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ORIGINAL PAPER

How to design a virtual reality experience that impacts the consumer engagement: the case of the virtual supermarket

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Abstract
The paper examines the effect of the recent VR technologies on consumers behaviour providing guidelines to design a rich and immersive environment that is able to deliver high-impact and memorable experience and engage audiences and potential consumers anytime and anywhere. In order to study the impact, firstly, the paper has identified and described the technological characteristics of VR in terms of the ability of the VR devices to surround the user and the nature of simulation and the consumer engagement expressed through varying levels of cognitive, affective and behavioural manifestations. Then, a VR environment with technological characteristics of interactivity, hypertextuality, virtuality (presence of virtual elements), modality, location specificity, mobility and connectivity has been designed. VR environment shows a virtual supermarket in the form of 360 degree video able to create highly immersive sensory experiences that promote the subjective presence of consumers and impress their senses, touch their hearts, and stimulate their minds. The results obtained show that applying virtual technology to marketing activities allows marketers to identify and respond to opportunities through new technologies which are faster, more effective, and lower cost and to become more responsive to consumers' needs providing virtual experience where they want it, how they want it and when they want it.

Keywords Computer-mediated environments · Human–computer interaction · Virtual markets · Consumer behaviour

1 Introduction

The development of virtual reality (VR) technology has implied the creation of virtual environments enduring humans to have a presence in these environments to interact with them, to feel them and to act on them. In order to implement high-realistic virtual environments, virtual reality techniques are combined with interactive engineering methods. In this context, interactive engineering is understood as the application of technology for the development of new designs or products that dynamically adapt to the user by using intelligent systems that simulate or perform actions in real time [1]. So interactive engineering approaches results from sophisticated joint studies combining the field of Numerical Engineering, Mechatronics, Mechanical and Industrial Engineering, Design and Manufacturing Science and within these approaches we recognize interactive design and interactive simulation.

Interactive product design is a major economic and strategic issue in innovative products generation. It is an approach that integrates user expectations in the product development process and advocates the virtual exploration of the solution space through a combination of cognitive, sensorial and physical interactions [2]. In this way the product is constrained by three factors: the expert's knowledge, the end-user satisfaction and the realization of functions [3]. The capture and use of knowledge from high-level experts leads to secured solutions during the design of product and crossing of different expert's knowledge ensures the creativity in the design. Regarding the end users' satisfaction, a product that does not allows the realization of end user perception, will not be successful. In fact if the perceived value, which also corresponds to the level of acceptance and pleasantness of the product, is low, it may be necessary to make some modifica-

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tions to the design in order to increase the perceived value. Users can formulate a judgment and give an evaluation about the product and its attributes. In order to determine the perceived value assigned by the user to the product, the product has to be experienced by users through sensorial interactions. As regards the realization of functions, a product is created for assuming specific functions and behaviours in a physical environment and this requires, during the phase of design, to deeply identify which are the physical interactions that occurs between physical component and environment [3].

Another useful strategy for designers to reach the efficient design through the cognitive or physical interactions is interactive simulation. It is often referred to as "human in the loop" HITL and it is a special kind of physical simulation in which physical simulations include human operators, such as in a flight or a driving simulator. Human-in-the-loop simulations permits a better understanding of human behaviour under complex situations and can visually highlight features that may not be readily accounted for in traditional simulations [4].

In this paper, an interactive engineering approach is considered to develop an interactive environment which is able to simulate the user shopping experience.

In the last times, in fact, one of the challenges online retailers face is how to provide customers with an online shopping experience that is as real as the in-store experience. In-store experiences are the best way to see a variety of products in detail, but they are not accessible to everyone, and customization is limited to the products present in the store. Online stores with the use of static and 2D images of products and simple 2D interfaces such as hyperlinks, labels, icons and menus allow users to browse entire collections of goods but cannot offer the same experience that brick and mortar stores can and lack personal experience. VR can change this by offering more immersive and explorative experiences with 360-degree video capabilities and interactive contents. Three-dimensional environment is presented in a way that compels users to believe that they are actually in another physical setting. VR can create a robust shopping experience and provide high-end features like room-scale sensing, complete immersion, or detailed controls. It also allows the customer to zoom in on fine detail, which aids in convincing the buyers of product quality and authenticity. The customers have the opportunity to assess the product as if they are examining it in person: so not only the customer experience improves, but the likelihood to purchase increases (as well as the number of returns decreases).

The VR puts the customers in the middle of that 360° environment so they can get a realistic feel of the room. Being immersed in a virtual environment, the shopping experience of customer becomes more realistic and tangible, ultimately helping customers evaluate a purchase. Thanks to the third dimension, VR provides an advanced way of visualization that increases the customer's satisfaction and thus shopping experience [5].

This paper focuses on developing an immersive virtual reality on line shopping environment that includes the major advantages of offline and on line shopping and to study its effect on consumer's behaviour. We provide some guidelines to design a virtual and multisensory environment that affects consumer responses, expanding the body of knowledge about the more recent and low cost ICT technologies (e.g. social media, interactive technologies et so on) and their impact on consumer behaviour. In this way, stakeholders in shopping can acquire a better understanding of how new IC Technologies can be used as tools to create immersive brand experiences, interactive marketing campaigns, and innovative product experiences for consumers and of how sensory marketing can be incorporated into their VR campaigns.

The paper is structured in this way. Section 1 describes the related work about VR in shopping, Sect. 2 explains the technological characteristics of VR in terms of type of devices and the nature of simulation and the consumer engagement expressed through varying levels of cognitive, affective and behavioural manifestations. Section 3 describes the case of study, that is a virtual supermarket, highlighting its technological features. Section 4 illustrates the methodology of research: *the measurement of virtual supermarket and its relationship with consumer engagement in terms of service quality and customer satisfaction*. Then, in Sect. 5 results have been reported. Finally, the conclusions have been drawn out.

2 Literature review: shopping and VR

Virtual reality (VR) has emerged as a technology that provides users with realistic, interactive computer environments and offers innovative modes for delivering memorable experiences in different context such as marketing contexts [6–8]. The feeling of presence lies at the center of all immersive virtual experiences [9–11]. Traditionally, presence has been conceptualized as the degree to which one feels present in the mediated environment instead of in the immediate physical environment [11] or as a psychological state in which the virtuality of experience is unobserved [12]. In other words, a person perceive the existence of a medium in his or her communication environment but responds as if the medium was not there due to the users immersion into the mediated environment [13].

Thus, the more presence a medium affords to users, the more the medium becomes transparent and experiential [14]. Depending on a mix of form and content variables (depth, breadth, range, mapping, and speed) as suggested by Steuer [11] or how many sensory channels are immersed in the

environment, a certain mediated environment could induce a varying degree of presence [14].

Making people feel present in a virtual environment is important for several reasons. First, activating presence engages the user [15] and has been associated with both an increased recall of the virtual experience and increased situation awareness of their virtual space [16, 17]. Secondly, people who are present in the virtual space are more likely to provide realistic behavior acting as if they are in a real situation [18].

