computer is a medium different from the physical world, one that offers the power of abstraction.*

—Cooper, 1989, p. 14, 17

Or, as recently proposed by Whitelaw (2015), above all, fields such as history, art and culture already offer a wide variety of experiences and artefacts; rich and nuanced language and presentation are needed to communicate this content and make it accessible and enjoyable for the public. We need to embrace a different mindset in designing interfaces to make them generous communication artefacts, aimed at showing, evoking, and enriching interpretation by revealing connections and structures that support access to and understanding of context and relationships that would otherwise be invisible or implicit.

As an interface, search fails to match the ample abundance of our digital collections and the generous ethos of the institutions that hold them. A more generous interface would do more to represent the scale and richness of its collection. It would open the doors, tear down the drab lobby; instead of demanding a query it would offer multiple ways in, and support exploration as well as the focused enquiry where search excels. In revealing the complexity of digital collections, a generous interface would also enrich interpretation by revealing relationships and structures within a collection

—Whitelaw, 2015

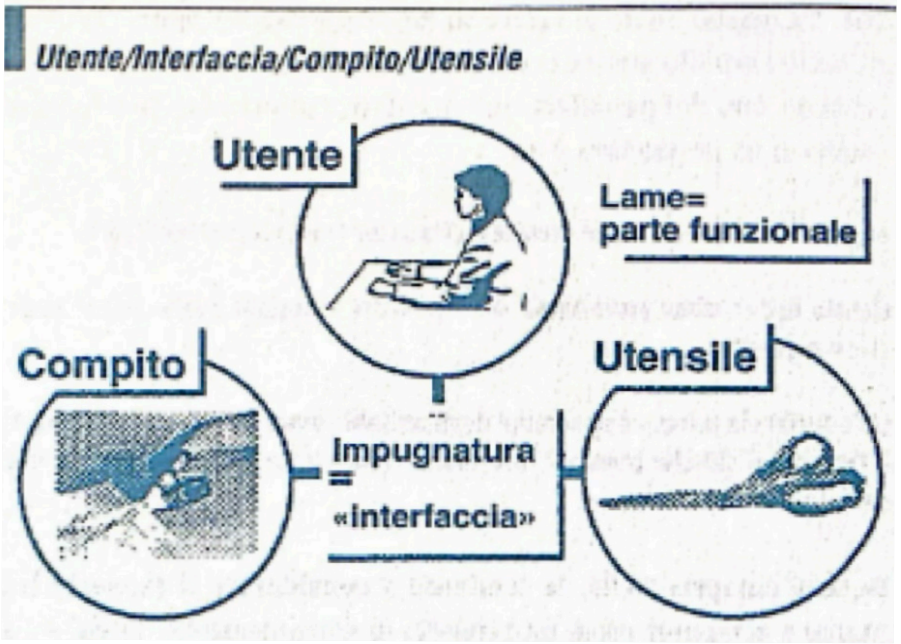
However, this is not merely a paradigm shift in terms of communication and multimodality (Bollini, 2023a), but rather a change of perspective regarding the very structure of the metaphorical system that has long governed the system of graphical interfaces.

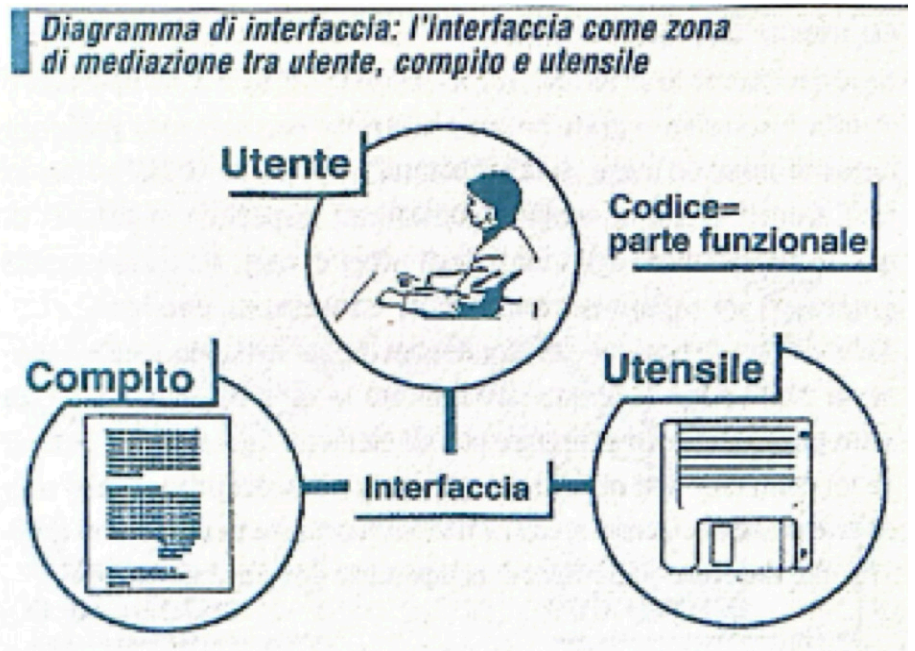
The first shift is from a mimetic representation of reality – a sort of flat, symbolic projection of it – to a metaphor that is, at the very least, narrative, which, as the interaction unfolds, introduces the temporal variable as one of the significant elements in the interaction between the inter-actors.

Mise-en-page

A step which, once the *zero posture* has been overcome, also involves moving beyond the "ontological framework of design", which views the interface as the interface surface of the triad user, task, and tool (Bonsiepe, 1995).

But the personal computer and its software with graphical user interfaces are not simply an evolution of the pencil or ink pen and paper, nor are they merely a transposition of these into an





10 / 11—Gui Bonsiepe, 1992
The general diagram of the relationships between the user, the task, the tool and the interface.

The diagram specific to the relationships between the user, the task, the programme and the interface

electronic medium. Rather, they represent a clear break which – like any radical innovation – enables us to act in ways that were previously impossible. [...] If information technology achieves nothing more than an increase in productivity, there will be no reason to regard it as a radical innovation.

—Bonsiepe, 1993, p. 7

Change implies

The use of a narrative metaphor and anthropomorphic agents [...] the use of a character in the interface to deliver first-person storytelling content from an explicit point of view.

—Don, Oren & Laurel, 1991

When we talk about fiction, we take a further step, particularly in terms of conceptualising representation.

Brenda Laureal, drawing on her studies in the arts – a Master of Fine Arts in acting and directing, as well as her PhD thesis on drama theory and criticism, defended in 1986 – proposes an alternative model based on Aristotle's Poetics. In Computer as a Theatre (2013), the metaphor is used to interpret the interactive relationship between people and computers by introducing the concept of performativity, which holds that interactions are meant to be enacted (Heckel, 1982).

The most interesting thing is that, when a play works well, people are simply not aware of the technical aspects at all (curtains, scenery, backstage, wings and so on).
They are simply engaged and captivated by what is being performed on stage, created by the actors and the machines.

According to this metaphor

The "stage" is a virtual world, populated by agents, both human and computer-generated, and other elements of the representational context.

—Laurel, 2013, p. 27

As Alan Kay (1984) pointed out, computers are therefore representation machines capable of emulating any known medium

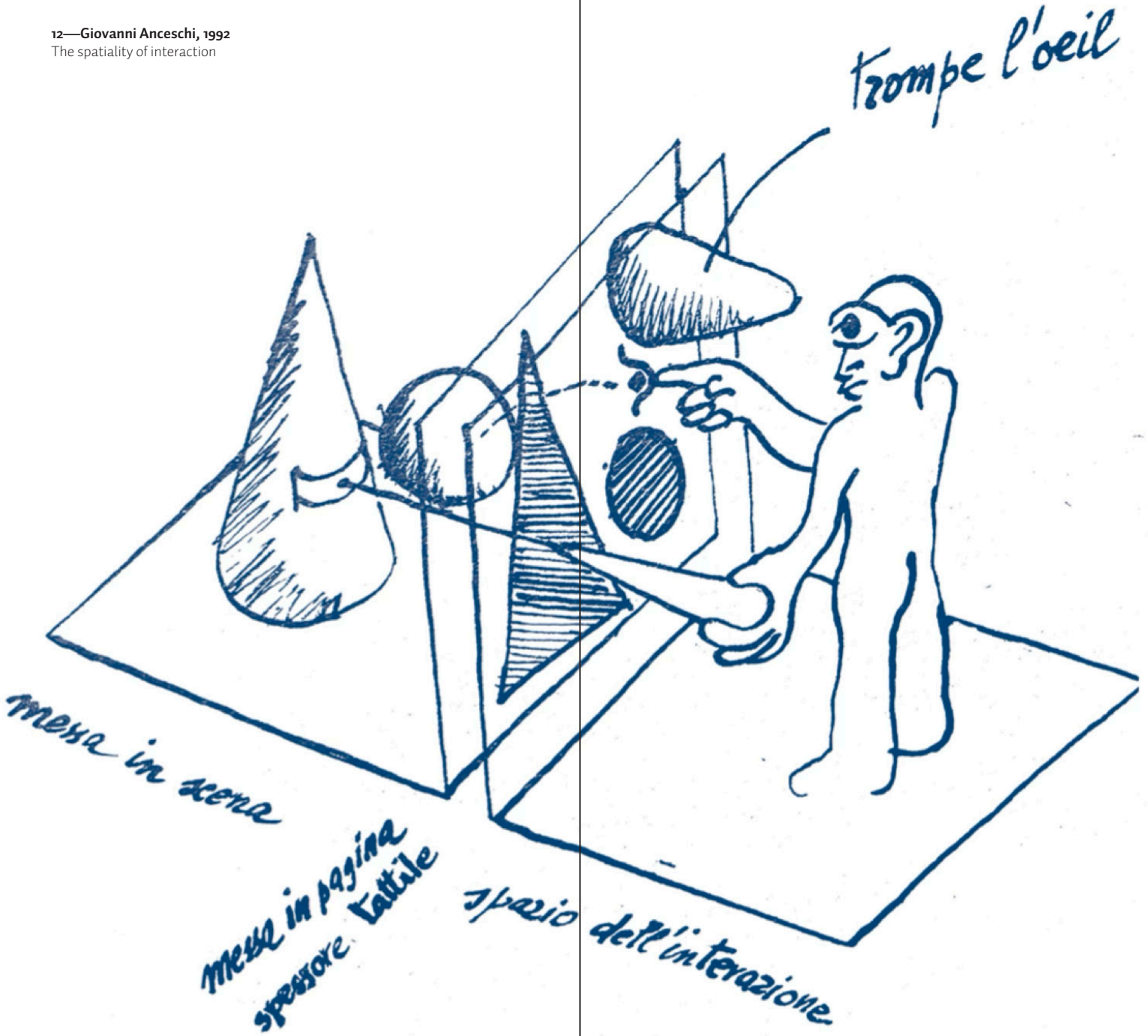
The protean nature of the computer is such that it can act like a machine or like a language to be shaped and exploited. It is a medium that can dynamically simulate the details of any other medium, including media that cannot exist physically.
It is not a tool, although it can act like many tools. It is the first metamedium, and as such, it has degrees of freedom for representation and expression never before encountered and as yet barely investigated.

—Alan Kay, 1984

Mise-en-Scène

The dramatic metaphor allows us to focus on the interactive relationship between the person and the computer: on the one hand, by drawing on the interaction and relationship between actors/players on stage and the inter-actors involved in the performance; on the other, by focusing on the concept of catharsis, which is analogous to the achievement of a goal, but from an emotional and experiential perspective rather than a functionalist one. In this model, performance

12—Giovanni Anceschi, 1992
The spatiality of interaction



is one of the fundamental factors of engagement and participation, in a dimension that is indeed mimetic but does not necessarily have a real-world reference.

