SOCIOTECHNICAL ENVIRONMENTS

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Designing digital encounters and their agency on users. A case study

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This paper analyses the interactive exhibit “Leonardo racconta Leonardo. Milano, vita, natura” (Leonardo Plays Leonardo. Milan, Life, Nature), an installation located in the cloister of Palazzo delle Stelline, Milan, about Leonardo da Vinci and his Milanese period. The installation allows visitors to meet a life-sized simulated hologram of the Master who tells stories about his life, the years he spent in Milan and his relationship with nature. The project is set in the field of HCI, looking at the world of digital encounters and interactive systems based on embodied interaction. We investigate if and how the designers’ choices succeeded in achieving the stated aims and persuading people to behave accordingly. Relying on user tests and direct observation, we discuss how the interactive exhibit and the digital Leonardo affected visitors’ behaviour, effectively capturing their attention and fostering interaction. Furthermore, we examine how visitors perceived the digital character and the gestures he, directly or indirectly, asked them to perform to trigger actions.

**Keywords:** Digital encounter; design; embodied interaction.

Introduction

This paper analyses and discusses Leonardo racconta Leonardo. Milano, vita, natura (Leonardo Plays Leonardo. Milan, Life, Nature)\textsuperscript{1}, an interactive installation about Leonardo da Vinci and his Milanese period located in the cloister of Palazzo delle Stelline in Milan. The building represents a unique location for Leonardo da Vinci, as it stands in an area the Sforza family had built around the complex of Santa Maria delle Grazie to host courtiers and dignitaries in the immediate vicinity of Sforzesco castle. It is located in front of Santa Maria delle Grazie, which hosts the renowned Last Supper and

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\textsuperscript{1} http://www.stelline.it/it/la-fondazione/mostre/leonardo-racconta-leonardo-milano-vita-natura [accessed 21\textsuperscript{st} February, 2017].
close to the recently restored vineyard of the Renaissance Master, near Casa degli Atellani.

The specificity of the location has been recently acknowledged thanks to a joint effort by Fondazione Stelline, the Lombardy Region and the Superintendence for Architectural and Landscape Heritage of Milan that chose the building to host *Hub Leonardo*, a cultural centre for the promotion of knowledge about Leonardo da Vinci and a multimedia hub designed to highlight the *genius loci*, the spirit of the place where Leonardo lived and worked. *Leonardo Plays Leonardo* is part of *Hub Leonardo* and aims to introduce citizens and tourists to the world of the Master through three digital holograms of a human-sized Leonardo da Vinci who welcomes visitors and tell short stories dealing with (i) his Milanese period (ii) his life and (iii) his relationship with nature.

This paper analyses the project from the specific point of view of how the agency (Latour, 2007) of the digital character impacts visitors, namely his ability to affect their behaviour, successfully capturing their attention and fostering interaction. Digital characters are indeed unusual agents.

If we consider the four categories of agents classified by Kaptelinin & Nardi (2009) – (1) *natural or cultural things*, (2) *natural or cultural non-human living beings*, (3) *human beings*, (4) *social entities* – it would be quite difficult to locate digital characters in only one of these categories. These agents perform actions according to the will of their designers and programmers, that is to say, on someone else’s behalf, thus characterizing their type of agency as *delegated agency* (Kaptelinin and Nardi, 2009) and producing unintentional or unexpected effects beyond what the designers had in mind. The authors (Kaptelinin and Nardi, 2009, p. 244) attribute these forms of agency to *cultural things*, artefacts created by humans to produce specific effects. This category of agents includes all works of art, industrial design products or machines as well as digital interactive artefacts.

There is no question that digital characters are not human beings, but it is also problematic to fully identify them as mere things. These kinds of characters – especially when personifying real women/men and portrayed as life-sized – resemble human beings in every way and appear to behave accordingly. They mimic human beings, and the ambiguity and fascination they trigger underlies a number of projects in the field of Cultural Heritage that offer visitors encounters with digital characters as a means of providing information and interpretive content in an engaging manner. Exploiting renowned characters as privileged witnesses of historic periods, artistic movements and important events is a common approach in the field of
cultural interpretation, whether the character is digital or a flesh-and-blood actor.