Virtual reality has emerged as a relevant interactive technology in the marketing environment, increasingly used in retail contexts and often developed in formats of smart device applications.

In literature the use of interactive technologies has been considerably studied on the way consumers engage and response in shopping and brand activities [19–21]. With the use of VR, consumers can experience products/brand/service virtually by examining and manipulating the visual images, functions, and features of products in a variety of ways. Previous marketing research into three-dimensional (3D) advertising (which is made possible on a two-dimensional (2D) screen using VR technology) has demonstrated that consumer learning is enhanced by such interfaces [22–24]. Compared to products presented in 2D modes, consumers tend to understand products better, prefer them to other products, and are more inclined to buy products when they are presented with 3D advertising [14].

VR also allows for realistically and efficiently recreating virtual supermarkets to investigate consumer perceptions and behaviour. Pantano and Servidio [25] showed the introduction of immersive virtual environments (VE) in traditional points of sale is influenced by the perceived ease of use of the innovative tools, the provided enjoyment, and the new store perception. In the work of Papagiannidis et al. [26], a virtual retail environment consisting of a two-floor shop with fashion clothing for sale was created to rate how level of control in the VE, level of realism of the VE, color and graphics vividness positively affect users' simulated experience (engagement, enjoyment, pleasure, satisfaction) and purchase intentions. Waterlander et al. [27] studied consumers' reactions to food are emerged by an analysis of a 3D web-based virtual supermarket at different products' different pricing or labeling strategies. Wu et al. [28] studied the impact of virtual fashion clothing stores on consumers' retailer interest, retail pleasure, patronage intention, and purchase behavior. Massara et al. [29] and van Herpen et al. [30] respectively indicated that virtual supermarkets are right to study consumers' reactions to product scarcity as well as consumers' emotional responses while shopping in different environments. The study of Van Herpen examines whether the increased realism of a virtual store compared to pictorial (2D) stimuli elicits consumer behavior [31].

Virtual reality provides an effective platform for experience marketing [32]. In experience marketing, developing and providing memorable events for customers is the main business focus which in themselves become products (the "experience"), with monetary value in the transformational benefits offered by the experiences. From the point of view of experiential marketing, consumers seek pleasurable experiences being both rational and emotional. For this reason, marketers should provide a greater realization of the richness and complexity of experience through technology, such as VR, as a medium for experience provision. The types of experiences that marketers should seek to deliver include those that are sensory (engaging all the senses), affective, creative and cognitive, physical, and related to social identity.

In fact, the use of the sensory marketing approach to enhancing the customer experience has described by several studies [33–42]. Schmitt [32] stated that branding in the experience marketing should provide products, communications, and marketing campaigns that dazzle their senses, touch their hearts, and stimulate their minds. Pine and Gilmore [43] recommend that consumer experiences should be designed around themes and include memorabilia in order to create memorable experiences [43]. Spence et al. [42] developed an organizing framework for research on sensory marketing considering how sensory cues influence cognitive affect and behaviour.

As humans sense the surrounding environment through the five senses (visual, auditory, tactile, olfactory, and taste), multisensory cues are important to achieve a high level of presence in VEs. Increasing the modalities of sensory input in a virtual environment can increase both the sense of presence and memory for objects in the environment. Sensory cues for virtual environments usually consist primarily of visual and hearing stimuli and, secondarily, of touch, taste, and smell often described as the lower senses [44].

Since the use of VR is wide in marketing, there is an ever-growing need to better understand its impact on consumer behaviour and on the experience that it delivers. The possible impact of emerging VR technology on consumers has only been discussed in some cases [45, 46] but, therefore, no systematic research agenda has been proposed on the recent Information and Communication Technologies (ICT) in general.

3 The technological aspect of VR

One of the more important advantage of using virtual reality is the feeling of presence has often been linked to virtual reality experiences: participants feel as though they are in a real environment rather than the VR.

From our research literature, we have found three factors that are implicated in the creation of presence within VE:

1. the ability of the VR devices to surround the user and to create the immersiveness of the experience [47, 48],
2. the nature of the simulation being experienced [49],
3. the individual difference characteristics of users (e.g. personality traits) [50–52].

Only the first two factors, more correlated to the technological aspect of VR, are described in detail in the following paragraphs.

4 The ability of the VR devices

Recently thanks to reductions in price, some VR devices have become increasingly popular, stimulating demand for entertainment content aimed at these devices. One popular form of content which has emerged is known as 360 Degree Panoramic Video (360 degree video, 360° video, 360 video), video which captures most of, or the entirety of a full spherical field of view. Immersive 360 degree video offers a unique, interactive, insider perspective and the video recording captures the setting in all directions. Importantly, the fact that the video is captured from a single position invokes a bodily sense of 'being there'. Further, it offers the capability to interact with the recorded video through controls that allow the user to pan around and look around in any direction within the captured context at any one time.

So the use of VR devices for 360 degree video contexts offer increasingly embodied ways to engage with the sense of presence. The device is utilized to generate a sense of presence, which can be defined as an illusion of non-mediation toward the virtual experience, or a subjective feeling of "being there." [53] This means that such technology leads the individual to temporarily perceiving his interactions and sensations as independent of the VR devices, as if he was seeing, moving, touching or interacting with the virtual stimuli directly. Presence could be therefore understood as a subjective feeling that results from the relationship between the quality of the device and individual characteristics.

According to Vergana et al. [54] VR applications can be classified according to visualization and interaction devices into two wide categories:

- *non-immersive* (the well-known *window in the world*), where the user's vision to the world is by means of the flat screen of a computer acting as a "window";
- *immersive*, which completely introduces the user into a virtual world by using glasses with two small screens placed in front of the user's eyes.

VR immersive applications are also subdivided into two subcategories, according to the visualization system of the virtual world [54]:

- the *head-mounted display* (HMD), which consists of active glasses with a small screen placed properly in front of each eye [55–57];
- the *virtual* CAVE (*cave automatic virtual environment*), where the virtual world is projected on the walls, ceiling, and floor of a room by diverse stereoscopic projectors. In this last case, the user must wear passive stereo glasses [58, 59] to achieve a 3D view of the virtual world.

The head-mounted display (HMD), with one small screen in front of each eye, is the special device used in immersive systems. The HMD will typically display two separate images on a screen strapped to the participant's face, one image for each eye, allowing for controlled visual perception (including depth perception) across a fairly wide field of view [54]. If a virtual environment is constructed and displayed appropriately, the viewers can perceive it as a believable virtual space they are immersed in.

5 The nature of the simulation

The use of immersive virtual reality techniques to simulate a grocery store presents exciting opportunities for research into consumer behaviour [31]. By using the virtual reality, a 3D store environment can be simulated in a realistic and cost-efficient way by generating feelings of being present in the virtual Environment [60–62].

