SAR for Kids: Spatial Augmented Reality as Tool for Art Education

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Abstract. This article, after describing some possible developments of spatial augmented reality (SAR) in urban areas since the first experiments by Bruno Munari, will present two SAR experiences into public spaces for cultural heritage education of school-age children. These experiences were aimed, on the one hand, to verify the potential of live drawing on large dimensions and on the other to represent one's own personal graphic interpretation of an urban façade on the basis of suggestions deriving from a specific event: the passage of the Giro d'Italia.

Keywords: Video-mapping · Spatial augmented reality · Sketching · Cultural heritage

1 Introduction

When the book *Painting Photography Film* was published in 1925, the artist and theoretician Lazslo Moholy-Nagy dedicated a chapter to what he called "Domestic pinacotheca". In it, the author tried to imagine the future developmental results of techniques to reproduce texts, images, and sounds. Ten years before Walter Benjamin's celebrated essay "The Work of Art in the Age of Mechanical Reproduction", Moholy-Nagy spoke of the possibility of developing an "image-transmission service via radio" that would allow for a further increase in the spread of photographic reproduction, which was already profoundly modifying the relationship of the masses with works of art. "It is probable that future development will place great importance on projecting kinetic compositions, which could even very likely be obtained from the mutual intersection of rays and coloured masses freely fluctuating in space" (Moholy-Nagy 1925).

In the new techniques of reproduction and the wireless transmission of images and sounds he therefore saw a factor capable of notably modifying the relationship between art and the public (Somaini 2017).

In 1954 Bruno Munari designed about a hundred compositions created with the most varied materials inserted in slide frames. The resulting projections, built with "transparent, semitransparent, and opaque materials, brightly or subtly coloured, with physical materials that are cut, torn, burned, scratched, melted, etched, crushed; with animal and plant tissue, with artificial fibres, with chemical solutions" [*trasparenti, semitrasparenti e opachi, violentemente colorati o a colori delicatissimi, con materie plastiche tagliate, strappate, bruciate, graffiate, liquefatte, incise, polverizzate;*

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con tessuti animali e vegetali, con fibre artificiali, con soluzioni chimiche] (Munari 1954), eliminate the physical nature of the material fragments and, projected onto large surfaces, render a monumental, spectacular aspect.

One of the goals of the experimentation was to bring artistic production, all contained in the exclusive circuit of galleries and museums, down to a private domestic scale. The glamourization of anonymous projected elements should create a creative short circuit that carries with it the fun and games necessary to involve spectators.

Spectators would be able to use a private art gallery projected on the walls of their rooms at home. In this respect, he states: "Modern living has given use music on disks (and no one thinks about calling an orchestra to their home in order to listen to music): now it gives us projected paintings; and everyone close to the disco can have their own projected art gallery, made, however, of originals and numbered copies" [*Il vivere moderno ci ha dato la musica in dischi (e nessuno pensa di chiamare una orchestra in casa per sentirsi una musica): ora ci dà la pittura proiettata; e ognuno vicino alla discoteca, può avere la sua pinacoteca fatta però di originali e di copie numerate, da proiettare*] (Munari 1954).

In 1959, Munari designed a game in a box for direct projection called "Scatola" for the company Danese in Milan. In the brochure, Munari specifies that the kit contains: "…all the material necessary to make small transparent compositions for projection in colour (like those that Munari projected in New York and Stockholm, in museums and private houses), a new technique for visual arts" *[…tutto il materiale occorrente per fare piccole composizioni trasparenti da proiettare a colori una tecnica nuova per l'arte visiva*] (Fig. 1).

Fig. 1. "Scatola" for direct projections by Munari (left) and direct projection on a wall (right)

In a similar way, works by Claes Oldenburg and Coosje van Bruggen follow the concept of art as a social function in a pop context. In particular, the large-scale projects — monumental sculptures in architectural scale or incongruous buildings in a sculptural key — aim to solidify the relationship between individual and community,

between private and public, through operations of gigantism applied to small objects taken from daily life that become monumental in the true sense of the word.

Therefore, if enlargement for Munari was an exploratory action capable of upsetting the sense of projected material fragments, for Oldenburg, the outsized object was an act of rejection towards a society that had made the object an idol to adore.

What unites the two approaches is the willingness to "see better", to observe and discover unexpected characteristics and details or simply reject their presence, enlarging them innumerable times until one becomes immersed within them.