The interface, therefore, is no longer simply the point of contact between the agent/person and the tool/computer that enables projective inter-action, but becomes itself a place of interaction. Or, as Anceschi emphasises:

More precisely, it is within the interface that interactions take place. The creator of the interactive device and its interface is the urban planner of this place, and through the techniques of anaphora and epiphora, they shape and adapt it so as to make it accessible. Or, more precisely, usable. That is to say, interactive. Whilst the user is its visitor, or rather its inhabitant, and brings to it their own purposes, their own energies and their own activity.

—Anceschi, 1992, p. 40

The depth of a space that is no longer merely a two-dimensional projection, but which may be real or blended, corresponds to the conceptual shift from page layout to staging.

Since the page has existed [...] *it has known its own rules for producing and distinguishing meanings. Differences in position are resolved into topographical hierarchies (in front, above, etc.), differences in size (larger or smaller) or even just differences in perceived weight (more or less significant), which are resolved into hierarchical effects.*
[...] *However, the interface (interaction) is never just a lay-out* [...] *it is not contained within the screen frame* [...] *but becomes a widespread interface.*

—Anceschi, 1993, p. 26

Mise-en-page assumes a traditional approach to interface design, in which the area displayed on a screen is organised in a compositional manner. The space is divided into sections according to conceptual and visual hierarchies that organise it within a two-dimensional layout, and the suggested interaction is either horizontal – scrolling, which remains on the surface of the content – or vertical, which, via links, delves deeper along sequential paths.

The transition to a performative dimension presupposes the intertwining of the co-presence of interactors in a phygital space, within which the different actors/players of the interaction are located, immersed and related. The focus is no longer solely on the organisation of space, but rather on the creation of a shared plot that develops within this space over time and along possible open paths.

This means orchestrating a

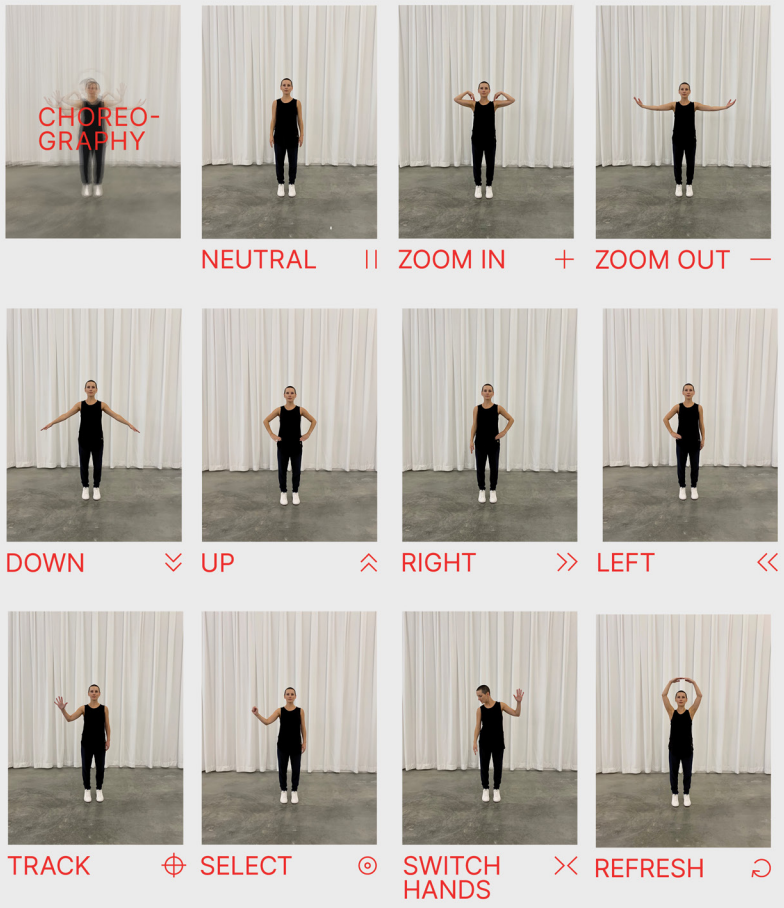
a goal-oriented dramatic narrative for interface design, which, like effective dramas, must be created around an evolving "action" and must engage the user as "protagonist" as directly as possible in an experience involving both thought and emotion.

—Laurel, 2013

Interface design, then, involves the creation of a hybrid space (regardless of dimensionality) in which people no longer see themselves as outside – using digital as a device – but inside an environment interacting with the various possibilities and other actors, human or not. According to this, the interface should be a choreographic notation of possible interactions and gestures, a kind of suggested plot, rather than a codified script, as a score of improvisation that naturally en-

ables people. The interactions are performative, rather than sequential or task-based, where the person explores paths and opportunities inter-acting, not anticipated by a fixed sequence, but dynamically accommodated according to new directions and goals.

And finally, the design also needs to rethink itself in light of this new approach, assuming a less constructive, more directing role, i.e., one oriented towards integrating and coordinating heterogeneous competences and components that converge in the construction of that environment where interactions take place.



13—Lins Derry, 2020-22
Lins Derry demonstrating the choreographic interface vocabulary in the instructional poster designed by Pablo Castillo Luna.

The interface as space. Digital technologies call for interfaces that are natural, transparent, and human-centered, shifting focus from visual tools to multimodal communication engaging multiple senses. Interaction becomes spatial and narrative, mediated by both physical and digital environments. Examples like gesture-based systems and phygital experiences show how users act across overlapping realities, where space and time merge. Projects such as virtual shopping, Augmented Reality installations, and immersive museums illustrate how space becomes an interface, extending experience beyond physical limits. In this context, people, artefacts, and data form dynamic relationships, enabling new forms of exploration, storytelling.

The interface as a space

The more technologies and digital services shape our world, the more access to them should be unmediated, easy and natural. Where natural means a transparent interface that speaks – so to say – the language of humans and not vice versa, as reminded by Shneiderman (1986).

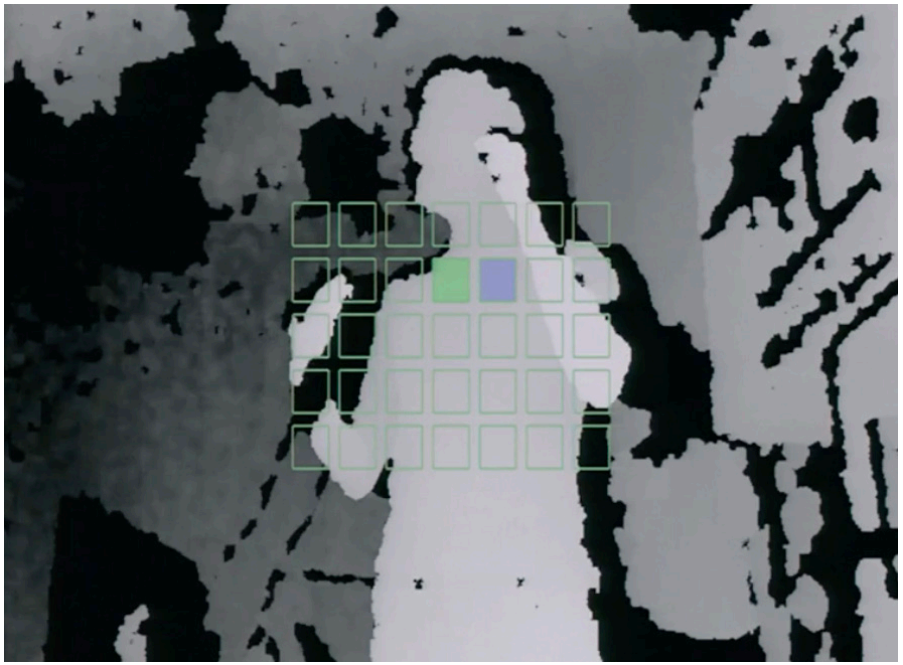
In light, therefore, of current technological developments, the cultural implications and the state of the art, a shift in perspective is needed in the debate on interfaces – one that shifts the focus, not so much, or no longer, on the medial/instrumental, and above all, visual, aspects of interaction, but rather on their characteristics and modes of communication.
The shift is therefore towards a concept of multimodal communication, rather than asserting the need to investigate no longer the medium, or the transmission technology (we shall instead speak of a single medium, according to Kay's (1984) vision), but the way in which communication is conveyed. The conceptual focus shifts from the *medium* to a relationship between the person and the task and its projective representation on the screen, but between the person and the narrative metaphor, mediated by space – be it physical or digita – according to a directorial design perspective (Bollini, 2023).

Besides, we are multisensory beings, aiming to fully perceive the different stimuli from the surroundings: visual, acoustic, tactile, taste, olfactory, as well as spatial and kinetic. Consequently, interaction should be multimodal, meaning it should address as many senses as possible within the technical framework.
The visual connotation that characterised the early decades of interface development – and which persists in mobile interfaces and 'multi-touch interactions' – is therefore calling for new paradigms. These paradigms explore the potential offered by ever-evolving technologies, but above all, they place people back at the core of the experiential dimension.

This immediacy of gestures – which are not shaped by the learning of a behavioural model, but are spontaneous and everyday – is well illustrated in the TED Talk (TED Talent Search) given by Aral Balkan in 2012. Back then, he demonstrated how a NUI – a *Natural User interface*

(Wingord & Wixon, 2011) – in a digital ecosystem populated by different devices should work. He showed the audience how easy it could be just by grabbing with your hand information from a surface or a device, a digital TV in that case, and transferring it to your mobile phone using the spontaneous gestures. The idea underlined by Balkan is that design should challenge technology – a Microsoft Kinetic system in that setup – to create a playful environment where users can move and act freely and spontaneously.

Launched in 2010 as a human motion sensor designed to integrate with the Xbox 360 and Xbox One, with a focus on the video/gaming world, Kinect was discontinued seven years later as an unprofitable technology/platform. However, many experiments based on its potential for spatial interaction – without the need for additional devices on the user's part, allowing the user to move freely within the space – have explored and opened new worlds and possibilities.



14—Aral Balkan, 2012
TED Talent Search
Great design should empower, amuse and delight
Microsoft Kinetik position detection

As Balkan points out, describing some of the interactions we have with everyday objects and processes – such as buying a ticket at a station using self-service machines, in his case at the airport:

Great design can give people superpowers [...] we have the potential to make things that amuse and delight. Great design empowers, amuses, delights; it makes the technology invisible and indistinguishable from magic.

—Balkan, 2012

15—Aral Balkan, 2012
TED Talent Search
Great design should empower, amuse and delight

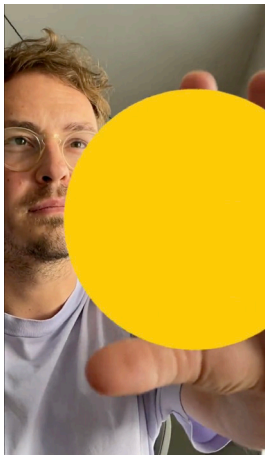
16—Aral Balkan, 2012
TED Talent Search
Great design should empower, amuse and delight

Similar explorations have been carried out by Turan (2023), albeit using a different technology – namely the GLSL/OpenAI X libraries – which he demonstrates on his Twitter/X account. Here, the interface's projective space becomes projective and multi-layered; within this stratification coexist the author's presence, their real and projective gestures, and the metadata of images, positions or movements on the screen captured by the smartphone's front-facing camera.
Commenting on the various experiments, Turan notes that:

imprecise exploratory inputs — like finding the right parameters when making highly-dimensional generative art — feel like they're better suited to fluid movements. [...] following on from my piece on Friday about new interfaces for exploring photo metadata — here's me querying a 75,000-image photo library using hand motion to write geospatial SQL queries in real-time.

—Turan, 2023

Where gesture becomes a new form of writing in space and of rewriting space.