In this context the nature of the simulation refers its ability to facilitate the global sharing of information and resources, and its potential to provide an efficient channel for advertising, marketing, and even direct distribution of certain goods and information services. An efficient VR environments that impacts on consumer decision making have to handle complex tasks of communication, coordination, cooperation, negotiation, and competition to respond to consumers' needs as for example Information Search (Product search, Attribute product search) to optimize product analysis process, Online communication & interaction to facilitate the exchange of information for example among the consumers about a product, Negotiation to establish product pricing mechanism.

So in order to enhance customers' virtual experience and obtain an efficient VR environment that respond to precise customer needs, some technological characteristics are required.

Taking in consideration the work of Javornik [46], they have been stated as: interactivity, hypertextuality, virtuality (presence of elements of virtual reality), modality, location specificity, mobility and connectivity (Table 1).

Table 1 Technological characteristics of VR environment and their description

Interactivity	Machine interactivity: to allow the access to different content	Person interactivity: to allow the communication with other consumers, service help, firms	
Hypertextuality	Number of linked sources (i.e. sites, product information, price)		
Modality	Static (i.e. text or image)	Dynamic (i.e. audio, video, or experiential)	
Connectivity	Blogs, social networking sites, content communities	Facebook, Instagram, Twitter, Youtube	
Mobility	Fixed interactive screens	Smart devices	Wearable devices
Location-specificity	On line maps		
Virtuality	Virtual elements		

In detail, we will describe these characteristics as follow.

5.1 Interactivity

According to Billinghurst and Kato [63], VR tools are interactive as they allow communication both with other people and with the medium. Sundar [64] defines interactivity as "the choices provided to users and the ability to go back and forth with the interface".

The interactivity link to related consumer responses is established for instance through consumers perception of how much control they view to have over a medium, to which extent it allows them to lead two-way communication and how responsive the see the medium to be [46, 64–66]. So, interactivity can be with the medium (i.e. "machine interactivity") to provide and interactively access hypermedia content in addition to through the medium (i.e. "person interactivity") to communicate through the medium to others.

5.2 Hypertextuality

According to some studies [20], hypertext is viewed in terms of a network of paths and associations, with an emphasis upon approximating the way the human brain connects information. For Bornman and Von Solms [67] hypertext advocates the concept of non-sequential writing of information allowing the user to connect information together by means of different paths or links.

5.3 Modality

Modality refers to the types of content provided by the medium [20, 64]. Content simply identifies whether static (i.e. text or image) or dynamic (i.e. audio, video, or experiential) content can be delivered by the medium. Experiential content includes stimuli impacting upon additional sensory modalities, such as tactile, proprioceptive, or olfactory senses.

5.4 Connectivity

The networked character or connectivity [20] is the technological capability of expanding and sustaining a model of network, where many users can be connected among themselves and can participate in the exchange of messages and are simultaneously potential senders and receivers [46, 68, 69].

5.5 Mobility

Portability or mobility is the characteristic of mobile devices being effort less to carry around and indicates a device's affordance for spatial dynamism [70]. The extent to which VR is mobile, depends on the type of device it is used on: fixed interactive screens do not allow mobility, while smart devices such as smartphones or tablets and wearable devices like head-mounted displays (GoogleGlass) can be carried around and allow VR to be mobile.

5.6 Location-specificity

Location-specificity refers to the on line maps that allows to visualize the store locator and the point of delivery of the products.

5.7 Virtuality (presence of virtual elements)

Virtuality here refers the multisensory interactions with virtual products obtained thanks to advances in computer technology. The salient attributes of virtual products can involve sensory input (visual, tactile, …) in regard to consumption experiences and they can be rendered to varying degrees in 3D visualization.

Table 2 Consumer engagement manifestations extracted by Dessart [73]

Dimensions	Sub-dimensions	Examples		
Cognitive	Attention	*I spend a lot of time thinking about (EF)*	*I make time to think about (EF)*	
	Absorption	*When interacting with (EF), I forget everything else around me*	*Time flies when I am interacting with (EF)*	*When interacting with (EF), it is difficult to detach myself*
Affective	Enthusiasm	*I feel enthusiastic about EF*	*I am interested in anything about (EF)*	*I find (EF) interesting*
	Enjoyment	*When interacting with (EF), I feel happy*	*I get pleasure from interacting with (EF)*	*Interacting with (EF) is like a treat for me*
Behavioural	Sharing	*I share my ideas with (EF)*	*I share interesting content with (EF)*	
	Learning	*I ask (EF) questions*	*I seek ideas or information from (EF)*	*I seek help from (EF)*
	Endorsing	*I promote (EF)*	*I actively defend (EF) from its critics*	*I say positive things about (EF) to other people*

EF engagement focus

5.8 Consumer engagement

The increased advances of interactive technologies has intensely transformed the communication and purchase-related processes [20, 21]: as a consequence retailers' strategies, operations, and competiveness significantly affect and capture the consumer engagement.

Based on the results from the existing literature [71–74], consumer engagement is defined as 'the state that reflects consumers' individual dispositions toward engagement foci (type of brand or product) which are context-specific. Engagement is a multi-dimensional concept expressed through varying levels of cognitive, affective and behavioural explicit manifestations that go beyond exchange situations [75, 76] (Table 2). The first dimension of engagement exposes its cognitive aspect. Cognitive engagement has been defined as a set of enduring and active mental states experienced by the consumer [73, 77, 78]. Gaining the attention and the absorption of consumers are key aspects of engagement. *Attention* is the availability and amount of time spent thinking about, and being attentive to, the engagement focus. Three types of attention can be:

- voluntary attention: consumers actively search out information that has personal relevance,
- selective attention: consumers selectively focus attention on relevant information,
- involuntary attention: consumer is exposed to something surprising, novel, threatening, or unexpected such as e.g. surprise, movement, unusual sounds, size of stimulus, contrast effects and colour.

Absorption is the level of consumer's concentration and immersion with an engagement focus [73].

Affective engagement captures the summative and enduring level of emotions experienced by a consumer with respect to his or her engagement focus [71, 73]. According to Dessart et al. [73], the affective dimension can be broken down into enthusiasm and enjoyment. Consumer *enthusiasm* reflects the consumer's level of excitement and interest regarding the engagement focus [76]. Affective engagement is also associated with a pleasurable state of *enjoyment* [78].

Behavioural engagement comprehends the behavioural manifestations towards an engagement focus, beyond purchase, that result from motivational drivers [79]. These manifestations can take the form of sharing, learning and endorsing behaviours, which are all inherently social [73]. *Sharing* and *Learning* are respectively the act of providing and of seeking content, information, experiences, ideas or other resources to the engagement focus while *Endorsing* is the act of sanctioning, showing support, referring resources shared by the engagement focus [73].