2 Spatial Augmented Reality

More than fifty years after Bruno Munari's experiments with projection, a form of contemporary art also based on the projection of light and the magnification of images allows for educational experiences in the form of interactive/immersive fun entertainment: spatial augmented reality (Bimber and Raskar 2005). Spatial augmented reality, which is found in public places in shows better known as video mapping (Antonelli and Mordenti 2011; Maniello 2014), represent first of all a new means to communicate and enhance the architectural heritage. Video mapping allows augmented reality experiences to be made in the absence of appropriate viewing devices (glasses or head-mounted displays), through video projections on large surfaces, which is capable of programmatically changing the architectural connotation and making the user participate in the representation of a virtual depiction in a real space (Ippoliti et al. 2012). The content of these projections can be more or less philologically and scientifically tuned according to the reference public and the goals of the event. In most shows that have populated the squares of small and large urban centres in recent years, the main goal is to emotionally involve the public/visitor, who thereby becomes immersed in another dimension of time (Leila Ciagà 2013). The repertoire of pertinent effects are those deriving from motion graphics (CGI sequences usually depict fragmentations, explosions, systems of particles, the effects of physical simulation, and digital clothing). Due to the ephemeral character of the show, there is limited time (between 7 and 15 min) in which a series of content aimed at pure visual entertainment, the understanding of plastic intelligence, and the history of the building on which it is projected must be concentrated. As of writing, the use of Google Trends to compare the three terms most used to identify this type of show, i.e., 3D mapping, projection mapping, and video mapping, sheds light on some facts (Fig. 2).

The first is that on the date of first detection in 2004, the use of the three terms was very distinct, a symptom of the novelty of the medium, which was freed for the first time from the pioneering activities of university laboratories or the R&D departments of large companies (e.g., Disney). The second is that on the contrary, after more than twenty years, the three terms are used interchangeably, as can be seen from the superposition of the lines, without any term in particular having the upper hand. The third is that the trend of the three terms, that is, the recursiveness of the query on Google is in slight decline, a sign perhaps that this type of show has partly exhausted its attractiveness tied to the surprise effect of seeing a live show for the first time. With regard to the latter point, it is clear that the medium may be exhausting its innovative

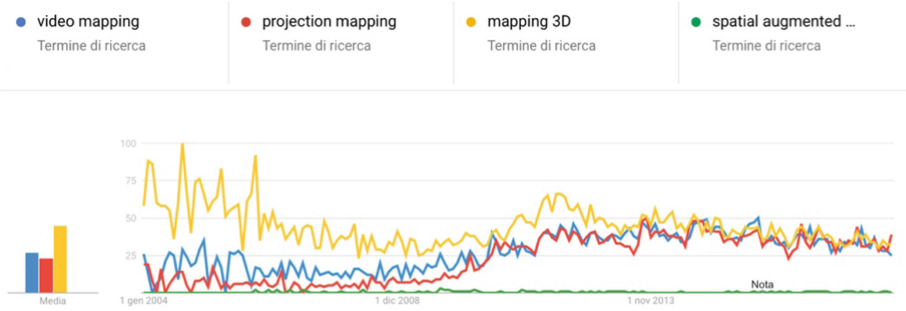

Fig. 2. Google trends diagram comparing three terms referred to spatial augmented reality

strength and that it should therefore be reinvented and remedied through other forms of entertainment. Watching videos on the Internet that are published daily on video-sharing platforms, one can see a general trend in the use of video mapping in commercial areas specifically dedicated to marketing and publicity. Another trend relates to shows that are produced to include elements for public interaction, engaging a public that usually passively watches a show in silence (often with the smartphone camera pointed at the illuminated façade), in the same way people might view a fireworks show or a theatre performance. Low-cost 3D sensors and scanners, infrared cameras, and a series of high-tech wearable accessories natively designed for gaming now allow projectable content to be personalized, choreographing the show based on the spectators' behaviours and gestures (Rossi 2013).

3 SAR for Kids

In recent years, these performance demonstrations of graphical calculus and electronic intelligence have been combined with secondary events aimed at educating and entertaining a public of children, usually between 5 and 10 years old, making sheets as large as an entire building available through the use of Munari's projective enlargement.

In Italy, some examples include (Fig. 3):

3.1 Glow Festival

Glow Festival, an International video-mapping festival, designed and realized in Ostuni (LE) by Studio Glowarp under Donato Maniello and Visual Designer Luigi Console. In the four years it was held (2013–2016), different activities dedicated to children were incorporated, including a section called Mapping4Kids. In this way, children would be able to send the organization their designs on a printed outline of the surface where it would be projected. In fact, as the call reads: "This year the GLOWFestival opens the door to the kids! We provide the paths (black and white) that will be printed on a A4 sheet (do not in any way distort the image when printing and scanning). At this point the imagination of the little ones will do the rest! The designs will transform the facades

Fig. 3. Spatial augmented reality events for kids in Italy

of the buildings through the imagination. Use any technique you want, the important thing is to respect the constraints imposed by the drawing that we provide. When you're finished, seeking help from someone older than you, scan the A4 image that you create and send it by mail with the form filled out by your parent".

