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Multidisciplinary Aspects of Design

Objects, Processes, Experiences and Narratives

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Designer and AR Technology: The Relationships Between the User and Virtual

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Abstract. A good communication strategy of an artefact must connect a multitude of elements, both in terms of content and shape, and make them become a vehicle between the company and the consumer. The proposed contribution, resulting from the "Meta 4.0" research, suggests an exploration of innovative methodologies, tools and technologies to communicate and sell a product. In the context of the Industry 4.0 aims, the proposal is that technologies associated with the virtualisation of scenarios and products - augmented and virtual reality - can be useful tools and possibilities for achieving the required aim. In fact, the adoption of augmented and virtual reality technology in the context of communication would facilitate cognitive processing on the part of buyers, making them more interested in a product. The contribution explores the practice of vision through transformative technologies as a relational, cognitive and sensory expertise, attributing to the designer the role of interlocutor in the dimension of the visual imaginary in the duality between virtual and real. Therefore, designing the virtual in an incessant desire to find innovative experiential dimensions with the media, to make visible the centrality of the individual in the relationship between subject and transformative technology. The practice of vision refers to the actual conditions of viewing, including the social conditions of perception, which are the subject of anthropological research. The aim is to present the basis of a theorised language that defines possible intervention scenarios for the figure of the designer within the design of the intangible image.

Keywords: Industry 4.0 · Transformative technologies · Reality and Virtual · Product and representation · Augmented and Virtual Reality

1 Introduction

The adoption of augmented reality in the communication and marketing of products related to furniture design facilitates users' cognitive processing and makes them more likely to buy. Although not very widespread, augmented reality is also currently used in product communication. If a product is virtually in the home, then the consumer has more knowledge of dimensional and technical parameters. In this way, the user can have a different experience that will motivate them to purchase. This concept was the basis of the research "Meta4.0 - Possibilities and potential of design for Industry 4.0", it investigates the practice of vision through augmented and virtual reality (AR and VR) and

how the designer plays the role of interlocutor and director in the relationships between virtual and real. The hypothesis is to arrive at a theoretical and practical definition of the possibilities, knowledge, methods and tools useful for a designer. The aim is also to provide a working and knowledge tool for SMEs to correct the use of AR and VR technologies. Through the case study in collaboration with the company Delka S.r.l. and the prototyping of an AR application, it was possible to theorise the users' perception of AR and identify the perceived factors of spatial presence and virtual intrusiveness.

A methodology was also defined so that SMEs could take advantage of AR and VR technologies. The research aims to understand how these technologies could be used by companies. Augmented reality could support the customer in arranging the furniture, but also supplementing user and assembly manuals and helping with assembly. The link between the virtual and real components plays a central role in the theoretical analysis carried out, a continuum between what surrounds the user and what the software superimposes on the real. The designer must understand and know both the virtual and the real world. Through new tools and knowledge, he has to redesign the virtual so that there is a proper interaction between the two worlds and he has to know how this knowledge can be integrated into the field of marketing and e-commerce 4.0.

Transformative technologies allow the user to live and experience a new reality. These experiences can generate strong suggestions that can induce an awareness capable of triggering a paradigm shift [14]. Indeed, AR engenders user experiences that can produce a new consciousness in human beings. It leads him to define new scenarios, attitudes and values. But these technologies mustn't forget the past. Even if they are being used in the communication field, they must retain the references to the relationship with the man that is typical of photography (Figs. 1 and 2).

Fig. 1. Virtual image design example in AR
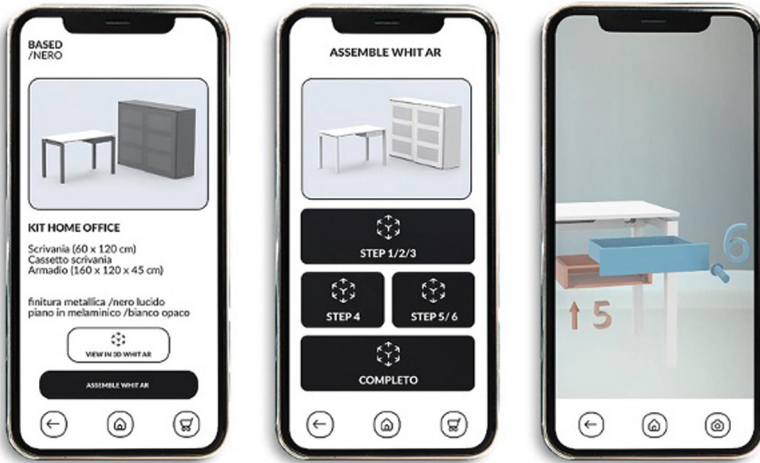
Fig. 2. Prototype of AR app developed for Delka srl.