6 Case of study: virtual supermarket

The relevant question for understanding the impact of VR environment on consumer behaviour is how its technological characteristics impact shopping experience. In order to obtain this information, we have created a VR environment that presents all the previous technological characteristics (interactivity, hypertextuality, virtuality (presence of virtual

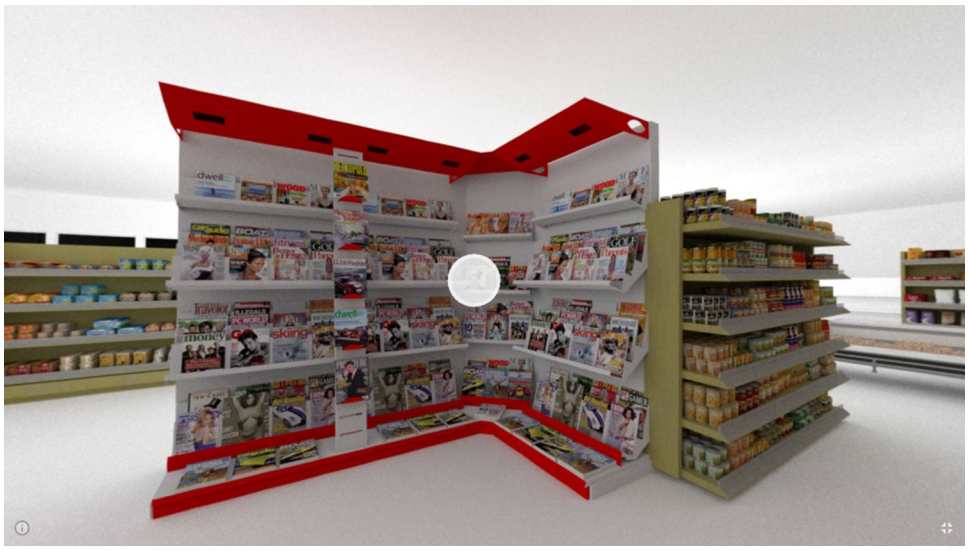

Fig. 1 360 degree virtual supermarket

elements), modality, location specificity, mobility and connectivity).

VR environment shows a virtual supermarket in the form of 360 degree video able to create highly immersive experiences that activate a sense of presence that engages the users and allows them to focus on the video's content by making the user feel as if he or she is physically a part of the environment. The virtual supermarket is designed to look like the actual aisles and shelves of a regular brand store, making the experience very user-friendly and real: users can walk through the aisles of virtual supermarket to see products on the shelves as if they were in real store (Fig. 1).

In general 360 degree video can be created, requiring only a modestly priced special-purpose camera or combination camera mount and a piece of post-processing software or using 3D computer graphics. In our case, 360 degree computer generated panorama images have been produced using 3D computer graphics software toolset, like Blender one of the best free and open source alternatives currently available on market. To produce the 360° images for our simulator, we have exploited its Cycles Render Engine which allows to generate ray-tracing production-quality images: this to achieve the best photorealism possible and enhance the immersivity and affectiveness of the images.

The virtual environment has been assembled using different high quality, royalty free 3D models, commonly available on the internet on repositories such as Google SketchUP Repository. Those models have been then customized to adapt their visual features to the simulator's didactic purpose. In particular, texture, details, colors and position in the scene of the 3D models have been set specifically to obtain a certain effect on the final user of the simulator. Ambient occlusion and advanced lighting effect has enabled to return an higher sense of depth to the scene.

Once generated, immersive images are not immediately usable as they are. Equirectangular panoramic projection in fact introduces a strong visual distortion that makes the image highly unrealistic. In order to experience the desired immersivity, some sort of playback system is required. Since our goal was to have the produced mages highly accessible from different devices (e.g.: smartphones, tablets, desktop or laptop PCs) we exploited Google VR view which allows to embed 360 degree VR media into websites. It is based on WebGL technology which allows it to be effectively cross-platforms.

Differently from Virtual Reality application, Immersive contents (like our 360° images) lack the interaction capabilities of the first. It is possible to change the viewing angle on the photosphere only. VR view allowed us to overcame this limitation, at least partially, since it allows the definition of Hotspots. These are regions on the photosphere that users can interact with. When clicked or tapped on, they fire a particular 'event' which can be intercepted by the Java application that handles the logic of the simulator. In this way it is possible to load some text in a portion of the page, start a video, change the 360° currently displayed and so on.

The hotspots of our video are shown in Fig. 2. Once the environment to be reproduced is decided, a short description of the expected didactical features is produced by the simulator maintainers. They also decide if for the new specific environment involved are CGI imagery or real world footages to be used. According to those principles, the visual artists charged by the video production gather or produce the required components. In particular they will film the environment using 360 panoramic cameras or assemble a collection of 3D virtual assets required to create an accurate reproduction of it. Once the visual parts of the new "room" of the simulator are ready, edited or rendered, they are uploaded into the simulator, at which point the "hotspots" can be posi-

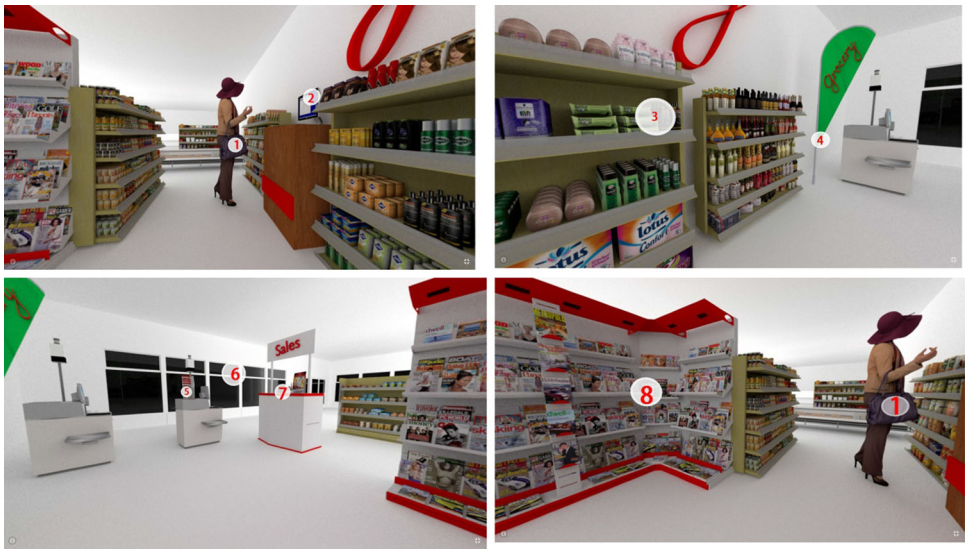

Fig. 2 The hotspots of the virtual supermarket

tioned and the new room's logic implemented. At this stage of the update process new texts are included ad the click events defined.

In the Table 3 there is the implementation of technical characteristics for each hotspot.

7 Methodology of research

The present study provides insights on consumers' experiences employing a quantitative approach (largely used in literature for exploring new phenomena and drawing up new theories [80–84]). A survey was conducted in order to collect the necessary data to analyze.