17—Harley Turan, 2023
Hand interface debug mode

18—Harley Turan, 2023
Controlling GLSL shader uniforms using hand

19—Harley Turan, 2023
Interfaces for exploring photo metadata

The paradox of the phygital space interaction

One of the most interesting aspects of this transition from a representation of an interactive space to an interaction that actually takes place across two spaces simultaneously can be interpreted through the so-called psychological effect introduced and explored by Mori from the 1970s onwards (1970), namely the *Uncanny Valley*.

Beyond its more specific application to the world of robots and humanoids, the effect confronts us with the pleasure, familiarity or unease generated by interacting with entities that simulate and mimic our humanity and physicality. What happens, then, when this paradox is transposed into hybrid spaces where aspects of the real, or the real itself, coexist with synthetic, simulated or symbolic spaces and representations? As is often the case, it is in art that we find explorations and interpretations of complex and future concepts. A project that effectively interprets the effect of attraction and discomfort generated by the contingency and overlap of physical, conceptual and digital spatial models is *Dissolved – the Uncanny Valley*, conceived and designed by Florian Feigl + Christopher Hewitt (2014).
The project is effectively a theatrical performance taking place simultaneously in two different locations: one set is in Berlin and the other in London. The physical performance spaces are also linked via the digital projection of images showing what is happening on one set onto the other, and vice versa, using a live video link. The audience can see the two stages superimposed and merged together at the same time, even though they are separated.

The Sophiensæle canteen and a gallery space in the former Victorian Ragged School in Beaconsfield, London, merge and overlap. A new space emerges: half-there, half-not, caught in a perpetual fade. A door swings wide open in one room and slams shut in the other. A wall exists and yet does not, and yet becomes an insurmountable barrier.

—Sophiensæle, 2014

The two sets have a similar layout – featuring a table and a door – with the latter serving as the source of the paradoxical dimension: a sort of stargate that allows the two spaces to intertwine in dialogue. In each location there are three actors, and it is their actions that affect both the local set and theother(s), acting in a synchronous, mirror-like or delayed manner, thus creating an effect of dissonance between what is seen and what is experienced.

The performers surrender their bodies and identities to this virtual world. In their encounter with the London-based artists, they create enigmatic hybrid beings that exist only for the moment of the fade in an in-between world. Actions and digital echoes can be followed in parallel on stage and screen, inviting speculation about the instability of cultures and identities when boundaries between traditional and artificial realities blur. People and things are what they are and at the same time something entirely different; they overlap, giving rise to a third entity, in a unsettling, captivating and at times highly comical performance. […] The audience watches a live performance and its traces in virtual space simultaneously.

——Sophiensæle, 2014

People sharing the same physical space might overlook each other as they engage in conversations with digital representations from the other setting, or they may end up synchronizing their actions when a door – part ot the stage design – opens and links the separate spaces together. From the outset, the reality of these characters remains uncertain, and we soon realize that their location, identity, and even the nature of the situation are unclear. A slight delay – just a few seconds – affects the connection between the video feed, the audio, causing the performers' voices to be heard again, echoed as though coming from a far more reverberant space there.

20—Florian Feigl + Christopher Hewitt 2014
Dissolve. The uncanny valley
London / Berlin

Although the aesthetics and objectives are entirely different, this is what happens in the phygital experience, where the two spatial realms collapse and merge, creating paradoxes of space and time.

The paradoxical concept of dislocation and contemporaneity underpins what is considered the first phygital experience.
This is the shopping system developed by Tesco and implemented in Seoul in 2011, namely the *Tesco Homeplus Virtual Subway Store* in South Korea. Inside the underground, the company's Homeplus division has set up a virtual shop: posters have been installed on the walls that faithfully reproduce the supermarket shelves.
A QR code is displayed on the image of each product, which commuters can scan with their smartphones, thereby ordering groceries that will be delivered to their homes shortly after their arrival. People thus find themselves in one place and act in another, to complete an action in a third, in a sort of potential ubiquity.

21—Tesco Homeplus, 2011
Tesco Homeplus Virtual Subway Store
Seul, South Korea

Another possible model of interaction at the intersection of physical space and the digital layer is that explored by Italo Rota in the installation *Life / Installed, four minutes to imagine the future*, during the 2012 edition of Fuorisalone, held alongside the Salone Internazionale del

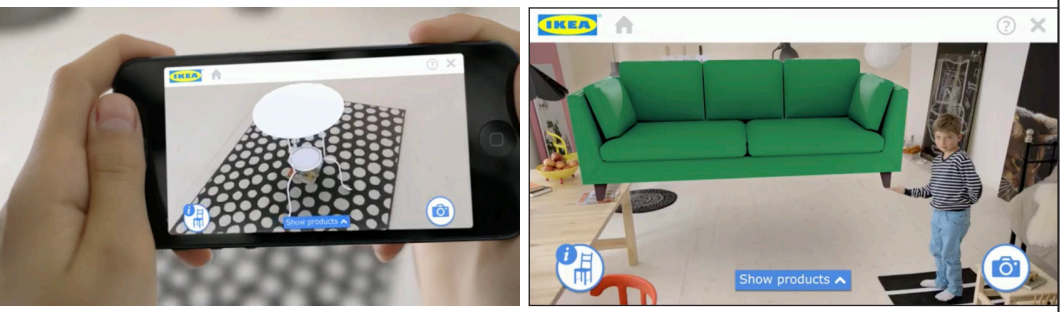
Mobile in Milan, in collaboration with Samsung and, in a commercial context, by Ikea in subsequent years. (Bollini & Borsotti, 2016). In this case, what is absent – or rather, amorphous – is the physical space which, thanks to the use of Augmented Reality (AR), is imbued with information and activated in terms of potential and interaction.
The space is deliberately grey and sterile, populated by three-dimensional objects, but it is through the use of a tablet that this space comes to life and takes on colour, revealing things that already exist even if they are hidden.

22—Italo Rota, 2012
Life / Installed, four minutes to imagine the future
Fuorisalone, Milano

This turning point gives rise, in fact, to two considerations.
On the one hand, it is no longer the physical space that must adapt and adjust its infrastructure; rather, it is the user themselves, with their personal device, who becomes the epicentre of the exchange – both subject and object of the *emo*-activation that digitally mediated interaction brings about.
On the other hand, the relationship extends over time even beyond the experienced space, which becomes an osmotic interface with the outside world, a sort of extension that prolongs knowledge and expe-

rience beyond the here and now to which the physical dimension confines us, thanks to mobile devices.

23—Ikea, 2014
Augmented reality catalogue



Whilst in the case of the Salone the content is already there and needs to be revealed using the device, in the 2014 IKEA augmented reality catalogue the process is the opposite. Within the space of one's own home and thanks to the 'augmented furniture' in the printed catalogue – in a perfect example of cross-media integration – it is possible to place three-dimensional images of chairs, tables, accessories and furnishings to see how they would fit into the space and how they would transform, in terms of size, colour and space, the domestic environment and our experience. The augmented and placed images can interact with people and, in turn, be photographed in an iterative process between the *real* and the *virtual*, and vice versa:

Thus, it is the object, across its various semantic and symbolic levels of meaning, that expresses its and functional dimension through its "narrative potential and [...] determines the conditions under which the object on display can express itself, be discovered and, at times, manipulated.

—Trocchianesi, 2013

However, by moving away from the paradigm of the 'exhibited' space and adopting an approach that instead embraces the potential offered

by technology and its language, the duality that is no longer mimetic and the concept of physical space fragment into infinite possibilities. Objects no longer belong to the fixity of space, but rather become individual s-nodes, epicentres of meanings and connections that can be re-aggregated according to semiotic dynamics potentially disintermediated (Bollini, 2013) from the concept of curation and planning, but rather recomposed through transversal associations of references and meanings.
New are the actors playing the role of 'virtual curator' according to logics that have more to do with the recurrences of search algorithms, or with explorations driven by *serendipity*, rather than with the conscious act of design aimed at recomposing, through deep, sometimes implicit links, the fragments of knowledge or narrative. Entities that re-mediate and disseminate information, creating new access points; no longer individual proprietary broadcasters or data producers, but rather epicentres of consumption, whose specific role is to reassemble knowledge and its sources according to different logics – yet through unifying interfaces – in a framework where the user and their experience are increasingly the true unifying epicentre.

A project that illustrates this wealth of experience and this freedom of exploration, reconfiguration and curation – from a personal perspective, as a journey and as a 'collection' – is the *Little Museum of Diaries* in Pieve Santo Stefano, designed by the Milan-based studio Dot Dot Dot in the province of Arezzo. The collection, inaugurated in 2013, forms part of the *National Diary Archive* project (1984), inspired by and dedicated to the journalist and founder Saverio Tutino, to whom not only a room in the museum but also the annual award of the same name is dedicated.
The museum, housed within the town hall – Palazzo Pretorio, one of the few historic buildings to survive the Second World War – occupies a minimal area comprising a 'corridor' and three rooms. It is precisely this limitation that has become one of the project's strengths, as it exploits the 'layering' potential of digital technology to expand, consolidate and multiply surfaces and space.
Not only that: the project transforms a historical archive of written documents into a multimodal experience. Paper and other two-dimensional media, rich in lives, stories and writing, come to life through the use of audio, video and dynamic interactions that engage

the senses and create a sense of being present and situated within the installations, which employ various modes and languages intimately connected to the emotional dimension of the stories told. Stories of ordinary people – intimate and personal – that thus become collective and universal, testimonies not only of individual lives but of a multi-faceted collective identity of experiences and emotions, ranging from that of Clelia Marchi, a peasant woman from Mantua, who entrusted her story to a double bed sheet (in the third room), to that which Vincenzo Rabito, a semi-illiterate roadmender from Ragusa, typed out in 1,027 pages without spaces in a sort of archaic alphabet.

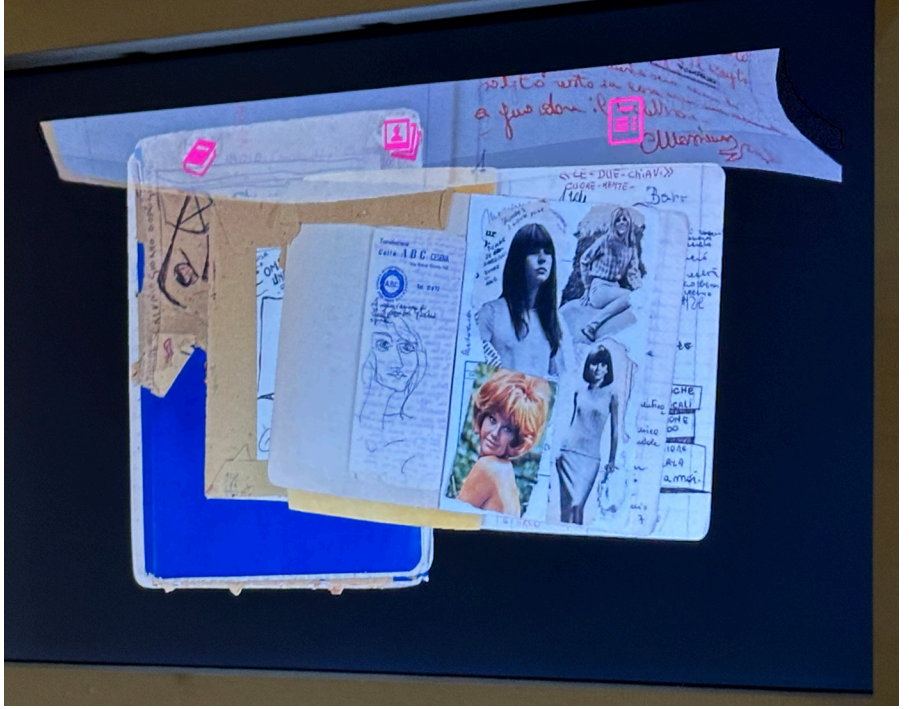
The rather narrow entrance corridor comes alive thanks to a wall where videos with audio, stories, and testimonies alternate with drawers that, when opened, release a swarm of letters before revealing documents, materials, and images from various diaries selected from the collection. The exhibition tells stories and creates an emotional itinerary that connects past to present, marking not only a physical route within the space, but above all a journey through emotions, lives and biographies, both intimate and universal, as many of the stories are.