To contextualise the project discussed here, it is worth presenting a brief overview of the various solutions that have been adopted in the field, listed below in order of the degree of realism they achieved. Specifically, we outline three broad categories of ways anthropomorphic representation have been employed, addressing digital representations in an inclusive sense that encompasses both 2D/3D characters and real people portrayed in videos: (i) digital narrators, (ii) digital appearances and (iii) real actors portraying someone else.

The examples in the first category (i) employ digital characters as witnesses and narrators and are not aimed at creating a sense of realism. An example is the installation *Bologna Story* by Cineca located at Palazzo Pepoli in Bologna. In this case, visitors are invited to sit in a virtual theatre and watch a stereoscopic video that traces the story of the city under the guidance of a 3D character, the Etruscan APO. The realism of the virtual reconstruction of the city across the centuries is contrasted with the cartoon-like representation of APO, who is designed to involve visitors in the narration and provide entertainment.

The second category (ii) encompasses projects characterised by the particular attention they pay to creating realistic settings and astonishing visitors with the appearance of highly realistic historical characters. Typically, these examples employ holograms and are based on tangible and embodied interaction (Dourish, 2001; Hornecker and Buur, 2006). An example is the installation located at Palazzo Ducale of Gubbio entitled *An audience with Federico* (In udienza da Federico), which brings Federico da Montefeltro back to life thanks to a professional actor and rear-projected screens. The duke engages in dialogue with an angel in a dramatized 15-minutes pièce, giving bystanders the impression of having these characters before them in the flesh. Visitors cannot interact with the digital characters; rather, the actors continuously perform their representation like ghosts juxtaposed in the present.

At Venaria Reale, near Turin, human-sized digital courtiers, scullions, cooks, ladies and gallants in period clothing appear when visitors walk past, in the project *Peopling the Palaces* by Peter Greenaway. The projections materialize in different rooms and locations, continuously stimulating visitors’ interest and giving them the impression of being surrounded by a baroque world. As in *An audience with Federico*, visitors to this exhibit
occupy a passive role, receiving information that is provided in a film-like fashion.

A similar approach is modelled by Studio Azzurro with *Story Bearers*, life-sized holograms of ordinary people that walk on rear-projected screens (Studio Azzurro, 2010; 2011). Visitors can stop the digital characters by raising their hands and, once stopped, the characters tell their stories, directly addressing the visitor who hailed them. The world of the digital characters in *Story Bearers* responds to users; they can interact with the system using a natural gesture and therefore move beyond the role of mere passive consumers of multimedia content.

An even more natural interaction with digital characters can be found in the *New Dimensions in Testimony* project aimed at allowing young students to “talk” with holograms of Holocaust survivors. The first experimentation provided a class of pupils with a hologram of a survivor sitting on a chair who was capable of understanding questions about his life and answering accordingly.

The third category (iii) achieves the highest degree of realism in that it includes experiences based on the performance of real people, actors in the flesh playing the role of historic figures. An example of this is provided by the project *Being Leonardo da Vinci. An impossible interview*, an itinerant theatre performance directed and interpreted by Massimiliano Finazzer Flory that has been staged mainly in museums and cultural centres. During the performance, the actor interprets the Italian Master, wearing period clothes and answering approximately 70 questions about his life, activity and work.

All the projects described above and included in the three categories have in common the fact that they employ anthropomorphic digital characters, interactive or not, as narrators or figures that help visitors to comprehend cultural content. In addition to verbal communication, they also exploit non-verbal registers, for instance by communicating through facial expression, posture, body movement, gaze and so on.