Furthermore, the designer must be able to govern the project without being over-whelmed by technological possibilities. Indeed, the profound emotional experiences generated by AR and VR allow the user to develop a greater awareness of physical and social reality. This allows new meanings to be attached to things and products. The paper presents a survey of the historical and critical investigation of the role of transformative technologies and, specifically, how augmented reality is a communication tool for marketing a product. AR is a virtual reality in which digital devices are used to superimpose additional sensory information (sounds, objects, avatars, graphics, labels) onto the real world (Table 1).

Table 1. Design matrix for the virtual image

Category	Action	Role
Person	Interaction	Functional
Scene	Addition	Non Functional
Object	Subtraction	Paradoxal

The practice of vision refers to the actual conditions of looking, including the social conditions of perceptual regimes, which are the subject of anthropological research [13]. A common sense belief is that vision is the action of an individual confronted with the representation of reality [1]. The different approach that the research wants to highlight considers vision as a social and cultural activity, a practice that is based on and conditioned by learning and the specificity of environments and artefacts. The mode of viewing an image, whether tangible or non-tangible, becomes a form of tacit knowledge among humans. It is incorporated and acquired through cultural and relational

learning, thanks to which we tend to apply our modules of interpretation of reality in a non-conscious way [19].

The contribution investigates how AR can become a helpful tool for communicating an artefact, material and immaterial service [5] and develops a network of elements between historical, archival and technological aspects, historically and critically investigating the role of the designer and its relationship between technology and society.

2   The Space Between the Real Subject and the Virtual Projection

The research investigated human perceptions of AR technology, identifying which perceptual factors of spatial presence and how these can positively affect the user. Furthermore, research has investigated the effects of the virtual on the user. The aim is to foster the development and application of these technologies. In the research programme, it was relevant to understand the role of the spatial dimension and the relationships between subject and representation [15].

From the case studies found, the presence of an empty space between the subject and its representations is evident: between eyes and words, between eyes and images and between the user and the display [8]. This space between the real subject and the virtual projection is where the experience manifests itself and, thanks to technology and design, a new reality is configured.

The contribution presents an initial definition of a design matrix for the virtual image, understood as the tool that defines possible future scenarios of intervention for the designer within the design of projects with augmented reality technology. The contribution highlights how intangible image design is linked to current technologies and innovative solutions.

Scientific literature shows that augmented reality causes a sense of deprivation of control over personal information, leading to increased perceived intrusiveness. Therefore, AR technology is relatively new to society and peer this unfamiliar when experiencing it for the first time. This induces an unpleasant feeling by increasing perceived intrusiveness. Furthermore, the AR application will project virtual products and information into the surrounding environment so the user may perceive this as too close to their physical world, increasing the perception of intrusiveness. Intrusiveness induces negative emotions, such as irritation and annoyance, which negatively affect society's reactions, causing reactivity towards the technology.

The AR and VR technologies are increasingly asserting themselves within the Marketing 4.0 sector through new ways of conceiving advertisements compared to standard online ads and through an innovative way of communicating and marketing products, especially in furniture design, fashion and personal accessories. Augmented reality can arouse positive attitudes towards the brand by stimulating the buyer to purchase.

After Apple's launch of ARKit in 2017, and more generally in all mobile stores, there are more and more apps exploiting AR. Especially in the Business to Consumer market, many international brands are boosting their e-commerce with this technology. Among the first is the Ikea brand which, within its application, makes it possible to display the product catalogue directly inside the customer's flat.

This allows the user to be facilitated in the purchase and choice of the product, but also to already have an interaction with the product and the brand, experiencing, before the purchase, the experience of already owning the furniture.

This allows the user to be facilitated in the purchase and choice of the product, but also to already have an interaction with the product and the brand, experiencing, before the purchase, the experience of already owning the furniture. In fact, from the literature analysed and a review of user tests carried out, it emerged that AR adds a new dimension to the product experience with two characteristics: the first is the superimposition of virtual content on reality; the second is that virtual objects are interactive and displayed in real-time. AR technology, therefore, is also able to arouse positive attitudes towards the brand by stimulating purchases.

But of central importance remains the link and interaction between the virtual and real components. This immersion of virtual information must, however, remain part of reality and not exceed it, or else it will be perceived negatively. Good design must take account of this limit that cannot be defined by technology. The research aimed at finding the functional elements of experience within the design of non-tangible images. Indeed, the scientific literature shows that augmented reality has limitations and problems concerning the interaction between users and technology. User tests carried out by studies on AR apps show that it can cause a sense of deprivation of control of personal information, making the user perceive even disturbing contexts to the point of losing the very perception of reality. In addition, it was found that for inexperienced or first-time users, it induces an unpleasant feeling that increases the perceived sense of intrusiveness.