24 / 25 / 26 / 27—DotDotDot, 2013
Piccolo Museo dei Diari
Pieve Santo Stefano (AR)

The system of rich, generous interfaces, tailored to the content, invites visitors to touch, listen, explore and interact. These are the actions visitors can perform, feeling and perceiving the physical space of the archive and creating space for the emotional experience.

In the Sala Rabito, letters emerge from a typewriter and are displayed on a table, whilst video projections on the walls and spoken accounts from people who witnessed the events described in the diaries are activated. The room was originally based on Kinetik technology capable of detecting movement by people on the flat surface and triggering the multimodal narrative, combining images and spoken accounts.

Over time, the museum has been enriched with new narrative devices, including a sort of jukebox dedicated primarily to the diaries of teenagers, where, by inserting cards, visitors can view content and contributions from the archives. A 'triptych' reminiscent of Bill Viola's installations presents, primarily through images with a deceptively glossy aesthetic, stories that are predominantly about violence, with reference to what was exhibited in December 2024. Finally, in the last room, where the inscribed sheet is displayed—an analogue relic and an intense diary of a life—several audio stations have been installed featuring 3D-printed everyday objects that tell further stories.



28 / 29 / 30—DotDotDot, 2013
Piccolo Museo dei Diari
Pieve Santo Stefano (AR)

The 3e model: a possible texonomy, based on the modes of interaction and possible interfaces between people, devices and space – i.e. *embodying*, *embedding*, *expanding* – frames this relationship within a triadic model. The *body* becomes a tool through wearable devices and biometric systems, enabling direct, sensory interaction. *Objects* act as mediators in the IoT and tangible interfaces, making digital processes intuitive and experiential. Finally, *space* itself becomes an interface, where movement and multisensory stimuli generate interaction. The case studies presented and discussed highlight how design can blend functionality, perception and meaning, fostering embodied, accessible experiences with a strong emotional impact. The project encompasses and elaborates on the context and situational meanings, placing the person back at the centre, in their empirical, corporeal and sensory dimensions.

The 3e model

The involvement of the senses, of the body, of being situated in a space, and of inhabiting the blended one, as described in the preious chapters, occurs at two levels. The actual one, thanks to the physicalisation of the virtual side of the system, and the phygital one, due to the embodiment and the tangibility of the technologies by the user or their contact in the smart environment.
All these factors converge and collaborate to shape the overall experience. Visual, acoustic, haptic, tangible, and kinetic interactions are the field applications to be explored by design. But in doing that, we mustn't forget that they are not a matter of technology or devices, but rather a value in people's experience from a human-centred perspective, or better, from a life-centred design, including not only humans, but also non-humans and more-than-human interactors.

In the *3e model. A possible taxonomy in the field of interaction design, between body and space* (Bollini, 2021) – which I proposed in 2020 and further elaborated over the years – *embodying*, *embedding*, and are possible key concepts to interpret the relationship between us and the hybrid space of interaction. The model is based on a matrix built to account for the complex intertwining between interaction types and interface models, aiming to systematise recurrent paradigms.
The parameters considered in this schema to describe several phenomena are the possible devices – conceived in a broader sense, not limited to technological ones – and the relationships generated with the space-time continuum. The categorisation attempts to describe and organise according to an organic taxonomy, not from a technological perspective, but from a people's experience perspective.

Approaching interaction design through this experiential and relational lens allows us to move beyond a purely technological understanding of interfaces and systems. By focusing on how bodies, environments, and hybrid spaces co-evolve through embodying, embedding, and expanding processes, designers can better address the richness and complexity of lived experience. This perspective encourages the creation of meaningful, inclusive, and adaptive interactions that acknowledge the entanglement of human and more-than-human actors, ultimately fostering more responsible and sensitive design practices within increasingly interconnected phygital ecosystems.

INTERACTION		DEVICE		SPACE & TIME
Wearable / Haptic	>	BODY	>	Embodying
Tangible	>	OBJECT	>	Embedding
Kinetic	>	SPACE	>	Expanding

Embodiying: the *body* as a device

In fact, when we talk about biometric and wearable interfaces, we are referring to systems in which our body and senses are directly involved in performing tasks. In the first case, we are talking about systems that use an individual's unique physical, physiological or behavioural characteristics to identify them, authenticate them or enable them to interact with a device: whilst these are currently used primarily in the fields of authentication, security or medicine, this does not mean they are not worth exploring further.
In the second case, however, we have objects that, in direct contact with our body – worn, in fact – use a combination of sensors and hardware and software components to detect movement, such as hand gestures, and send the data to the device. The device then interprets the data and responds accordingly.

Computer scientists as well as physicians, psychologists and designers are exploring various possibilities: by inserting chips and sensors, or by adding bionic prostheses or by using the skin as a projective or contact surface.

For instance, the Microsoft Research Group explored the potential of a touch interface directly projected on the skin using the Kinetic system. This innovative solution still adopted the paradigm of a mobile touch screen, as represented by the *Omnitouch project* in 2011 (Harrison, et al., 2011). The concept has been improved thanks to the collaboration of the MIT Media Lab: in this second case – *Duoskin* (Kao, et al., 2016) ¬– a temporary tattoo made with conductive lamina – customizable conductive foil – and in different shapes is applied to the skin to interact with other devices such as a laptop or a tablet, providing remote commands such as scroll, point, tap or click.

More recently, Disney's various theme parks have adopted a wearable device – the Magic Band, in its various versions – to make the visitor experience completely frictionless. Whilst ethical considerations regarding data collection have been taken into account, particularly in the case of minors, the system – developed by John Padgett, a Vice President of Business Development, and designed by Frog – is a wearable: a coloured plastic wristband based on RFID technology that allows for a completely transparent and seamless interaction within the parks and the experience for those wearing it, whilst optimising flows and logistics for the parks themselves and forming part of the MyMagic+ experience since 2013 (Kuang & Fabricant, 2019).

A much more mature, systemic and holistic project is *Quietude*, developed by the University of Siena, Santa Chiara Fab Lab (Project Coordinator) under the direction of Prof. Patrizia Marti, with two spin-off companies from the University of Siena, Glitch Factory and T4ALL (Technology for All), and in collaboration with the University of Southern Denmark, Siena Art Institute, financed by the European Union within the Wear Sustain Program (Marti & Recupero, 2019).
This project explores deafness through a participatory perspective. Hearing loss represents a significant global issue: approximately 466 million people currently experience disabling hearing loss (World Health Organization, 2024).
These figures highlight the urgency and scale of the problem, but existing solutions, such as hearing aids and implants, are generally effective from a technical standpoint; however, they often fail to adequately address the experiential aspects of wearing such devices.
Hearing aids continue to carry a social stigma, and their design rarely reflects user-centred considerations. Issues related to acceptance, aesthetics, and ergonomics remain largely unresolved. Therefore, it is crucial not only to compensate for hearing impairment but also to respond to the broader and more complex everyday needs of deaf individuals.

We tried to address this issue from a feminist perspective, starting with the reflection that glasses are probably the only personal device that evolved from being medical aids to a fashion accessory. Most of the other medical aids have a very medical look and have a boring and flat design. This project aimed to change the stigma of deafness into something desirable.

—Marti, 2024, p. 45

31—Quietude, 2019-20
Santa Chiara Lab, Università di Siena,
Glitch Factory, T4All

32 / 33—Quietude, 2019-20
Santa Chiara Lab, Università di Siena,
Glitch Factory, T4All

The project involved deaf women through a series of workshops designed to place their experiences and perspectives at the heart of the design process. In addition, designers, psychologists, ethicists, makers, engineers and Italian sign language interpreters were also involved. This research work highlighted a number of issues that were subsequently addressed in the project:

Deaf people also want to be aware of environmental sounds around them. We experimented with different materials, including different simple technologies like vibration motors, to see where people are more sensitive to vibrations on their bodies. For example, we asked them to draw body maps to match their feeling of deafness. What does it mean not to hear and not be heard? We experimented with different vibrations, very simple prototypes, just to share the experience of vibration.
Since one of the requirements that emerged during the workshop was the aesthetic of hearing aids, we started prototyping jewels

—Marti, 2024, p. 46

An added bonus is that these eco-sustainable artefacts combine the functional purpose of medical aids with the aesthetic and social considerations of people with disabilities, whilst linking production to the local material culture. The jewellery is developed in various shapes and styles, drawing inspiration from the local craft culture in which the project is situated; specifically, the manufacture of leather and combines traditional materials with technologies – in this case, based on microelectronics – and is designed with their function in mind.

The feeling of vibration, temperature, texture that, or consistency is a matter of perception able can arouse emotions, thoughts, and knowledge. We could then assume that we are experimenting as a sort of embodiment in which, although mediated by a technological tool, our body itself is the device.

Embedding: the *object* as a device

The typical applications in the field of Internet of Things (IoT), ubiquitous computing and the already mentioned tangible interfaces, and the many devices used as mediators between the ecosystem, digital or blended, the plot and the interactors.
They are actual mediators, physical objects in connection with our hand, body and senses, but also cognitive means to explain how to play or behave towards the situated experience.
So, to quote Steve Jobs

I would describe a computer as a bycle for the mind – a fabulous machine thath coul turn the music power of a single person into the ability to traverse a mountain in a day.

—Kuan & Fabricant, 2019, p. 7

Tangible interfaces are introduced in the contact surface physical elements to let us interact with the immateriality of data and information tangibly and spatially, possibly including the haptic and other sensorial stimuli.
This implies embedding action triggers within objects and the environment, such as displays and smart or boundary objects.
The underlying idea is to restore a physical and experiential dimension that counterbalances the immaterial nature of the digital world and restores a role to our bodies and their natural gestures, as in the case of Aral Balkan, which we have already discussed.
Interaction, however mediated, feels natural and helps to reduce the cognitive load, but above all allows us to draw on the knowledge people already possess in order to understand new complex systems in an accessible and, as far as possible, transparent manner.

An good example – and one of the first – of a tangible user interface is the *Reactable*, developed by New Interactive, namely Sergi Jordà, Alvaro Barbosa, Gunter Geiger, Rubén Hinojosa, Martin K. and José Lozano, together with Xavi Rubio and Carlos Manías (as part of their degree projects at ESUP), in collaboration with the Lab in Occitania since 2003 (a project still ongoing) and commercially available since 2009.

34— Reactable, 2003
New Interactive + Lab in Occitania

The project started in February 2003, with the ambitious goal of developing the best computer-based musical instrument we could imagine, without being necessarily constrained by any predefined technology. In that sense, the Reactable really started from a concept, and not from a technology.

—Jordà, Sergi, et al., 2007

The Reactable is an innovative electronic musical device designed to offer an accessible and intuitive approach to sound creation. It provides performers with the possibility to explore and shape audio in real time, modifying its structure and parameters while engaging in a highly interactive and creative process.

At its core, the system relies on a tangible tabletop interface, where users interact directly through physical objects and touch gestures.

The instrument consists of a circular, illuminated surface that responds to the placement and movement of specific elements. By positioning, rotating, and linking these objects, performers can assemble and manipulate various sound components – such as synthesisers, audio effects, loops, and control modules – to generate dynamic, customizable musical compositions.

Reactable's pucks represent the building blocks of electronic music, each one having a different functionality in sound generation or in effect processing, in a way deeply inspired by modular analogue synthesizers such as those developed by Bob Moog in the early 60s.

—Jordà, Sergi, et al., 2007

The musical console has been adopted by Björk during the *Volta* tour (2007-08), Björk was one of the first musicians to use the Reactable live, introducing it to a mainstream audience at the Coachella Festival on April 27, 2007.