What distinguishes these categories is the digital characters’ degree of realism and how they trigger interaction. *Bologna Story* (i) and *Being Leonardo da Vinci* (iii) have very different approaches to realism since the first presents a cartoon-like 3D character and the second a real actor performing on a stage; at the same time, however, they use the same methods to engage visitors. Indeed, they place users in the role of passive receivers of information, spectators of a film/theatre show with which they cannot interact. For both the projects, the character’s simulation, however
realistic it may be, serves the purpose of involving visitors in the story and does not aim at astonishing or surprising. In contrast, the four projects in the second category (ii) all seek to simulate highly realistic encounters with digital characters, deliberately concealing the technological equipment in question in order to increase the sense of wonder.

All of these examples engage visitors in fascinating narrative experiences in which they meet digital historical figures or ordinary people, but they differ in that they offer visitors different levels of interaction. The projects of the first and third category as well as the first two projects of the second category do not permit users to interact at all; viewers cannot produce an effect on the digital system through their own actions. This impossibility to act is underlined by the physical separation designers impose between the digital characters and the users, who are cast as passive consumers of a movie. The Story Bearers of Studio Azzurro and the survivor hologram, that introduce interaction by means of natural input, namely gestures and speech, are subject to different considerations. Being configured as interactive systems, they act as cultural things (Kaptelinin and Nardi, 2009) and, usually by implementing the intentions of human beings (designers and programmers), they produce effects on human beings, in this case the visitors who modify their behaviour according to the actions and re-actions of the digital characters. Interactivity, together with realism, is therefore a key-factor: by reacting to visitors’ actions and consequently modifying their behaviour, the digital characters trigger a virtuous circle of action and reaction that is at the basis of all human communication.

In this study, we understand the three interactive installations of Leonardo Plays Leonardo to represent examples of cultural things, “inherently persuasive” design products that embed and embody the arguments of the people who designed them (Redström, 2006). Whether or not the designers managed to achieve their aims and persuade visitors to behave accordingly is an open question and one we address here in this paper. At the same time, we seek to understand if the digital character in each case can move beyond the simple condition of interactive object and be perceived by users as a sort of human being.

**Methodology**

The study presented here is grounded in quantitative and qualitative data gleaned through diverse methods of inquiry.

The first set of available data is the usage statistics provided by the system, which records every interaction performed at each of the three
installations. The data collected to date cover 83 non-consecutive days of usage and provide information about the date and time of the interaction, the number of users, the number of videos watched and the language selected.

In order to shed light on the statistical data and gain insights from users, we also conducted interviews using the think-aloud protocol (Someren et al., 1994; Dorst and Cross, 2001) with a consistent set of expert users. Eight post-graduate students in Design, aged between 22 and 26 and coming from six different countries – 3 Italian, 1 Chinese, 1 Turkish, 1 Bulgarian, 1 Greek and 1 Polish – were recorded while they interacted with the system and then involved in an informal post-experience focus group. The same sample of users also completed a questionnaire designed to verify the consistency of the opinions they expressed in the interviews and focus their attention on the experience of use and how much they enjoyed it. Furthermore, direct observation of the aforementioned expert users as well as casual visitors allowed us to gain useful insights into the relationship between these people and the digital Leonardo.

**Description of the system and how it is used**

Three installations are the core of the interactive system of *Leonardo Plays Leonardo*. Each installation is composed of two parts: a back-end concealing the computer and video projector and a front-end structure holding a 90” holographic screen together with the interaction and audio equipment.

When entering the cloister of the building, visitors catch sight, at a distance, of a man dressed in Renaissance-style clothing moving into and out of the three screens. Every time he enters the stage, he wears a different outfit and displays a different mood: sometimes he is thoughtful and wearing luxurious clothes, at other times he appears wearing work clothes and gives the impression of being very busy, still other times he invites bystanders to come nearer. When visitors approach one of the screens, Leonardo appears. He speaks Italian and asks the user to choose his or her preferred subtitle language: visitors can choose Italian by raising their right hands and English with their left. Once a language is selected, a first video begins to play, chosen randomly by the system form among the five contained in each installation. A brief introduction displays the title of the piece, then Leonardo appears and talks for about two minutes, addressing the bystanders directly. When a story ends, users can choose to listen to
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another one – by raising their right hands – or to end the interaction – by raising their left. All five of the videos use the same mechanics of interaction and, once they have finished, Leonardo kindly bids the user goodbye and begins moving in and out of the screen once again.