A total of 50 participants (students, postdocs students, PhD students and researchers) from an Italian University, Faculty of Engineering, with an age from 20 to 30 years and without any payment for their participation, took part in our survey to allow consumers engagement with virtual supermarket to emerge (Table 4). We assumed this sample as well suited to our research because, in general, being young participants, they have a certain expertise of advanced technologies (i.e. smartphones), they are aware of internet and mobile tools for shopping [26] and in particular, being students coming from a Faculty of Engineering, they have IT and computer skills. Similarly, current literature on technological innovations in retail settings frequently involves this kind of subject for research [26, 85, 86], since they can be considered the "shoppers of the future" [87].

Before starting the survey, some introductory explanations regarding to the technological features of VR, the consumer engagement manifestations and the virtual supermarket were conducted in small groups of 10 people at time in order to be able to respond better to their doubts and questions. Then these participants were invited to visit the entire virtual supermarket taking all the time they needed. Finally, all 50 participants evaluated the virtual supermarket and its impact on the consumer engagement completing the Table 5 with a 3-point Likert scale. The interviewers evaluated with a value of 1, 3 or 5 if their perception of the relation of behaviour with the technological attribute was low, medium or high.

The collected data were analysed using the SERVPERF model [88]: in this way we investigated the measurement of virtual supermarket and its relationship with consumer engagement in terms of service quality and customer satisfaction. Online service quality is defined as the level to which a Web site enables to online customer an efficient and effective delivery of products and services, shopping, and purchasing [89]. From previous literature, research in online service quality is focused on online shopping, virtual community, online bank, website design, online library, online service and online travel [90–94]. Many factors may influence perceived online service quality in online customer such as web design, links, interactivity, accessibility, reliability, ease-of use, responsiveness/efficiency, security/privacy, functions, contents et so on (Z. [92]. In our work, the overall service quality was considered as the overall quality of the virtual supermarket in terms of its technological attributes (Interactivity, Hypertextuality, Modality, Connectivity, Mobility, Location-specificity and Virtuality).

The SERVPERF model considers service quality only evaluated by perceptions without expectations and without importance weights according to the formula:

$$SQ = \sum_{j=1}^{k} Pij$$

Table 3 Technical characteristics in the virtual supermarket

Technical characteristics			Virtual supermarket
Interactivity	Machine interactivity: to allow the access to different content	Person interactivity: to allow the communication with other consumers, service help, firms	Hotposts # 1–8
Hypertextuality	Number of linked sources (i.e. sites, product information, price)		Hotspot #2 permits to link to web sites to order products from online stores Hotspot #5 permits to link to web sites that compare the prices of products of different brand stores Hotspot #7 permits to visualize leaflet, flyer for offers, promotions and seasonal events of the different brand stores
Modality	Static (i.e. text or image)		Hotspot #4 permits to visualize text or images of recipes to induct the consumers to eventually buy the ingredients
	Dynamic (i.e. audio, video, or experiential)		Hotspot #3 permits to visualize videos of recipes to induct the consumers to eventually buy the ingredients
Connectivity	Blogs, social networking sites, content communities	Facebook, Instagram, Twitter, Youtube	Hotspot #1 permits online communication and interaction with others to recommend or communicate web sites/products/recipes/discounts to a friend
Mobility	Fixed interactive screens		Visualization of the 360 degree video by using fixed interactive screens
	Smart devices		Visualization of the 360 degree video by using tablet or smartphones
Location-specificity	On line maps		Hotspot #6 permits to search locators of stores or delivery points
Virtuality	Virtual elements		Hotspot #8 visualization of interactive 3D magazine to read recipes

Table 4 Ages of participants

Age	Number
20–24	35
25–30	15
Total	50

where SQ = overall service quality; k = the number of attributes; P_{ij} = performance perception of stimulus i with respect to attribute j.

The perception of stimulus i with respect to attribute j was considered as the perception of the consumer behaviours (cognitive, affective, behavioural) with respect to the technological attributes. The performance of the perception was evaluated by the consumer by using a 3-point Likert scale (1,3,5). The choice of using a 3-point scale is justified because of its simplicity and practical convenience in administration and scoring in accordance of the Komorita [95] and Bendig [96]. In this regard, some authors recommended the usage of simplified scales; specifically they suggested the truncation of the Likert scale into a 3-point scale because this will facilitate understanding from the interviewers [97]. Moreover, as stated by some works, the use of dichotomous or trichotomous measures does not result in any significant decrement in reliability or validity [98, 99].

8 Results and discussion

As anticipated, the aim of the research consists of understanding consumers experiences through new technologies. 50 participants indicated their points of view, by evaluating the technological elements of VR in relation to the consumer engagements. The results obtained from the participants are shown as mean values in Table 6 and described in detail in the following paragraphs. In our study, the SERVPERF mean of the virtual shop was 4.8 of 5 showing a high impact on the consumer engagement.

Table 5 Table to fill-in

	Consumer engagement behaviour						
	Cognitive		Affective		Behavioural		
	Attention	Absorption	Enthusiasm	Enjoyment	Sharing	Learning	Endorsing
	The cognitive availability and amount of time spent actively thinking about and being attentive to the engagement focus	*The level of consumer's concentration and immersion with the engagement focus*	*A intrinsic level of excitement and interest regarding the engagement focus*	*The feeling of pleasure and happiness derived from the interaction with the engagement focus*	*The act of providing content, information, experience, ideas or other resources to the engagement focus*	*The act of actively or passively seeking content, information, experience, ideas or other resources to the engagement focus*	*The act of sanctioning, showing support, referring*
Interactivity Hotposts # 1–8	*I spend a lot of time thinking with hotspots #1–8*	*When interacting with the hotspots #1–8, I forget everything else around me*	*I find hotspots #1–8 interesting*	*I get pleasure from interacting with hotspots #1–8*	*I share my ideas and experience with hotspots #1–8*	*I seek more ideas or information about hotspot #1–8*	*I promote hotspots #1–8*
Evaluation (1, 3, 5)							
Hypertextuality Hotspot #2 permits to link to web sites to order products from online stores Hotspot #5 permits to link to web sites that compare the prices of products of different brand stores Hotspot #7 permits to visualize leaflet, flyer for offers, promotions and seasonal events of the different brand stores	*I spend a lot of time thinking with hotspots #2, 5, 7*	*When interacting with the hotspots #2, 5, 7, I forget everything else around me*	*I find hotspots #2, 5, 7 interesting*	*I get pleasure from interacting with hotspots #2, 5, 7*	*I share my ideas and experience with hotspots #2, 5, 7*	*I seek more ideas or information about hotspots #2, 5, 7*	*I promote hotspots #2, 5, 7*
Evaluation (1, 3, 5)							