Rotating and moving volume knobs using free gestures on a visual interface that responds to user input offers a direct and intuitive way of interacting that combines tactile, haptic, acoustic and visual elements. Sound waves, vibrations and other physical phenomena associated with sound are visualised.

The interaction is a sort of choreography: the spatial movements and gestures of the musician scratching and playing produce a multimodal acoustic and visual effect connected to the show performed on the stage by other persons. In this case, the underlying knowledge of a physical console helps, even in a different visual context, to orientate on the type of gestures that can be operated on the interactive surface and the hybrid nature of the tangible interaction suggests use and movements of the visual-acoustic elements produced and represented on/by the interface.

35—I Mirabilia, 2012
Erika Rossi et al.

The Mirabilia (The Wonders) – an interactive dolls for hospitalized children – is an awarded master degree thesis developed by Erika Rossi (Rossi, et al. 2011) at the IUAV university under the supervision of Philip Tabor and Gillian Crampton Smith that introduces an emotional variable in a IoT project. The project that explores how interactive toys can support the emotional well-being of children living with chronic or terminal illnesses in a hospital, based on the concept of smart objects.
The main idea is that physical, tangible objects can respond to children's psychological needs more effectively and intimately than screen-based applications. Through non-invasive interactions and playful behaviours, the dolls aim to help young patients express emotions that are often difficult to communicate, while also supporting the work of doctors, nurses, and psychologists.

The project began with an analysis of existing tools for hospitalised children, many of which focus on digital interfaces to teach, entertain, or explain the hospital environment. While useful, these solutions often overlook the importance of empathy, social relationships, and physical presence. This led the research toward interactive objects capable of creating more human-centred and emotionally meaningful experiences. Several precedents inspired the project, including toys based on haptics, storytelling, emotional expression, and distant communication.

The main medium used in existing projects to reach these goals are screen-based applications offering fun interactions, colourful interfaces and intelligent metaphor. However, as these solutions focus heavily on the digital interaction they do not cater for social relation ships and human empathy, important qualities for children in hospital. The focus of the project therefore moved to physical objects, which filled this gap by improving the children's connection to the world outside the hospital, with external stakeholders such as family, classmates and teachers. This enabled me to move closer to the initial goal of the project, which was to improve the human-to-human and human-to-machine interaction.

The majority of existing projects using physical objects, however, aim to improve the relationship between hospitalised children and their family and friends outside, which triggered the question: what are the challenges faced by these children within their everyday environment?

—Rossi et al., 2012, p. 1

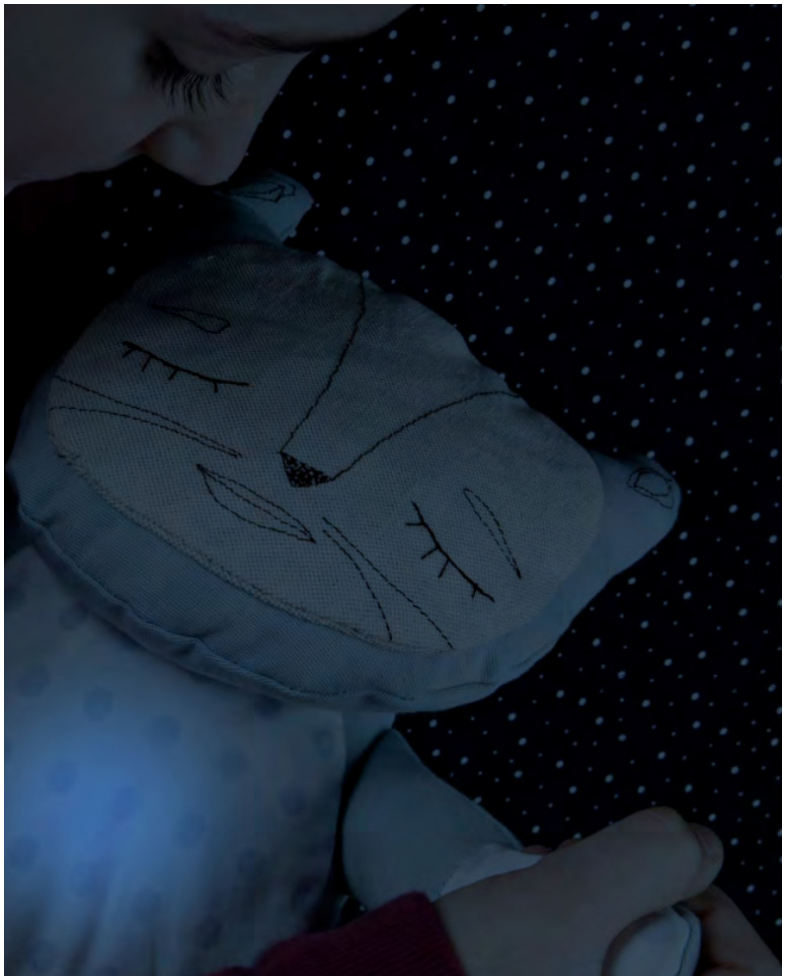
Field observation and interviews at Meyer Children's Hospital in Florence helped identify the most relevant psychological conditions experienced by hospitalised children aged 6 to 12.
Among the many issues observed, guilt, loneliness, and shyness emerged as the most significant. These became the basis for the three dolls that make up I Mirabilia: *Odo*, *Lucio*, and *Tello*.

Odo is designed to address guilt and fear, especially during the first phase of hospitalisation. It acts as a secret-keeper: children can whisper worries into its ear, and later choose whether to reveal them.
In this way, Odo becomes a mediator between the child and the psychologist, helping children externalise difficult feelings in a safe and private context.

Lucio focuses on loneliness. It is intended for night-time use and creates a gentle connection between two children in different rooms through light and vibration. By allowing children to signal each other and receive comforting feedback, Lucio supports friendship, reassurance, and emotional closeness during the most vulnerable hours.

Tello is aimed at reducing shyness through collaborative storytelling. Using sound-triggering "lollipops," children collectively invent stories in waiting rooms or shared spaces. This playful activity encourages imagination, socialisation, and indirect emotional expression.

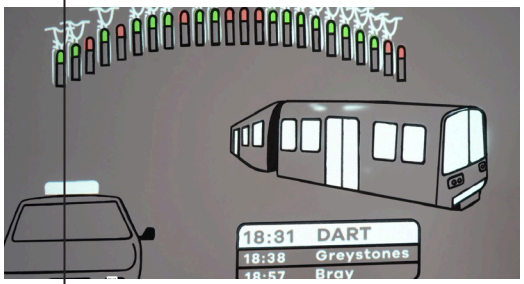
Although hospital testing was not possible due to child-protection regulations, prototypes and simulations were evaluated with children outside the hospital environment, producing encouraging feedback. Overall, the project shows how interaction design can contribute to children's psychological care by creating playful, sensitive, and meaningful therapeutic tools.

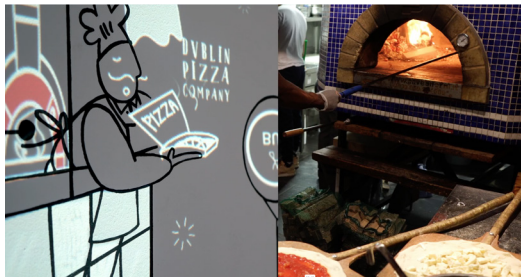


36—I Mirabilia, 2012
Erika Rossi et al.

Finally, I would like to present, as a final example, a project that represents a sort of transitional zone between *embedding* and *expanding* – that is, the integration of technologies into objects, in this case the space itself – and the expanded experience, where the body moves through space following natural gestures and interactions.

In more recent times, Lightscape Studio has been experimenting with Arduino and an electric ink developed by Bare Conductive Company. In that case, the solution adopted transforms almost every surface into an interactive one.
The *Dublin Interactive Mural* is a real-time information table connected through APIs to public transport schedules, bike sharing, shops and restaurants, aimed to facilitate social interactions among people. Touching the painted lines, the correspondent service is activated, and multimodal feedback such as lights, animations and sounds are played on the wall. You can call a taxi, order a pizza and then spend time together with your colleagues in the common open space.





37—Dublin Interactive Mural, 2020
Lightscape Studio

The space as interface. Digital interaction often distances us from our embodied, situated experience, abstracting us from space and time. Yet cognition and understanding are deeply rooted in the body, which has always evolved alongside technology, integrating it to reshape perception and knowledge. Placing the body back at the centre means rethinking space as an interface: an intelligent, hybrid environment where physical presence, movement and sensory experience activate interaction. In this perspective, technology becomes secondary to design, enabling immersive, performative experiences shaped by people' actions. Case studies show how space, not devices, drives engagement, transforming interaction into a dynamic, personal and ever-changing *happening* grounded in embodied participation.

The space as an interface

In the previous chapter and in the first set of case studies, various interface models and possible interactions were outlined, focusing primarily on the relationships between devices – including the body itself – that is, embodiment and embedding; the relationship with space, however, warrants separate consideration.

The relationship mediated by technology according to the zero posture – that is, the fixed setup of computers – but also the mobile experience that sees us absorbed in constantly staring at the small screen in our hands – hence the term tech neck, a sort of return to the fixity of the first vertebra (Baricco, 2019) – seems to make us ignore our bodies. Our experience, which is always situated, embodied and contextualised not only in a space, but in a specific, unrepeatable moment, that is, in time, seems to abstract itself and disconnect from these bodily and spatiotemporal dimensions.
But our relationship with the world and our understanding of it are also mediated by our bodies. As Martina Ardizzi (2025) reminds us in her recent *L'algoritmo bipede* [*The bipedal algorithm*], humankind in its evolution has created technological tools, that is, external functional elements, by integrating them into the biological system to alter the experience of the environment. In this sense

Man (sic!) is an empirical creature who draws on experience to shape and construct his mental world. The advent of technology alters the experience accessible to our bodies, our senses and our brains, shaping the mental world along a new trajectory.

—Ardizzi, 2015, p. 8–9

Whether we are talking about *motor tools*, operated by our hands, for example, or *sensory tools* – a *prothesis* such as the microscope – *cerebral tools*, such as writing, or *ontological tools* – as is the case with the frontier of artificial intelligence – technology has blurred our anthropomorphic boundaries, rendering them eternal in relation to our bodies, within which, however, body, mind and technology merge in an ontological process.

Even language, the quintessential technology and unique to the human species, is not merely an abstract cognitive-symbolic activity, but a process involving sensory and motor experiences.

The embodied cognition approach highlights precisely how our cognitive processes are not isolated from the body, but are in fact deeply rooted in it. In a linguistic context, this means that in order to understand the meaning of a word or a sentence, our brain activates bodily and motor representations associated with that experience.

—Ardizzi, 2015, p. 26

What, then, does it mean to place the body back at the centre of our world of interaction, within a hybrid space where sensory experiences, physical space, and representational forms—whether projective, mimetic, abstract or symbolic—coexist with digital space in an inseparable relationship?

What does it mean to use the space itself as an interface? An intelligent space, in which technologies are distributed – often no longer visible – and where, even more so than with 'embodiment' and 'embedding', the focus is not on technology – if it ever was – but on the intimate relationship between person and space, in its natural state, within an artificial space.

Here, in its etymological sense from 'artifex', the *craftsman*, that is, one capable of generating and shaping the relationship and activating it, as well as in its ambivalent meaning of a device or expedient:

An expedient devised with artistry to achieve a better effect, to create an illusion, to make something appear more beautiful.