3.2 Fotonica

At Macro in Rome, in December 2017, the agency Flyer Communication, which had already designed the LPM Live Performers Meeting, one of the largest events related to audio visual digital arts, organized the FOTONICA Audio Visual Digital Art Festival. The festival hosted events tied to contemporary audiovisual performance. Light installations, NetArt, Vj sets, lectures, and workshops characterized the festival programme. Some of the workshops included Video Mapping for Kids, run by Gianluca Del Gobbo. "During the workshop the kids will create a visual-sound project that will be shown that same evening. They will be invited to work on paper, creating colourful shapes out of it. They will use them to create sounds by putting them on a big interactive screen which will be projected on the facade of L'Aquila cinema. The sound synthesis is generated in real time from the arrangement of forms on the screen, producing melodies that children can invent simply by changing the arrangement of forms". In this case, therefore, visual performance is combined with the spontaneous design of an accompanying audio track.

3.3 Kidsbit

The Kidsbit festival in contrast, held in May 2018 in Perugia, was created expressly as an event dedicated to children. In fact, the slogan was "Creatività digitale per famiglie del 21esimo secolo" [Digital creativity for 21st-century families]. The festival was organized by Associazione ON, which is dedicated to favouring the training, education, and personal and professional development of both children and adults, especially in relation to the tools offered by new technologies. One of the events, *La Città Che Vorrei* [The City I Would Like] held in Piazza IV Novembre on the façade of the Palazzo dei Priori, was dedicated to a video-mapping show for the whole family. In this case, the organization Antica Proietteria, following the example of Mapping4kids in Ostuni, made available the entire layout of the Palazzo. The instructions in the call then summarize all the steps necessary to participate: "…(2) Print it on a normal sheet of A4 paper. (3) Use any colours you want to draw what comes to mind: heroes, heroines, princes, princesses, monsters, aliens, or abstract compositions. (4) VERY IMPORTANT: Sign your drawing with your name. (…). (6) Come, together with all your family, Friday 25 May at 9:30 p.m. in Piazza IV Novembre!" Of particular note is the emphasis on the importance of the signature, which is probably aimed at a hypothetical phase wherein parents share their photos, proud to see their son or daughter's name projected in block letters on one of the main monuments in the city. In this case, the theme for developing the drawings was not open; the call was expressly dedicated to stimulating children's imagination, requesting drawings of their ideal city, composed mostly of some iconic childhood elements (hearts, coloured flowers, rainbows, etc.).

4 Case Studies

Within this cultural framework, the present article presents two experiments with spatial augmented reality for children. The goal is twofold: verifying the potential of live large-scale drawing through direct projection (Senigallia, Piazza Roma 2015) and representing the graphical interpretation of an architectural façade based on suggestions deriving from a specific theme, the Giro d'Italia passing through (Osimo, Piazza Marconi 2018).

4.1 Fosforo 2015

The first experiment took place in Senigallia in May 2015 at the Fosforo: Festival delle Scienze, organized by the cultural association Next. Integrated with a canonical video-mapping show organized by the University of Camerino, a projection system was set up to project children's drawing activities made in the square onto the city hall of Senigallia in real time.

The system was basically composed of a web cam affixed to the column of a copy stand. The web cam was directed downwards where the drawing paper in A3 format containing the outline of the building's façade was situated on the support platform. The part of the sheet between the bulk of the drawing and the edges was filled with

black to prevent it from containing any part of the drawing, given that the projection of that part, outside the façade, would not be projected (Fig. 4).

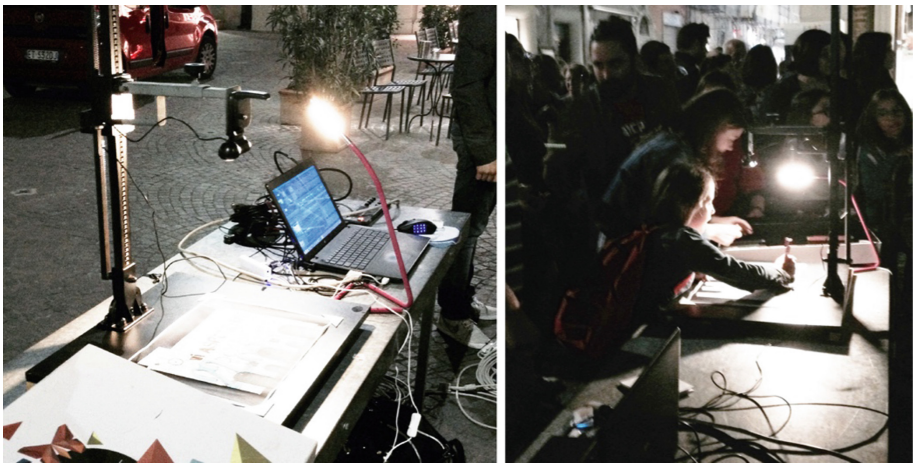

Fig. 4. Set-up of the copy stand

A jig was fixed onto the platform of the copy stand in the mapping phase so that the sheet would not move by itself, thus losing the spatial coordinates to register the drawing with the architectural partition of the façade.