Table 5 continued

	Consumer engagement behaviour						
	Cognitive		Affective		Behavioural		
	Attention	Absorption	Enthusiasm	Enjoyment	Sharing	Learning	Endorsing
Modality Static Hotspot #4 permits to visualize text or images of recipes to induct the consumers to eventually buy the ingredients	*I spend a lot of time thinking with hotspot #4*	*When interacting with the hotspot #4, I forget everything else around me*	*I find hotspot #4 interesting*	*I get pleasure from interacting with hotspot #4*	*I share my ideas and experience with hotspot #4*	*I seek more ideas or information about hotspot #4*	*I promote hotspot #4*
Evaluation (1, 3, 5)							
Modality Dynamic Hotspot #3 permits to visualize videos of recipes to induct the consumers to eventually buy the ingredients	*I spend a lot of time thinking with hotspot #3*	*When interacting with the hotspot #3, I forget everything else around me*	*I find hotspot #3 interesting*	*I get pleasure from interacting with hotspot #3*	*I share my ideas and experience with hotspot #3*	*I seek more ideas or information about hotspot #3*	*I promote hotspot #3*
Evaluation (1, 3, 5)							
Connectivity Hotspot #1 permits online communication and interaction with others to recommend or communicate web sites/products/recipes/discounts to a friend	*I spend a lot of time thinking with hotspot #1*	*When interacting with the hotspot #1, I forget everything else around me*	*I find hotspot #1 interesting*	*I get pleasure from interacting with hotspot #1*	*I share my ideas and experience with hotspot #1*	*I seek more ideas or information about hotspot #1*	*I promote hotspot #1*
Evaluation (1, 3, 5)							
Mobility *Fixed interactive screens* Visualization of the 360 degree video by using fixed interactive screens	*I spend a lot of time thinking with the use of fixed interactive screens*	*When visualizing with fixed interactive screens, I forget everything else around me*	*I find visualization with fixed interactive screens interesting*	*I get pleasure from visualization with fixed interactive screens*	*I share my ideas and experience with visualization by mean of fixed interactive screens*	*I seek more ideas or information about visualization by mean of fixed interactive screens*	*I promote visualization by mean of fixed interactive screens*
Evaluation (1, 3, 5)							

Table 5 continued

	Consumer engagement behaviour						
	Cognitive		Affective		Behavioural		
	Attention	Absorption	Enthusiasm	Enjoyment	Sharing	Learning	Endorsing
Mobility *Smart devices* Visualization of the 360 degree video by using smartphones	*I spend a lot of time thinking with the use of tablet or smartphone*	*When interacting with tablet or smartphone, I forget everything else around me*	*I find visualization with tablet or smartphone interesting*	*I get pleasure from interacting with tablet or smartphone*	*I share my ideas and experience with visualization by mean of tablet and smartphone*	*I seek more ideas or information about visualization by mean of tablet and smartphone*	*I promote visualization with tablet and smartphone*
Evaluation (1, 3, 5)							
Mobility *HDM* Visualization of the 360 degree video by using HDM	*I spend a lot of time thinking with the use of HDM*	*When interacting with HDM, I forget everything else around me*	*I find visualization with HDM interesting*	*I get pleasure from interacting with HDM*	*I share my ideas and experience with visualization by mean of HDM*	*I seek more ideas or information about visualization by mean of HDM*	*I promote visualization with HDM*
Evaluation (1, 3, 5)							
Location-specificity Hotspot #6 permits to search locators of stores or delivery points	*I spend a lot of time thinking about hotspot #6*	*When interacting with the hotspot #6, I forget everything else around me*	*I find hotspot #6 interesting*	*I get pleasure from interacting with hotspot #6*	*I share my ideas and experience with hotspot #6*	*I seek more ideas or information about hotspot #6*	*I promote hotspot #6*
Evaluation (1, 3, 5)							
Virtuality Hotspot #8 visualization of interactive 3D magazine to read recipes	*I spend a lot of time thinking about hotspot #8*	*When interacting with the hotspot #8, I forget everything else around me*	*I find hotspot #8 interesting*	*I get pleasure from interacting with hotspot #8*	*I share my ideas and experience with hotspot #8*	*I seek more ideas or information about hotspot #8*	*I promote hotspot #8*
Evaluation (1, 3, 5)							

Table 6 Results: mean values

	Interactivity	Hypertextuality	Modality		Connectivity	Mobility			Location-specificity	Virtuality
			a	*b*		*C*	*D*	*E*		
Cognitive										
Attention	4.92	4.84	4.2	4.84	4.4	4.68	4.72	4.8	4.92	5
Absorption	4.92	4.92	4.52	4.92	4.88	4.76	4.8	5	4.6	4.92
Total_Co	4.92	4.88	4.36	4.88	4.64	4.72	4.76	4.9	4.76	4.96
Affective										
Enthusiasm	4.96	5	4.52	5	4.92	4.76	4.84	4.96	5	5
Enjoyment	5	5	4.44	4.92	4.88	4.72	4.84	4.96	4.44	5
Total_Af	4.98	5.00	4.48	4.96	4.9	4.74	4.84	4.96	4.72	5
Behavioural										
Sharing	4.96	4.76	4.88	4.92	4.92	4.04	4.76	4.96	4.72	5
Learning	4.96	5	4.92	4.92	4.96	4	4.8	4.88	4.84	4.96
Endorsing	4.6	4.68	4.4	4.88	4.88	4.4	4.68	4.92	4.88	4.92
Total_Be	4.84	4.81	4.73	4.92	4.92	4.15	4.75	4.92	4.81	4.96
Total	4.90	4.88	4.55	4.91	4.83	4.48	4.78	4.93	4.77	4.97
SERVPERF SCORE	*4.80*									

a = static content, b = dynamic content, c = fixed interactive screens, d = smart devices (i.e. smartphone), e = HDM

8.1 Interactivity

Our results are in line with the previous studies confirming that interactivity leads to affective responses (Total_Af = 4.98) [46, 66, 100–102]: there is less evidence for it for more cognitive involvement (Total_Co = 4.92) for which some studies report positive effect [66, 103] and others lack thereof [45].

8.2 Hypertextuality

Our results (Total = 4.81) confirm some previous findings. Firstly, consumers are more willing to search for different types of information when search is made easy both within sites or across sites [104]. Then, in a real-life setting individuals tend to visit web sites of products and brands store, which they are interested in. Therefore, if a stimulus that increases their involvement in the web site is given to the consumers, they could feel (highly) involved with the brand or product [46]. So, when feeling more involved, individuals are more motivated to process the web site content and are more likely to utilize interactive features to facilitate this processing [105].

8.3 Modality

The different types of information representation or modality—visual, audio, video—elicit different responses from consumers. In our case, the static modality (Total_static = 4.55) is slightly under evaluated in comparison to dynamic modality (Total_dynamic = 4.91). This confirms the marketing research showing that richer online information creates more positive responses [106, 107]. Richness in modality contributes to the formation of more positive attitudes towards a brand and related products and consequently more intense purchase intentions (Total_Be_static = 4.73 vs. Total_Be dynamic = 4.92 [108]. Also, richer visual and sound effects in video impact consumers' positive attitudes and willingness to share their experience (sharing static content = 4.88 vs. sharing dynamic content = 4.92) [106].