—Treccani

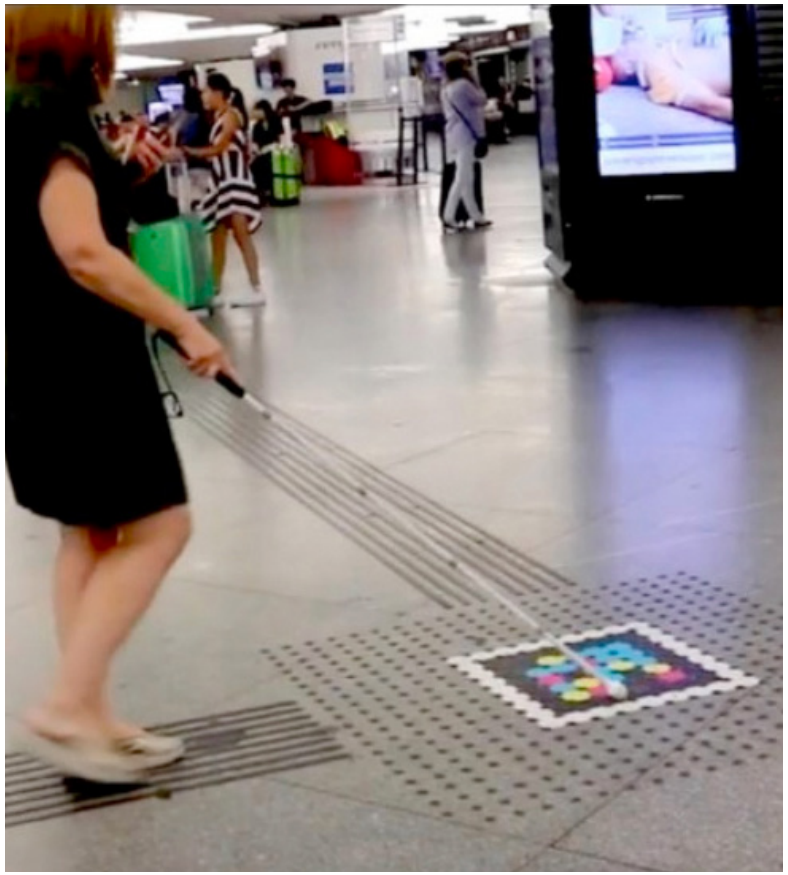
Just as in theatrical metaphor, and in dramatic fiction, this generates new worlds in which actions are performed to captivate, engage and fascinate the interactors.
Thus, space is one of the main drivers of proxemic, kinetic and sensory interaction, because the situated presence of the body, as stated by Budd in the *Undercover Manifesto* (Bowles & Box, 2010), means that the aim of design is to prepare environments, both physical and virtual, to encourage and shape people's experiences, allowing them to 'happen'.

It is movement, our being and acting, that activates space as an interface, whose technological substrate expands our very corporeality.
Interaction augments, enhances and expands our sensory perception and access to knowledge, adding, integrating, broadening, extending and empowering our experience of/in the blended reality.

Whilst this discussion does not focus on technologies – which are transient tools in a state of constant flux – they nevertheless play a role in the possibilities offered to the project for constructing spatial metaphors, embodied narratives, and suggesting choreographies of situated performative experiences. The case studies selected, presented and discussed in this chapter seek precisely to map out some of these possibilities, focusing, therefore, on the experiential concept and on its design-driven translation into an experience which, whilst mediated and made possible by digital technology, finds its raison d'être in the actions and creations of the participants, in their emotional dimension and response.

Some are based on proximity technologies – fairly traditional or basic ones, such as QR codes – demonstrating that it is the design, not the technology, that makes the difference; others on augmented reality; and still others on intelligent algorithms and artificial intelligence, or on virtual reality and immersive environments. In all the selected cases, the common thread is the designed experiential context – the stage – within which the interactors, through their movements, curiosity, emotions and presence in the space, *perform* a personal experience that is different every time, amongst the many possible *choreographies*.

Navilens



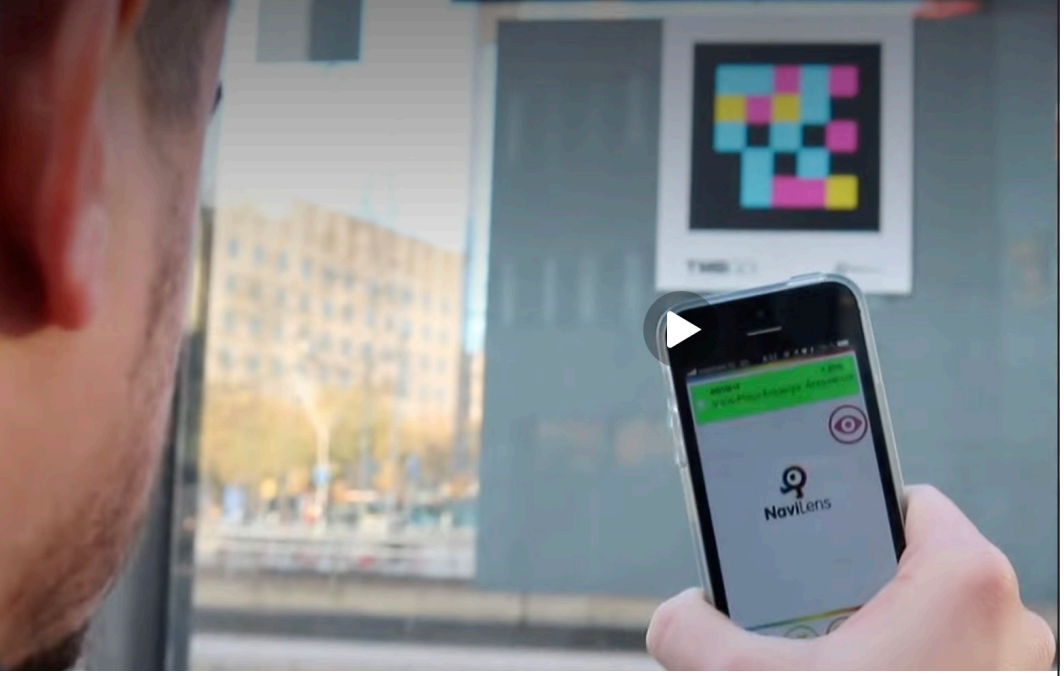
38 / 39 / 40—NaviLens, 2021
Laboratorio de Investigación en Visión Móvil,
University of Alicante, with NvaiLens startup

A first level of interaction between people and space is represented by the shift from the traditional two-dimensionality of the monitor to the three-dimensionality of space, mediated by the 'second' screen. The personal device, in turn, acts as a sensor, capable of detecting environmental signals or stimuli and translating them into an interaction. It is based on this exploratory model that the City of Barcelona has developed a mart guide to the city's public transport, explicitly designed and conceived to make its use accessible to people with visual impairments, empowering them in their experience of urban mobility.

NaviLens. The cutting-edge technology for blind and partially sighted people is a complex, transmedia signage and communication ecosystem based on the dynamic interaction of people in space, a mobile app to be installed on one's smartphone, and a series of QR codes distributed at key or significant points in the space and within local transport systems, integrated with existing pavement signage.
As the website states, the system has recently been extended to other cities and other areas of the public sphere, such as the Archaeological Museum of Mursia, and is available in 34 languages.

NaviLens helps make cities smarter and more inclusive.
The capabilities of this code allow users to interact more easily and accessibly with their environment in places such as underground stations, bus stops, museums and public buildings.

—Navilens



Once the app is installed, a blind or visually impaired person can use their phone, moving it around, so that the camera picks up the tags whilst the phone is pointed upwards, even when the user is walking or in motion. The tags are identified even from a considerable distance (up to 15 metres) and at an angle of 160°, and the calculations are performed algorithmically to guide the user correctly. The system also utilises acoustic features, such as audio feedback and Voice User Interfaces (VUI), giving users the impression of being guided whilst ensuring they retain a high degree of independence.

Here, the space serves as a display surface across which QR codes are distributed. These act as touchpoints providing access to information; when scanned using a personal device, they are converted into audio messages, following a multimodal redundancy model that makes the interactions accessible.
Although interaction with the space is mediated by the presence of a smartphone, it is the user's freedom of movement within the urban environment that triggers and generates this interaction through spontaneous and natural movements, enabling spontaneous mobility and expanding the possibilities for autonomy, self-sufficiency and self-efficacy among those who use it.

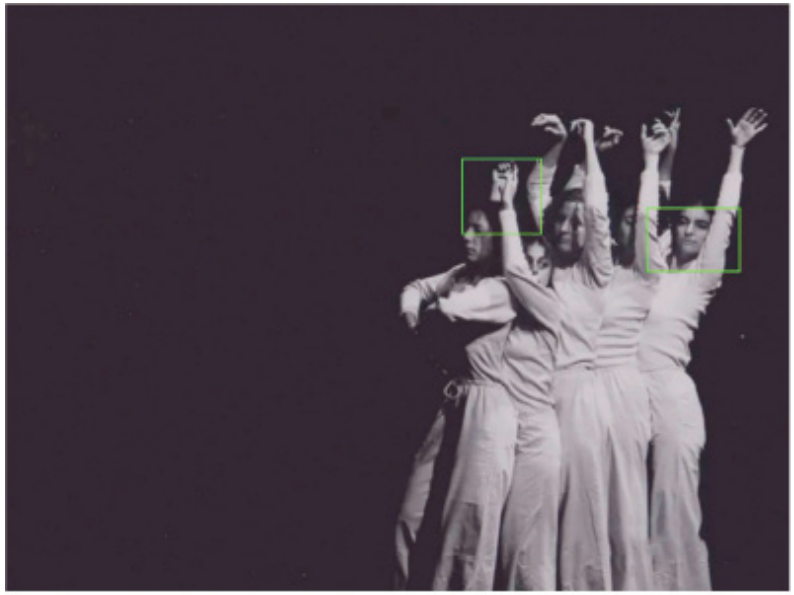
Bodies of knowledge

The possibility of using the space itself as an interface opens up a range of conceptual possibilities and allows us to renew some of the kinetic paradigms in which we have been flattened by the two-dimensionality of screens. The fluidity of movement, by bringing the body back to the centre, also restores its multiple sensory dimensions, giving people and the project itself a depth of expression that the two-dimensional composition of text and images has greatly impoverished and stereotyped. Then, can kinetic interaction be more freely experienced when mediated by technology embedded in the environment instead of from mobile devices, as in our
daily lives?

The project *Bodies of knowledge* was presented at BIO26, the 26th Ljubljana Biennial of Design, in 2020. It tackles the complex issue of 'translating' a multimodal archive – given the very nature of its content – into a phygital installation in which the various communicative and experiential layers overlap, mirror one another and engage in dialogue people, knowledge and space in a interactive dialog.

The Temporary Slovene Dance Archive (TSDA) was established in 2012 when Rok Vevar, its founder, started to compile the documentary and audiovisual archive of contemporary dance as his personal cultural-activist project. The TSDA stemmed from his own need for documentary records and an archive, and out of his own curiosity about the history of the artistic practices and the community. The aim of the TSDA is the historicisation of contemporary performing arts and covers mostly the material regarding contemporary scenic arts, dance and theatre of the non-institutional scene in Slovenia.

—Culture.si



41 / 42 / 43 / 44 / 45—Bodies of knowledge, 2020
BIO26, 26th Ljubljana Biennial of Design
Archive materials

As its creator, a contemporary dance historian and archivist, states

TSDA stemmed from my own need for documentary records and an archive, and out of my own curiosity about the history of the artistic practices and the community that essentially constituted my cultural habitus. Here I am referring to artists and their practices that are not only present in Slovenia, but are internationally extremely active and dynamic, despite the fact that they are for the most part institutionally underrepresented. In this respect, TDSA is an emancipatory, activist project aimed at making marginalized artistic practices more visible and providing study material for artists, theorists and historians.

— Vevar, n.d.

The archive comprises a wide variety of materials

which includes printed material, in-house process documentation, a register of Slovene dancers and choreographers, correspondence between artists and producers, photographic and audiovisual material, choreographers; and artists; files, dance festival catalogues, dance films, footage of performances, contemporary dance pedagogy programmes and a variety of other objects related to relevant artistic practices.