When the AR application projects virtual products onto consumers' faces or into an environment by creating too much proximity to the personal sphere of the inexperienced user, it has the perception of intrusiveness. This intrusiveness induces negative emotions, such as irritation and annoyance. This negatively affects consumer reactions, causing negativity towards technology. Perceived virtual intrusiveness is defined as the cognitive reaction towards media or advertising that evokes feelings of annoyance or irritation. Similarly, AR can evoke feelings of intrusiveness. To avoid this it is advisable that users first see themselves, then at virtual images and that gradually increases. They can be viewed in steps. This gradual construction of the image is perceived by the user as a control of the technology that is thus not perceived negatively.

Research has understood how anthropomorphism and the staging of humane communication [6, 7] support designing virtual images with AR technology. The paper presents a design model to be used when defining virtual scenarios to break down the sense of perceived intrusiveness. If the design is a discipline capable of envisioning a new reality, then it is the designer who must understand how tools can become useful tools for communicating virtual products.

3   From Photography to Augmented Reality

AR technology can bring to life and experience a new reality, and these experiences can induce an awareness that can push the subject toward change and the possibility of experiencing emotions [11]. It is, therefore, necessary that these technologies, and their communicative functions, do not forget the research base related to the relationship

between product and human, proper to photography because it is on these that design must be based.

Since its discovery, photography has been a tool for communication. As early as the late 19th century, photography lent itself to industry to tell the story of technological and cultural advances and social innovations taking place. Then with the Bauhaus, from being a storytelling tool, photography began to become a tool for representing artefacts. Since the Weimar School, photography increasingly begins to become a tool for telling the story of technological innovation and the form of artefacts. The research conducted examined how photography for design, has been used in different ways. Photographers such as Willi Moegle, Hans Finsler, Aldo Ballo and Marirosa Toscani, and Lucia Moholy have represented design objectively and pragmatically. Others such as Wolfgang Siol, Erich Consemüller, Mauro Masera, or Giorgio Casali, on the other hand, have emotionally photographed the artefact, bringing out a design related to action, with ambient shots and with the presence of people. Two different approaches to design photography, one more related to objective photography and one more interpretive, in which the photographer interprets the object and creates a scene and then photographs it [7]. To give a critical reading to these aspects of the research, we used the Barthesian interpretation, especially the elements of *Studium* and *Punctum*, proposed by the author in the essay "Camera chiara" [1]. The French author defines *studium* and *punctum.*

The *studium* is part of a visual awareness gained through experience. It allows a careful reading of the photograph, in which the *spectrum*(photographed element) is understood and read from the side of the spectator who will decide, then, to appreciate the image as it stands. If the *spectator* (observer of the photograph), after observing it, does not understand the concept, there will be nothing left. It is only through the *studium* that he appreciates the composition and the lighting that the photograph communicates. The *spectator*, through effective communication by the photographer, understands the image well and what he wants to communicate: the beauty of the object, the innovative material, and the use and iconicity of the subject.

Conversely, the viewer will be impressed if there is *punctum* in the photograph, an element that breaks the relationship between the photographer and the viewer. At the moment when the operator (the photographer) loses control of the scene, the spectrum moves and something only reach the spectator: this is the *punctum.* The uncontrolled pervades the image and reaches beyond the photograph. The *punctum* overwhelms the spectator and, unconsciously, he too becomes a participant and spectrum of the scene. *Punctum* is not common, it is not for everyone, although it has multiple readings. In a photograph, there is only one studium but there can be multiple *punctums.* Small details that, thanks to the spectator, bring the photograph to an inexhaustible source of emotions.

Inserting *punctum* into a photograph is seemingly impossible because it is unconscious, and unconsciously it lives in the image as it does in the viewer. Through an emotional openness on the part of the *spectrum* and the *spectator*, the *punctum* manifests itself simultaneously in both, causing them to become accomplices in a single emotion.

Through iconographic, critical and historical analysis, the research identified recurring *punctum* elements in design photographs, and after cataloguing, schematizing and summarising them, the study produced a design matrix. An attempt was made to apply

this matrix to AR technology to define possible methods and tools for designing the virtual. Through knowledge, an attempt was made to define a designed interaction between the two worlds [15]. An attempt was then made to define some design paths for the designer.

Very important is the link between the virtual and real components, in the relationship between what surrounds the user and what the software brings into the real [11]. However, this data immersion must be integrated into the world [18]. In AR, the user must be able to move around the environment because in AR reality it is the perception of the real that allows him to stay in touch with reality and direct his actions. The paper proposes to define a methodology for understanding how the discipline can help the designer in the use of these technologies, precisely through a conscious design of the virtual [17].