High quality audio within a video is an effective feature because it has the ability to create a certain mood, which allows users to feel further absorbed into content (Total_af static content = 4.48 vs. Total_af dynamic content = 4.96). The auditory experience in VR marketing campaign can capture sound from all directions and this surround sound method causes the users to feel present in the setting.

8.4 Connectivity

Social media comes in many forms (e.g. blogs, social networking sites, content communities) and many applications (e.g. Facebook, Instagram, Twitter, Youtube). The solid result obtained (Total = 4.83) shows that through these media, consumers can share their thoughts and feelings concerning their sensory experiences like for example cooking or eating, and thus provide information concerning their food (e.g. taste, smell, plate presentation) and eating environment (location,

atmospheric, social interaction) [109] or to share and express thoughts and opinions on products and services at any point throughout the retail process [110].

Encouraging consumers to instantly share personalised experiences to the online community (Total_Be = 4.92), is perceived as 'playful' and 'credible', and it has the potential to be a driver for future behaviour consumers who are more likely to listen to previous customer reviews [46].

Popular social media sites allow consumers to share and express thoughts and opinions on products and services at any point throughout the retail process [110, 111]. The ability to share satisfaction or dissatisfaction with the brand in real-time presents challenges for retailers, who often lack control over the consumers social network influence [112]; and negative reviews in an online community drastically affects brand credibility, brand perception, customer loyalty, sales and share price [110].

8.5 Mobility

Our findings show the advantages of mobility under three aspects: *location*, *fingertips* and *feeling of presence*. As regards *location*, our results indicate a slightly preference versus the mobile devices (Total fixed screen = 4.48 vs. Total smart devices = 4.78) showing that devices that are not linked to a specific location and can deliver the VR content anywhere and anytime, allow a tailor-made solution at the exact time and place defined by consumer and thus lead to more positive attitude, purchase intentions and higher trust. Consumers are no longer restricted by fixed interactive screens that do not allow mobility due to the widespread adoption of mobile devices, shifting traditional space and time boundaries [111, 113], and empowering consumers with increased flexibility and control over when, where and how they select and purchase goods and services [110]. Moreover, by implementing mobile VR in-store, the shopping experience can be drastically enhanced, as consumers can easily access enriched product information compared with both online and physical stores without VR [110, 112]: consumers utilise mobile devices in-store to perform price and product comparison to find a cheaper alternative whilst shopping in-store [112] or to see virtual product demonstrations in-store increasing purchase certainty of that product [114].

Virtual experience shown on smart devices are accessible at one's *fingertips* and if consumers perceive them useful, they are likely to use them again and develop positive attitude towards them (Total_Co_fixed = 4.72 vs. Total_Co_mobile = 4.76 and Total_Af_fixed = 4.74 vs. Total_Af_mobile = 4.84).

The way in which the virtual experience can be viewed add a *feeling of* embodied *presence* and develop an awareness of how consumers may feel if placed in a similar real context (Total_Co_mobile = 4.76 vs. Total_Co_HDM = 4.90). In our case, 360 degree video can be viewed in different ways at many levels of immersion by using a no immersive device such as (fixed screens or smart devices) or by using an immersive device such as *Google Cardboard* connected to the mobile phone (Total_Af_mobile = 4.84 vs. Total_Af_HDM = 4.96). In the first option users view the 360 degree video within a rectangular framed screen, but with the ability to pan around in 360 degrees and to zoom in, in any one direction. This view affords the perspective of embodiment that mirrors being able to look around, but does not provide a full-bodied sense of being. Virtual reality with head mounted display (HMD) allow a much more immersed view and greater degrees of freedom in movement, resulting in a strong sensation of immersion in the environment depicted in the 360 degree video. The ability to move one's head to look around in a 360 degree environment without having to manipulate and turning the video around is a key advantage. The HDM use serves two main purposes: it prompts a much more relatable sense of presence as the field of vision changes when the head is moved and it also creates a fully immersive first-person perspective that is prompts an almost visceral response.

8.6 Location-specificity

Location-specificity refers to the online maps that allows specific information on store locator, delivering location: thanks to the new modality of purchases such as click and collect, consumers can complete transactions of their purchase in the virtual experience, via mobile application or web browser, later collecting the products in-store or at a collection point [111]. The interesting result (total = 4.77) shows that knowing with an online maps system where consumers can collect their order increases the ease of purchase, and this is beneficial for both consumer and retailer [115].

8.7 Virtuality

Interactive 3D visualization offers a remarkable method to simulate many aspects of a physical product by incorporating visual, tactile, and behavioural affordances in the virtual product to support the consumer making purchase decision as described in the work of Li et al. [22, 24]. According to Li, *Visual Simulation* of a virtual product permits to obtain *Visual Translation/Rotation, Contextualization and Stereopsis [22].* In the first case, unlike 2D representation, virtual product or environment can be moved in 3D, to be increased or decreased in its size or to be rotated to view it from any angle. As regard *Contextualization,* the placement of a product in the context of 3D environments simulates how the product could look in the physical environments. The addition of *stereopsis* via 3D glasses (i.e. a different viewpoint is presented to each eye) provides increased sensory infor-

mation and fidelity, making information about the depth and shape of products and their settings more vivid and realistic.

Tactile Simulation of a virtual product permits *Touch and Manipulation [22]*. Motor control and force feedback allows the consumer to feel haptic forces (i.e. weight, inertia, resistance) when manipulating a product to feel product properties such as the texture of a product, the smoothness, edges or softness of a product with the mouse or other devices. The sense of touch can have a persuasive influence on consumer behaviour. Prior research shows that touching a product increases product attitudes, purchase intentions, and confidence in the evaluation of products [116–118]. Jim studied the impact of 3D virtual haptics in marketing and his study focused on the roles tactile stimulation plays in product perception and evaluation [116].

In computing, haptics is the science of applying the sense of touch to human interaction with computers [116]. Haptics involves the sensation of shape and texture a computer user feels when virtually "touching" a digital object (for example, a 3D model of an automobile) with a force feedback device [119]. To date, utilization of tactile and force feedback devices and supporting software that allow consumers to feel and manipulate 3D virtual products with respect to various features including shape, weight, surface textures, and temperature is a promising but under-explored area in marketing and consumer behavior research [116].

Behavioural Simulation in a virtual environment allows *customization* and *spatial navigation [22]*. In the first case the consumer can modify the form or content of a product. For instance, using a computer mouse, a consumer may change the colours of the product. In our case thanks to spatial navigation, the consumer can better navigate inside the magazine, that means that option of search of a word/content is facilitated.