Figure 1 Users in front of the interactive installations

Designers’ choices and users’ perceptions

Giving citizens and visitors the chance to enjoy a digital encounter with Leonardo da Vinci was the main aim of this project, which drew inspiration from the aforementioned examples and in particular those pertaining to the second category. We borrowed from them the idea of using life-sized characters, the mechanics of interaction based on bodily movements and gestures, and the choice to feature human actors instead of virtual characters. At the same time, the challenges we faced were different, especially given that it was impossible to hide the technological apparatus with the help of darkness as in the abovementioned projects. This choice was precluded due to the location, in a cloister, and the resulting light conditions: the perimeter of the corridors facing onto the inner garden with its old magnolia tree is filled with windows, so there is significant amount of light at almost every hour of the day. We therefore chose to transform a problem into an opportunity and create a very evident, high-tech and
industrial sort of portal that would suggest a timeless space in which visitors could encounter Leonardo. Indeed, the edgy stainless steel structure, greyish screen and clearly visible sensors were intended to create a marked impression of detachment between the contemporary structure and the historical character, dressed in Renaissance clothes.

Figure 2  The structures of the Leonardo Plays Leonardo installation: on the left, the back-end wooden box; on the right, the stainless-steel frame with screen.

Three out of eight expert users expressed an opinion about the structure during the think-aloud session. All of them expressed aesthetic appreciation for the installation but two out of three would have preferred a structure more in line with the historical character. For example, R3 reports: ‘The frame is too rough, industrial and contemporary. I’d change the style, given the historic figure’. Evidently users did not pick up on the idea we wanted to evoke of a time portal or did not consider it relevant.

Instead, the eight expert users focused specifically on the digital character, which was designed with the aim of capturing visitors’ attention and making them feel as if they were face-to-face with Leonardo, in the flesh. The choices we made in order to convey this intended sense of realism were, first of all, to use an actor rather than a virtual character, secondly, to project him life-sized and, finally, to have the actor direct his speech towards the camera in order to maintain eye contact with viewers.
All the expert users reported having experienced a sense of having a real person in front of them, addressing them directly; they particularly appreciated the realism of the digital character. In the think-aloud session R2 says ‘It seems the character is right in front of me’ while R7 states: ‘The interesting thing is that Leonardo seems to be a real person in front of me and telling about his works’.

At the same time, our intention that the character maintain eye contact was prised by evaluators, who report a resulting sense of interaction and intimacy. R1 says that ‘it’s nice that the character looks in my eyes while he is telling the story. It seems to augment the interaction and the involvement’. R4 focuses more on the intimacy triggered by the eye contact: ‘The real size character is ok, and it seems he’s talking to you intimately, with direct contact. I like the actor and that it seems he’s talking only to me’.

These results are confirmed by the questionnaires the respondents filled out following the experience. Indeed, they give the feeling of interacting with a real person quite a high score (2 very high, 5 high and 1 average). The informal focus group that followed the test session further confirmed this impression even while adding an unexpected insight: every one of the users was confused by Leonardo’s appearance. That is, they expected to see a tired, old man with a white beard, as Leonardo is traditionally portrayed, not an energetic man in his fifties with a short red beard, as we imagined he probably appeared during his last period in Milan.