—Culture.si

Not to mention the donations and bequests from the choreographer and contemporary dance activist, as well as from educators, critics, dancers, photographers and so on.

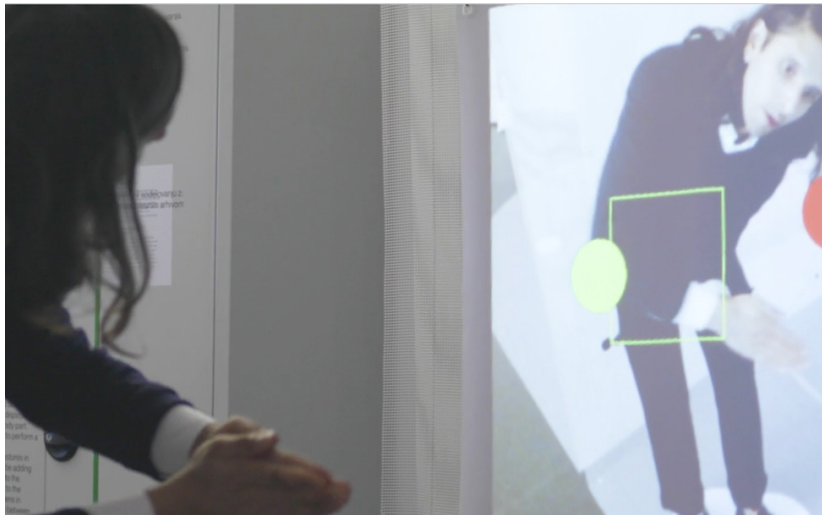
The project was curated by Thomas Geisler and Aline Lara Rezende, in collaboration with aolo Patelli as Design Mentor; Ida Hirsenfelder, Knowledge Mentor; Matev Straus; project Manager; and the team comprising Cyrus Clarke, Giulia Cordin, Juliana Lewis, Luigi Savio and Monika Seyfried, in collaboration with Rok Vevar and since 2018, the archive has been housed at the Museum of Contemporary Art Metelkova in Ljubljana.
This interdisciplinary group, drawing on diverse skills and backgrounds, tackled the complexity of the theme and materials through a concept based on the interaction of bodies in space – as in dance and other choreographic practices – and translated the materials into a 'payable archive' installation.

The installation shifts the archive from a site of knowledge retrieval, to one of knowledge production. By dismantling and mobilising documents, technologies and institutional framings into new compositions, the intervention invites visitors to access, navigate and contribute to the content of the archive, through movements and gestures. In the spirit of contemporary dance, Bodies of Knowledge breaks the internal logic of the archive by releasing the emancipatory power of movement.

—Patelli, 2020

The historical documents – texts, visual materials and audiovisual content – a challenging mix in terms of curation and exhibition, have been organised and interpreted using AI technologies and machine learning algorithms, typically employed in the fields of surveillance and security, to link them to the movements of visitors within the exhibition space.

The projective surfaces of the installation located in the room and dedicated to particular three different body segments – namely legs, arms and head – engage visitors in a performative experience. People



46—Bodies of knowledge, 2020
BIO26, 26th Ljubljana Biennial of Design

47—Bodies of knowledge, 2020
BIO26, 26th Ljubljana Biennial of Design

can freely move in the exhibit and, triggered by the graphic elements – i.e. the coloured circles – can act out the gesture and positions that are mirrored by the content of the archive, dynamically and real-time sorted and proposed on the surfaces, producing a unique situated happening, "but the fragments persist in the temporary archive until the end of the biennial".

Historiographic structures dissolve, allowing for the emergence of alternative associations. Digital data are opened up not only as research information but as a physical experience. Given the specific nature of the topic and the types of documents collected, the project plays on the transformation of the conceptual mechanism of access and use of the documentary material – from information *retrieval* to *experience* – and, on the mode of interaction that, in turn, generates knowledge.

48 / 49—Venice Canal View, 2009
The Canal Gande, in Venice

Venice Canal View

Nevertheless, can kinetic interaction be more freely experienced when mediated by technology embedded in the environment instead of mobile devices?

CanalView. Venice From the Water, an interactive platform for virtual tours, presents a physical performance simulating a walk along the Grand Canal in the city of Venice. Designed by Marco Luitprandi, Chiara Masiero Sgrinzatto, Luca-Nicolò Vascon, Alvise, Rabitti Giovanni Rosa, and produced by the companies NuovoStudio Factory, Officine Panottiche and the Wetoo group, the project was developed in 2009.
The project begins with the mapping of the façades of buildings overlooking Venice's Grand Canal, reconstructing, through a detailed photographic survey, the waterfront on both sides of the city's main waterway. This material has been used as part of the Venice Canal View virtual experience, proposing a physical performance simulating a walk along the Grand Canal itself.
Situated in a *calle*, the typical Venetian square, the shape of the canal is projected onto the two-dimensional surface of the floor. In this natural setting, people walking freely along this path activate a projection onto the buildings' façades – the real landscape – based on video mapping and the curtain walls of the Grand Canal.
The movement and orientation of viewers within the three-dimensional set determine the digital performance, whilst images of the canal's buildings create a second layer on the calle's wall, treated as a sort of scenic backdrop.

50—Venice Canal View, 2009
Interactive performance

51—Venice Canal View, 2009
Interactive performance

The idea of the theatre metaphor is embodied here by the interactors – the people who are simultaneously players, active spectators or interactors, as well as those activating the dynamic visualisation of the spatial scenario. The space, open like a stage, expands the experience, transcending sensory constraints and creating this paradox of overlaps, almost a Chinese box of experience and spatial hybridisation.

52—Venice Canal View, 2009
Interactive projective performance

The Cloud Pavilion

If it is the presence of people that activates the digital layer of the space, interacting with data according to their movements, the *installation* in the German Pavilion at the *17th Venice Architecture Biennale 2021* – curated by Roman Miletitch and Julian Wäckerlin – takes this concept to its logical conclusion, overturning the relationship between presence and absence, between the physical and the digital.

The German Pavilion, in its current form, is a neoclassical building, renovated during the Nazi era in 1938 to bring it into line with its monumental aesthetic; since then, apart from the removal of Third Reich symbols, it has remained largely unchanged. It is precisely this stately, architectural and symbolic dimension that lends even greater solemnity and a sense of alienation to the exhibition design created for the post-pandemic edition of the Biennale.

The *Cloud Pavilion* has always been highly controversial, precisely because it completely transcends the concept of space-time, interpreting it in a dystopian manner, partly in the wake of the trauma and emotions stirred up by the pandemic emergency that had kept us all confined to the cramped, intimate spaces of our homes, estranged and distanced from other human relationships and contact.

The exhibition structure is completely absent, negated or reduced to the mere presence of large QR codes on the perimeter walls of the central apsidal hall and the other rooms. But the physical space in which visitors wander, perplexed and estranged, is transcended by its 'virtual twin'. Upon entering, visitors are in fact invited to download the app onto their personal device, smartphone or tablet, to access an alternative realm with their own avatar, which will represent them in the phygital or onlife (Floridi, 2015) experience and is revealed only within the digital realm. Here, those present in the physical space can meet and converse with one another in the virtual space or access, via QR codes, the pavilion's actual experiential content.

Stripped of human presence, the experience is filled with narrative content. Each exploration is individual and different; although various people can interact with one another in virtual space, they are guided

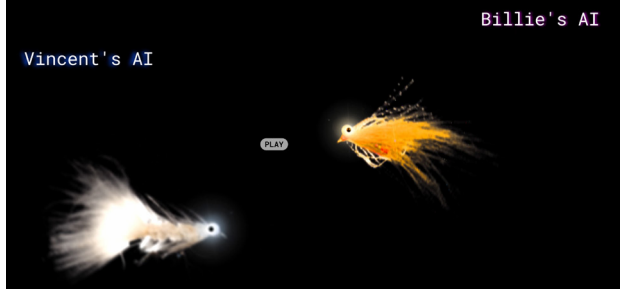
through the transmedia content by non-human agents – two artificial intelligences – and thus, in a non-physical, projective and simulated space, a boy and girl of the future converse, recounting the past story of the future world that will be in *2038, The New Serenity*.

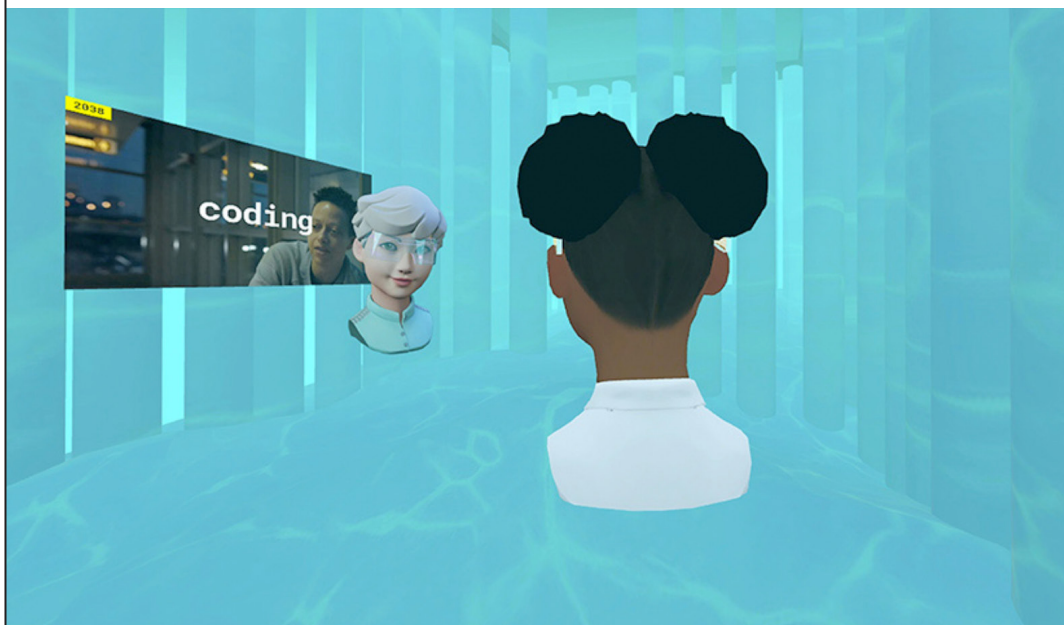
2038 – The New Serenity, invites you to discover a story between fact and fiction. In a series of films, it tells the history of a better world in which everything, though imperfect, is better in some pretty profound and radical ways. Based on the knowledge and visions of a collaborative team of international experts from Architecture, Art, Ecology, Economy, Philosophy, Politics, Science and Technology, team 2038, [initiated by Arno Brandlhuber, Olaf Grawert, Nikolaus Hirsch, Christopher Roth], trives to explore our future society through prefigurative politics, illustrating modes of organization and social relationships to come.

—2018.xyz

The 3D virtual space interface – based on the new-brutalist aesthetic of video games – is linked to a still-growing app and website related to the work of a non-profit association.
Flat and intangible touch points, namely the QR-codes, have replaced objects, or any other physical form of presence, offering the fixity of the actionable and acted upon gesture in a system in which interaction is filtered and only made possible through the personal device, i.e. a two-dimensional space. The only feasible action is to point to and access the fragments that constitute and replace the situated and embodied experience.

Deeply impacted in its design by the pandemic event – symbolising the many crises and transformations we are facing – the empty, dystonic, dystopian neoclassical space creates a further contrast or, perhaps, the emptiness needed to immerse oneself in the cloud playful space of the exhibit, expanded, immaterial and therefore boundless.