The simulation of products using this taxonomy (visual, tactile, and behavioural) does not mean that these salient attributes are only what consumers consider during product inspection [22]. Somewhat, it is more realistic to perceive a sequential order of information input from visual to tactile to behavioral. That is, visual analysis is exhausted before any attempt to initiate haptic exploration [120, 121], followed by behavioral trial. Each subsequent exploration can generate additional information and improve the understanding of certain attributes of a product. However, three modes of exploration may not always be necessary in product inspection [22]. This is the case of our interactive magazine, where the visual simulation and the behavioural simulation were considered.

Our results (total 4.98) confirm the previous research on virtual reality in consumer studies. It was discovered [46] that virtual models led to high product involvements and more enjoyment and experiential value ($Total\_Af = 5$) and they have a strong impact on consumer behaviour in virtual environments [122–124]. Moreover, by creating captivating on-line virtual experiences with products [125], marketers can potentially increase the value of product information presented, engage consumers in an active shopping experience, establish an on-line competitive advantage and promote the concept of sensory marketing refers to "marketing that engages the consumer's senses and affects their perception, judgment and behavior" [53].

9 Conclusions

The paper examines the impact of the recent VR technologies on consumers behaviour providing guidelines to design a rich and immersive environment that is able to deliver high-impact and memorable messages and engage audiences and potential consumers.

The results of our study led us to propose some implications among stakeholders in virtual shopping such as retail managers, marketers and, more in particular, store designers for the designing of an online shop. In fact, a key finding of this study is related to the large importance consumers give to the technological elements of the VR such as Virtuality (4.97), Mobility HDM (4.93), Modality Dynamic (4.91), Interactivity (4.9), Hypertextuality (4.89), Connectivity (4.83) and Location specificity (4.77).

9.1 Interactivity

The virtual environment we have designed with connotations of virtuality and interactivity affects consumers' attitudes and purchase intentions. In fact our study confirms that interactivity (the degree to which users can manipulate the form and content of a mediated environment in real time) plays important roles in formulating virtual experience. It allows to the consumers to maintain high levels of control over access, timing and sequencing of information and services and to obtain and exchange product information, reviews, and ideas freely. Moreover, stakeholders should consider integrating interactive technologies in a virtual shop in order to catch consumers' attention by displaying informational and entertaining attributes of the virtual products in an exciting way. Since motivational factors play a key role in the consumers, defining time spent on product searching and online shopping: experiential (hedonic) shoppers always find more enjoyment in interactive environments than in environments with static 2D product visualizations.

9.2 Hypertextuality

The use of hyperlinks in an online shopping environment (with direct links to order and buy product, to compare products prices and to products offers and promotions) enables

consumers to reduce their decision-making efforts by providing vast selection of products, price-related information and product comparison. So stakeholders in virtual shopping should consider that providing screened and comparison information for alternatives, attracting advertising and sales events, permits to the customers to reduce the cost and the time of information search, the effort in making purchasing decisions and increase their level of satisfaction.

9.3 Connectivity

The characteristic of connectivity in a virtual shop allows consumers to share and express thoughts and opinions on products and services at any point throughout the retail process. Then the real-time capacity in a virtual store to build online relationships with other consumers in order to share satisfaction or dissatisfaction with a product or to encourage positive product promotion presents challenges for retailers (who often lack control over the consumers social network influence) since it affects brand credibility, brand perception, customer loyalty, sales and share price. Finally, managers may also use brand community to offer suitable product discounts and coupons in order to provide customers with monetary benefits, increase brand community quality and user satisfaction.

9.4 Mobility HDM

The virtual supermarket is designed to resemble the actual aisles and shelves of a regular brand store, making the experience very user-friendly and real: users can walk through the aisles of virtual supermarket to see products on the shelves as if they were in real store. This feeling of presence that allow user feel like they are truly in the synthetic environment being presented [126, 127] is a key characteristic of a great VR experience. In fact, the feeling of 'being there' increases significantly the effectiveness of VR applications: several studies have confirmed that the more human senses are engaged in a VE, the more immersive is the experience and the better is the performance of the subjects (as in real environments) [53, 128–130]. Stakeholders in retail should consider the effect of HDM in consumer engagement during the shopping. Our finding show that consumers prefer a virtual visualization that moved from a desktop PC to laptops, tablets and mobile phones to HDM: so there is no time to lose to provide customers the comprehensive virtual experience where they want it, how they want it and when they want it. VR completely immerses the user inside a virtual world or experience, typically through the use of a head-mounted display (HMD) connected to headphones, giving the users the possibility to navigate through that experience.

9.5 Location-specificity

The results of our study show that consumers enjoy to use of online maps in their virtual shopping journey because it maximizes their shopping experience enabling them to see exactly, for example, the location of real shops or the provenience of goods. Retailers should consider, for example, implementing online maps connected to a click and collect service since it could make the shopping journey more convenient for consumers: it enables shoppers to purchase items online and to visualize the more appropriate location of the store where to collect that purchase.

9.6 Modality_Dynamic content

As regards the dynamic modality feature of a virtual shop, our findings induce crucial managerial implications. Marketers should consider to provide a virtual experience for customers through an appropriate content that can appear in audio and visual formats, such as music, voice narrative and video: all these possibilities in comparison to the static modality impacts more effectively the communication process and allows the customers to make an informed decision without needing to see the product in person.

In conclusion, online shopping bypasses many disadvantages of conventional stores like limited opening hours but it presents products only using text and images and it doesn't give the possibility to the customers to interact with products and view them from every side as in a real shop. Virtual Reality (VR) has the potential to create novel shopping experiences that combines the benefits of on- and offline stores, creating a virtual shopping experience that simulates the shopping experience of a brick and mortar shop and giving shoppers a realistic view in a virtual environment. The VR immerses the customers in the middle of that 360° environment so shoppers can wander in virtual malls while making purchases in real time: the shopping experience becomes more realistic and tangible, and helps customers to evaluate a purchase.

To sum it up, retailers may introduce virtual tours, interactive product displays, tailored shopping experiences, 360-degree videos with the obvious business benefits such as improving the shoppers journey with activing possibilities for shopping, reducing marketing costs and allowing users to feel like they are there in the aisles without the time and expense of travelling to multiple locations for their shop.

In addition, currently, retailers spend sometimes huge amounts of money on research and development on product placement and store layout in store shop. Virtual reality may allow retailers to try out and to test store layouts, shelving, concepts, decor, and marketing materials, gathering data on ways people shop and then adjust the layout.

The objective of the paper is to communicate and disseminate recent computer engineering and VR/AR research and application development that demonstrate the capacity of VR/AR to change radically the commerce and shopping experience in the near future, even if our study presents certain limitations. Perhaps future research could examine more interaction with products of the virtual supermarket and could provide more detailed results in consumer engagement. In future the aim will be increasing people interaction with products: all items shown on the shelves of the virtual supermarket will be available for purchase, when the consumer will select the product, it will be are stored in the customers' online shopping basket. Then, the consumer will pay online once their order is completed and he will schedule a time for home (point, store) delivery. The success of such virtual shopping may rely heavily on how it will be implemented on devices such as, for example, consumer smartphone.

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