The sheets with the layouts were given to each child during the evening. The children then approached the table and had about 5 min to complete their drawing while spectators directly observed the growth of the drawing and, contextually, the simple gestures of the children, who could act freely using various materials (coloured pencils, felt-tip pens, crayons, etc.), including finger paints. Finger paints wound up being the preferred tool for this type of activity since they are capable of amplifying the performance aspect of live drawing (Fig. 5).

Fig. 5. Some pictures from the event in Senigallia.

4.2 #fotofinish 2018

In Osimo, instead, a different approach was taken, asynchronous and similar to the activities experimented with in Mapping4kids in Ostuni or Kidsbit in Perugia. The opportunity was based on the Giro d'Italia passing through Osimo in 2018 and the events organized by the city administration to celebrate the event. Alongside a video-mapping contest called *Il Giro sui Muri* aimed at students and professionals in the sector on themes tied to the Giro and to the world of cycling in general, a slide show entitled "#fotofinish" was created to be projected on the façade of the Nuova Fenice Theatre in Osimo in Piazza Marconi. The slide show was composed of a series of drawings made by students at some schools in the district of Osimo. For this activity, some schools were involved organically in order to create collective, non-personal class drawings. Art teachers were equipped with A3-format sheets of paper containing line drawings of the façade of the theatre.

The theme on which the representations were to focus in some way allowed students, with free techniques and teacher guidance, to synthetically depict some symbolic elements evocative of the Giro d'Italia and cycling in general. The collective drawings therefore represented a unifying moment to build knowledge both of the sporting event and the architectural heritage with which the drawings were to interact.

The analysis of the resulting drawings shows some dominant colours: pink, that is, the colour of the jersey of the winner of the Giro, and the green, white, and red of the Italian flag. The same drawings also contained some recurring figures that depicted the shape of the Italian boot and bicycles stylized with different degrees of detail, as well as a series of block letter texts used to sign the drawing.

Around half of the resulting drawings left the white background of the sheet, while in the rest, the architectural partitions of the nineteenth-century La Nuova Fenice Theatre were coloured in order to differentiate each part of the building (Fig. 6).

Fig. 6. Comparison between the original drawings and projections on the façade of the Osimo Theater

5 Conclusions

Magnifying drawings and images during a public video-mapping show on urban façades means experimenting with new educational forms aimed at a variegated public composed of adults and children, experts in artistic subjects or simple occasional tourists. Children's drawings, direct and spontaneous, unmediated by digital processing, thus move from a real, manipulable aspect to another that is more abstract and strange. One immediately relates to the individual architectural partitions without scaled mediation.

From scribbles to more complex and primitive human depictions, each drawing presents an unconventional aspect for the child, mediating the step from one reality to another, more extended one, thereby activating an involuntary process of cognitive appropriation of the architectural building.

The playful experience of seeing one's own drawing projected on a large scale represents an approach to knowledge of the artistic and architectural heritage through gesture and action.

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References

Antonelli E, Mordenti A (2011) La videoproiezione architetturale. In: DisegnareCon, vol 4, no 8

Bimber O, Raskar R (2005) Spatial augmented reality. A K Peters, Wellesley

Ippoliti E, Meschini A, Moscati A, Rossi D (2012) Interfacce e tecnologie visual 3D per conoscere, condividere e valorizzare il patrimonio culturale. In: DisegnareCon, vol 5, no 10

Leila Ciagà G (2013) Riproduzioni e ricostruzioni digitali tra ricerca storica, divulgazione e spettacolo. In: Irace F, Ciagà GL, Lupo E, Trocchianesi R (eds) Design & Cultural Heritage. Electa, Milano

Maniello D (2014) Realtà aumentata in spazi pubblici: tecniche base di video mapping. Le penseur

Moholy-Nagy L (1925) Malerei Fotografie Film

Munari B (1954) Le proiezioni dirette di Bruno Munari. In: Domus, no 291, Milano

Rossi D (2013) Smart architectural models: spatial projection-based augmented mock-up. In: Digital heritage international congress 2013, vol 2, pp 677–684. IEEE

Somaini A (2017) Da Dioniso alla televisione" Archeologia dei media e ruolo storiografico del disegno nel progetto ejzenšteniano di una "storia del cinema". In: Faietti M, Nardoni P, Schmidt ED (eds) Ejzenštejn. La rivoluzione delle immagini. Giunti