53 / 54 / 55—The Cloud Pavilion, 2021
2038 – The new serenity

56—The Cloud Pavilion, 2021
The German Pavilion in Venice

Planets

Space, therefore, lends itself to multiple interpretations, whether it be the urban landscape that reproduces and reconfigures itself through our intentional presence, or the void of structures and relationships in post-pandemic places – though not of meaning and narrative, which have migrated to the onlife realm. This project seems to sum up all these concepts in a unique experience in between physical and digital is the one carried out by Team Lab in the project Planets.

teamLab is an international art collective. Their collaborative practice seeks to navigate the confluence of art, science, technology, and the natural world. Through art, the interdisciplinary group of specialists, including artists, programmers, engineers, CG animators, mathematicians, and architects, aims to explore the relationship between the self and the world, and new forms of perception. In order to understand the world around them, people separate it into independent entities with perceived boundaries between them. teamLab seeks to transcend these boundaries in our perceptions of the world, of the relationship between the self and the world, and of the continuity of time. Everything exists in a long, fragile yet miraculous, borderless continuity.

—teamLab, 2001

The Planets museum has been established in Toyosu, Tokyo, since July 2018 and will end in 2027. It has been conceived as a place where you are expected to experience the exhibition "With Your Entire Body, Immerse, Perceive, Become One with the Art."

The artworks change depending on the presence of people, and the existence of the artworks is continuous with your body and with others. Immerse yourself physically in the massive artwork spaces, perceive them with your body, and become one with the art.

—teamLab, n.d.

The concept of the *body immersive* is the synthesis of a physical as well as synesthetic experience generated by the convergence of the real and digital space mediated by art, senses and time.
Physicality and virtuality – the enabling substrate of technology – are reflected, intertwined and interpenetrated. The spectrum of possibilities offered ranges from the more material – two passages in which the sensory experience is not mediated by the digital but only experienced by the visitor's body to the more abstract. The feedback from the intelligent environment generates the physical experience of people.

The museum visit is a journey organised in a sort of experiential matrix subdivided into 4 interactive ambiences and 7 installations, each based on a specific idea and experience model.
To enter the exhibition, visitors are asked to walk barefoot along a corridor, a narrow channel of water: the artwork Waterfall of Light Particles at the Top of an Incine. This is the first step to immerse themselves in order to reconnect with their bodies and become aware of their sensory perceptions and sensations. In modern life, we are surrounded by flat hard surfaces that do not exist in nature; therefore, we have lost consciousness of our bodies, and this installation is a space to perceive them again by adopting a mindful and conscious proprioceptive posture, both physically and emotionally. In other words, the project proposes a full re-appropriation of the corporal self, alongside immersion in increasingly hybrid, blended, virtual, and perceptual experiences at the same time.

At the end of this path, people access a wide, blurred space where the metaphor of water is reinforced and augmented. The Drawing on the Water Surface, created by the *Dance of Koi and People – Infinity*, is a virtual simulation of swimming carp, which brings out the spontaneous

57—teamLabs, 2018
Planets, Tokyo

reaction of people of stretching out their hands, dipping them into the water in an attempt to catch the fish, creating a dance between the Koi and themselves. This movement generates a choreography involving senses, spaces and tactile emotions mediated by the simulative effect induced by the visual layer. The interaction between viewers and the installation causes a constant change in the artwork, generating a transformative continuum within the environment, shaped by individual and collective movements.

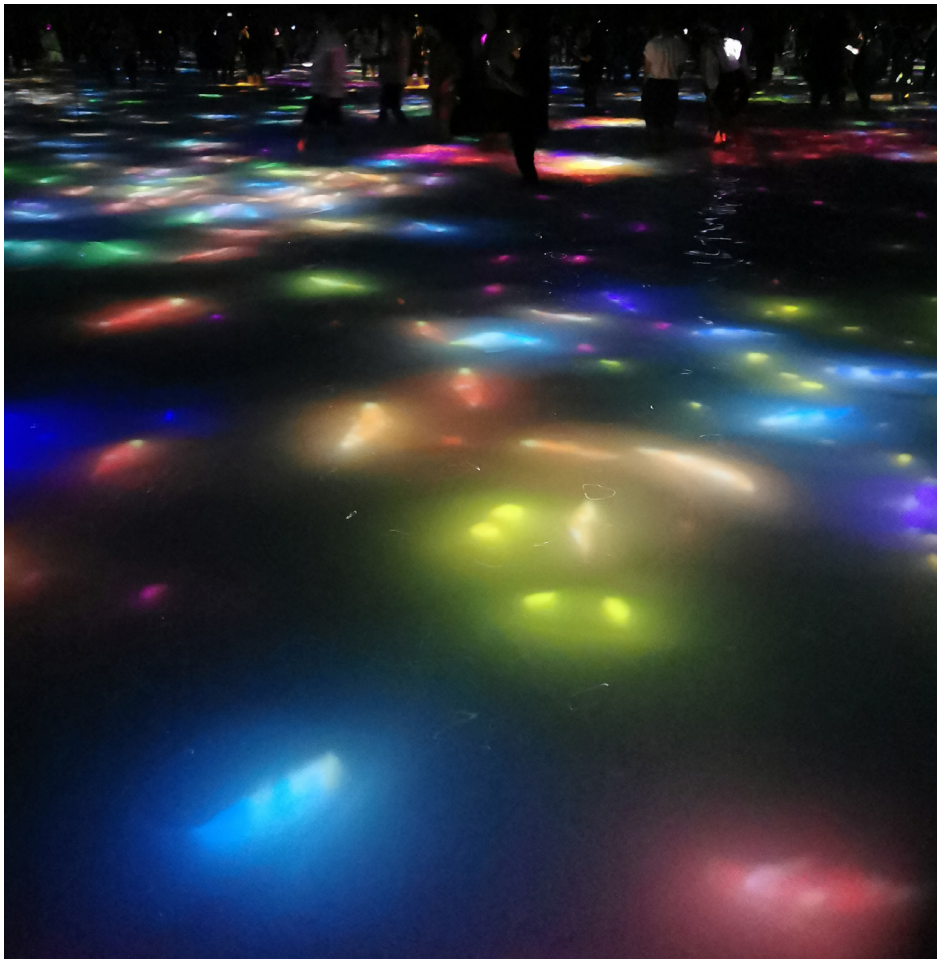
Also in the subsequent sections of *The Infinite Crystal Universe*. People's interaction with the environment is fundamental to the very creation of the immersive artistic experience:

Pointillism uses an accumulation of distinct dots of color to create a picture. Here, light points are used to create three-dimensional objects. The light sculpture extends infinitely in all directions. People use their smartphones to select stars to throw into The Infinite Crystal Universe. These stars are reborn in three dimensions, creating the artwork. The presence of people and their location within the work affect these three-dimensional stars, which in turn influence and are influenced by other stars in the space. This artwork is forever evolving, changing from moment to moment due to the people in the space.

—teamLab, 2018

A further ambience proposes a time-based animation that presents the changing of the seasons through the blossoming and falling of flowers: *Floating in the Falling Universe of Flowers*. Flowers grow, bud, bloom, and in time, the petals fall, and the flowers wither and die. The cycle of life continues endlessly and never repeats: people can perturb it through an app that provides specific interactions with artwork that is not prerecorded, but rather happens in real time and thanks to the generative presence of visitors.

Going through the exhibit, visitors enter a three-dimensional space filled with free-floating light spheres: *Expanding Three-dimensional Existence in Transforming Space - Flattening 3 Colours and 9 Blurred Colours*. When people move through or strike the spheres, they change colour and resonate all together. The shape of the space is determined by the floating spheres, and changes according to people's actions: pushing, bouncing, or colliding. As a result, the spheres influence one another, changing colour together and transforming our perception of space, blurring or flattening it.



58 / 59—teamLabs, 2018
Planets, Tokyo

60—Za'atari refugee camp in Jordan

Clouds over Sidra

I would like to conclude this series of case studies with one that is particularly close to my heart, as it offers a different perspective on the world of virtual reality, moving beyond the highly stereotypical image of three-dimensional reconstruction – whether more or less realistic, or more or less based on neo-brutalist aesthetics – which stems primarily from the world of video games. However effective and much a part of our daily lives these images may be, they are also deeply stereotypical and so deeply ingrained in our collective imagination that they are profoundly limiting our ability to imagine, explore and develop new possible ways of both interacting with and representing these three-dimensional or immersive worlds

The project was conceived and developed by Gabor Arora and director Chris Milk for the United Nations, and directed by Gabo Arora and Barry Pousman, co-produced by Samantha Storr, Socrates Kakoulides, Christopher Fabian and Katherine Keating. It is a multimodal immersive documentary, based on the use of virtual reality and headsets, and was first shown at the World Economic Forum in Davos, Switzerland, in January 2015.

Clouds over Sidra, tells the first-person, subjective story of Sidra, a 12-year-old girl who lived for 18 months in the Za'atari refugee camp in Jordan. Sidra fled Syria because of the devastating civil war, living in the camp with her family, and you can talk to her, listen to her story, go with her to school, or you can be surrounded by children laughing and chattering, running towards you, and asking to play with them.
The experience is emotionally intense, despite the limitations of the headsets; the director's skill makes us feel part of the scene, present in the place, in contact with the people telling us their stories, or being taken by the hand by the children running towards us with smiles on their faces.

61 / 62 / 63—Clouds over Sidra, 2015
Za'atari refugee camp in Jordan

But the reality in which this experience is 'consumed' is quite different. A room at one of the world's most exclusive events, an audience of policy-makers and stakeholders – seated in some luxurious meeting room – a clean, sterile elsewhere – deciding the fate of these people, often unable to imagine the impact of their deliberations.
Here, phygital offers a powerful and thus intimate insight to generate identification and empathy from a proprioceptive point of view.

64—Clouds over Sidra, 2015
Davos meeting, January 2015

So, what comes next?

At present, the number of unresolved questions exceeds the conclusions that can be drawn, largely due to the rapid evolution of the field and the fact that we are navigating a transitional moment. Many emerging phenomena have yet to fully define their identity or develop an appropriate language. Moreover, the extended period of isolation has deeply challenged traditional notions of space and presence, prompting a reconsideration of their very foundations. Still, several relevant issues can already be identified.

One of these concerns the role of technological devices. As previously discussed, they function as powerful amplifiers, offering significant potential to enhance interactions and extend human sensory capabilities. They also enable the development of more inclusive and supportive solutions, particularly for individuals with physical, emotional, or cognitive needs. At the same time, however, such technologies risk becoming opaque systems – what Jason Lanier (2013) – and other critics describe as "black boxes" that may be exploited in ways that compromise privacy, data integrity, and social behavior.

Another key aspect relates to the evolving role of designers. Within an increasingly complex context, they are required to adopt a transdisciplinary approach, educational background that allows effective collaboration across diverse domains of knowledge and practice. Consequently, their role shifts toward orchestrating multiple contributions and integrating them into a coherent and holistic project vision. As digital migrants, we still perceive a certain distance between ourselves and the technological environment. Yet, this perception may differ significantly for future generations, who are growing up within a "phygital" ecosystem where natural and artificial dimensions are seamlessly intertwined. Understanding the implications of this anthropological transformation represents a significant and still unpredictable challenge for the near future.

Artificial intelligence is certainly one of them: although chatbots can convincingly imitate human language, they lack the fundamentally embodied experience that underpins human cognition, both in its evolutionary development and in everyday functioning. This absence becomes evident in their difficulty fully grasping context and situational meaning, since they do not have access to sensory or bodily interactions with the world. In fact, chatbots possess no lived, physical grounding: their "experience" is entirely confined to the linguistic prompts on which they are trained. Without a material, tangible body through which to engage with reality, their understanding remains abstract and disembodied.

On the contrary,

the need for physical experience in an artificial language that simulates natural language highlights the significance of the embodied aspect of the human mind. One way or another, we are treating new technologies as ontological tools. We shall return to this last point; for now, we conclude that bodily experience has shaped the evolution and nature of human language in a way that remains unprecedented and unique.

——Ardizzi, 2025, 31

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