Another point worth addressing is how users perceived interaction with the digital character. When designing the mechanics of interaction that were to have characterized the system, we decided to employ a mix of implicit and explicit interactions, both of which take advantage of the human body as an input system. The first type of interaction occurs without any intention on the part of users: they simply pass in front of the installation and, in so doing, unwillingly trigger a reaction in the digital system, namely the whimsical appearance of Leonardo inviting users to act. This is an implicit interaction based on motion detection and aimed at surprising visitors and giving them the impression that Leonardo was there waiting for them.

The other kind of interaction is instead activated by deliberate gestures on the part of users: they must raise their right or left hands and approach the screen to choose the subtitles language (right hand for Italian and left for English) and to make the stories continue (right hand) or stop (left hand). The first kind of interaction, the implicit one, was easily understood by all the expert users, who were naturally drawn to approach the screen and
surprised when Leonardo appeared and immediately made contact with them. Regarding this point, R6 states: ‘Entering the corridor I see three panels with a character moving. He attracts me. When I approach the screen a sort of contact is established and Leonardo invites me to enter his life’.

The second kind of interaction, the explicit one based on hand gestures, entails different considerations. All of the testers immediately understood the mechanics of interaction and appreciated them, as they made clear in the questionnaires as well. Indeed, the majority of expert users felt confident using the system (5 high confidence, 3 very high confidence) and they generally appreciated the use of the body to interact with it (4 neutral, 3 high, 1 very high), but four respondents complained that the degree of interaction offered was limited.

During the process of designing the system, we actually decided to limit users’ freedom of interaction in order to enhance the sense of having an encounter with a real person and empower the narrative approach. Just as would be the case with a real person, once Leonardo begins telling a story he carries it through to the end, without being interrupted. Furthermore, Leonardo – that is, the system – decides which story to tell, in order to simulate the behaviour of a sentient character as much as possible. This choice, and the motivations behind it, were perceived as limiting by expert users, however. R2 states ‘It’s interesting the modality of reaching out a hand to interact with the system, but it seems limiting the possibility of choosing only the language and whether to continue with the story or not’. In other comments respondents go further, suggesting other forms of interaction. R5 would have preferred to ‘choose the topic to better interact. It would be nice to have Leonardo asking questions and, by answering them, to get other topics’.

**Mechanics of interaction and users’ behaviour**

The above comparison between the designers’ intentions and users’ perceptions and understanding highlights both problem areas and strengths in the system’s ability to fully communicate its meaning and how it functions. Nevertheless, in order to fully understand the agency of the designed system on users we must assess the capacity of the interactive installations to foster the “correct” behaviour.

Direct observation of the expert testers during the think-aloud sessions, as well as observation of other casual visitors, showed that almost all of them immediately understood how the system worked and behaved
accordingly. In particular, the mix of implicit and explicit interaction proved to represent an effective means of engaging users gradually, as it is capable of attracting their attention and then fostering interaction. The whimsical and unexpected way Leonardo appears when user approach (implicit interaction) worked well to surprise them and kindle their curiosity. During direct observation, mainly in the first days of the exhibition, we noticed that most people stopped and listened to Leonardo and some of them decided to start interacting with the system. In other words, the system persuaded users to behave as they were expected to, namely to be intrigued by the digital character and to stop in front of it.

Once engaged in the interaction, most of the users followed the instructions provided by the digital Leonardo and used their hands to launch the narration. The presence of a person, albeit digital, who modelled the gestures users were asked to perform turned out to be very effective in avoiding incorrect actions and misunderstandings. These results are in line with what emerged from the tests with expert users and the questionnaires, as discussed in the previous section. Hence, from the point of view of interaction itself the system proved to be efficient in persuading users to act as we had foreseen: they were indeed attracted to the screens and did not encounter any major problems in the interactions.

In terms of involving users in the interaction, however, the results were not as satisfactory: specifically, the aim was to retain their attention and convince them to listen to all five of the videos at each installation. Quantitative data gleaned from the system logs show that the vast majority of users listened to either one video or all five of the stories. Indeed, the percentage distribution is: 46% 1 video, 4% 2 videos, 4% 3 videos, 2% 2 videos and 43% 5 videos. Therefore, the data highlight two very distinct behaviours: on the one hand, there are users called by Leonardo to interact but evidently not very interested in the stories or bored by them while, on the other hand, there are visitors keen to listen to the digital character.