4   Tools for Creating Virtual Images

The research aim is to define methods for designing with AR technology based on theories of photography [1]. Grammar was to be defined by paying attention to human perception and the relationship between society and the representation of the virtual. The research aim is to define methods for designing with AR technology based on theories of photography [1]. Having defined what are the factors of human quantity useful to humanise and anthroposophists [17] an attempt was made, through representations of designed intangible components (*punctum*), to establish what are the characteristics of AR.

A historical reconnaissance of photography was carried out to have a visual and theoretical collection that holds together the designs of different product photographers. It was analysed how in photography there is a design dimension of the image both real and virtual, understanding virtualisation as non-realistic. Therefore, research was carried out that aims to bring out the design-ness to propose methodological design guidelines that can be applied to make virtual images. Among the authors analysed, a reconnaissance of the archives of photographers Aldo Ballo, Giorgio Casali and Mauro Masera, as examples of what was photography for design, was carried out, and for each photographer and photo analysed, the elements of image design were identified. They were then associated with the *punctum* feature by finding the recurring elements.

Once the output was defined, we continued through bibliographic and iconographic research to define the actions and methodologies useful to identify the matrix of elements to support the design of the virtual image. The definition of the human quantity factors in the matrix is the result of an analysis of scientific papers and the identification of the elements present in photographs, videos and graphics.

The matrix is divided into three macro-areas (category, action and role), and for each, there are as many elements. When The designer designs a virtual visualization of a scene and needs to place elements within it, he or she can start based on this schema. Being based on the concepts of photography, the designer can find useful references to be more communicative because then there will be both *studium* and *punctum* elements. Inserting elements such as a person, scene, or object, and having them act (interaction, addition, or subtraction), defining them a role (functional, non functional, or paradoxal) allows one to generate a combination that works and has already been tried and tested

in photography. The history of photography serves as a foundation as AR technologies allow much more information to be communicated, thus facilitating cognitive processing by the viewer.

A website (https://sites.google.com/view/ar-toolkit) was also planned that can help designers define a communication and marketing strategy with AR. This tool allows designers and SMEs to set the sales method of the product and guide them in information regarding the technology. The toolkit also presents guidelines for designing and prototyping an AR application. Starting from the type of business and communication, the SME can make a prototype of its AR application.

During the research, the matrix and the website were constantly tested with the company Delka srl. During testing, several improvements emerged which were then implemented, such as identifying the purpose of the communication: (I) B2C for the consumer, (II) B2B for the retailer and (III) B2C and B2B for the fitter.

The website also provides an understanding of how AR works and how to use it, e.g. one can: (I) superimpose virtual content on physical content, (II) interact with the product, and (III) have virtual objects in a fixed position.

Delka srl thus allowed its users to observe a product in their own home or office. Thus, users saw the dimensions of the products and were able to create compositions with the furniture present or all virtual. Another test allowed us to understand how AR technology can serve to assemble the product. This experiment was helpful because the support given to the user was efficient and it was not difficult to understand the steps.

The toolkit aims to raise awareness of AR and VR technology among SMEs and designers by highlighting how, with a focus on the furniture industry, these can be used in communicating and marketing a product. It also suggests a methodological approach and framework for developing a mobile app to use AR.

Communication achieved through the matrix and toolkit can reduce intrusiveness and improve the effectiveness of AR technology for marketing a product. The research found that aspects such as the spatial dimension, the design of an empty space, and the relationship between the user and virtual space are issues that could be investigated further.

5   Conclusion

Today, there are many areas of interdisciplinary research that take into account the relationship between technology, neuroscience and visual models, and they all offer the possibility of investigating new theories in which looking is preparing for different models of representation [8]. The contribution presented the results of a research that saw AR technology as an innovative communication tool and as such, it was necessary to prepare design guidelines. The research led to the definition of a design matrix for the virtual image. The designer can now use these tools to communicate an artefact or an asset.

The proposed matrix for designing the virtual image makes it possible not to lose the progress made in the history of photography but to develop new scenarios based on established theories. The interest in representation theory thus finds its place in connection with the past and in the design discipline itself.

Watching is not merely the reduction of a relationship between perceptual stimuli and the processing of virtual information, the process is much more complex and involves a design approach that brings together the real, virtual, perception, technology and message and must therefore involve a designer.

If it is the designer who has to design these new realities, he or she must be able to control the physical and virtual space and timing of the experience. In a society with so many changes, it is necessary to know the experiences of the past in order to have a basis for the future and to avoid having to experiment with each new technology from scratch.

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