Direct observation as well as the test with expert users shed light on this percentage distribution. Specifically, we noticed that many passers-by were surprised by Leonardo’s appearance and drawn to interact but, once the story started, they immediately left: it is true that the three installations were located in a passageway and most of the visitors were not there to view the exhibit. Furthermore, the data show that a significant component of the interactions involving just one video were in English (about 25%), which is not surprising since the language spoken by Leonardo is Italian. R4 comments that reading the subtitles prevents the viewer from looking the
character in the eye, and R6 adds that it would be nice to listen to Leonardo in English. Hence, the design choice of maintaining a philological approach may have hindered non-Italian users from listening to all five of the stories.

Comments by expert users, on the other hand, may clarify why the majority of users listened to more than one video and a great many of them all five of the stories. R3 says that ‘the stories are not too long, enjoyable and not boring’ and R5 adds: ‘it’s nice to listen to his stories regarding nature... it’s both didactic and entertaining’. Other comments focus on the ability of the actor to retain viewers’ attention and the quality of the scenography. R6 says that ‘it’s nice the way the actor interprets what he’s reading or thinking or writing. I like his facial expressions and the scene props’. As a matter of fact, the quality of the scripts and the professional actor’s ability to interpret the Master played an important role in keeping visitors interested. Furthermore, comments highlighted a great appreciation for Leonardo’s costumes: R3 says that ‘the character speaks well and it’s nice that he changes clothes in the different stories’ and R4 adds ‘I like the change of clothes. It lets me understand that the setting changed’.

In an effort to summarise, we could argue that the mechanics of interaction – designed as a mix of implicit and explicit interaction – proved efficient in modifying users’ behaviour in accordance with the designers’ will but that the digital character played a fundamental role in communicating how the system functions and retaining viewer’s active interest.

Conclusions: is the digital character just an interactive thing?

Recalling the four categories of agents proposed by Kaptelinin & Nardi (2009) and the reasoning presented at the beginning of the article, the interactive installations Leonardo Plays Leonardo plainly fall under the category of cultural things. Characterized by delegated and conditional agency, they act on someone else’s behalf and produce unintentional effects. However, it remains difficult to fit the digital character completely within the category of things and the results of our research seem to corroborate the idea that such characters actually go beyond this category. Indeed, evidence from our inquiry suggests that users considered the digital Leonardo more than a simple cultural thing. During the tests with users we observed that testers constantly referred to Leonardo as a real person with whom they were experiencing an authentic encounter. Furthermore, the
questionnaires confirm that most users had the impression that they were interacting with a real person, standing before them in the flesh. Another point worth noting is that most users immediately understood how to interact with the system by imitating the gestures of the digital Leonardo. This aspect may seem secondary but it is particularly relevant for systems based on embodied interaction (Dourish, 2001), which are usually rich in labels and other paratextual apparatuses intended to train users to interact with the system and inform them how it functions.

Finally, during direct observation sessions we frequently identified behaviours that are typical of in-person communication. During sessions with a lot of background noise, several users brought their ears closer to Leonardo’s mouth to hear better, a meaningless behaviour given that the two stereo loudspeakers were very visible at the base of the system. Furthermore, we observed that most users tended to maintain a distance from the digital Leonardo that proxemics (Hall, 1990) would define as personal – from 1 to 1.5 meters – and only drew nearer, to an intimate distance, in order to interact with the system.

Despite these considerations, we cannot assert that digital characters such as our Leonardo constitute something more than cultural things. We can, however, remark that they tend to stimulate behaviours that go beyond those fostered by common interactive systems, an aspect that deserves to be taken into due account by designers in general and interaction designers in particular.

References


