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The Future of Fashion: How the Quest for Digitization and the Use of Artificial Intelligence and Extended Reality Will Reshape the Fashion Industry After COVID-19

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Abstract

The aim of this paper is to analyze how extended reality (formed by virtual and augmented reality), and artificial intelligence are influencing the fashion field. During and after the Covid19 pandemic, a radical shift happened: most activities, from shopping to showrooms and fashion weeks had to move online. While e-commerce was already a consolidated pillar of fashion shopping, it recently started to evolve to achieve through AR (augmented reality) and VR (virtual reality) what customers could before find in physical stores: interesting experiences and sensory stimuli. Online traffic peaked, creating even more room for technology based on artificial intelligence. With its disrupting powers, AI (artificial intelligence) has all the potentialities to take over each step of the fashion value chain. Furthermore, with the quarantine the production of fashion was slowed down by the absence of workers in production sites. Artificial intelligence and automation could be an answer. In this paper AR, VR and AI technologies are analyzed with practical examples on what has happened and is happening in the industry, from a perspective based on the challenges imposed by Covid-19. Results indicate that AR, VR and AI have the potential to become in the near future the norm in the fashion media and technology ecosystem, reinforcing the digitization process of the industry.

Keywords: Virtual Reality; Augmented Reality; Artificial Intelligence; Fashion; Covid-19.

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Virtual and Augmented reality

VR and AR seem to be the new hype technologies in fashion retail and events, mainly for their interactivity. The use of interactive media has been one of the most relevant trends in the last years: just think of Pokemon Go, an AR app that became famous worldwide. In this era where the stimuli from media never leave us alone, it seems that people are looking for even more. It is not enough to browse social media, e-commerce sites, shops. Customers want to be surprised and involved. According to Neiman Marcus, even the concept of Omnichannel approach, which was set as the new trend only few years ago, will become obsolete: the Omnichannel approach links media together, making them work as one channel with different touchpoints.[1] The new approach is what Neiman Marcus calls Seamless Retail, which means to create experiences with any kind of touchpoint, like media, shops, websites, catwalks.[2] The key word for this new trend is experience, not only as a memorable shopping experience, but as a proper aesthetic experience that involves and even enhances our sensory perceptions. As fashion brand flourish, becoming everyday more numerous, the competition to obtain customer loyalty is incredibly high. VR and AR seem to be the new solution to create an online memorable experience, to differentiate one's brand from competitors and to create powerful and immersive storytelling. After Shopify added the possibility to all merchants to add AR 3D models, conversion rates increased by up to 250%.[3] This is part of what is called Engagement Marketing. Engagement Marketing is based on the idea to actively engage customers:

> "Engagement Marketing, done well, means connecting with audiences who want to hear from you, in relevant, meaningful, interesting ways. If you can pull that off, everything changes. It's a deceptively simple idea. The ability to psychologically connect with an audience — to move people emotionally and drive action — has always been paramount to successful advertising and marketing. It's never been about simple tools or tactics."[4]

In particular, with AR and VR brands are able to create a deep and meaningful engagement based on senses, on gamification. The Covid19 brought the importance of digital to evidence. With most of the stores closed, fashion brands had to bet everything on social media and e-commerce. A report created by Business of Fashion and the McKinsey & Company highlighted the fact that:

> "Social distancing has highlighted the importance of digital channels more than ever and lockdowns have elevated digital as an urgent priority across the entire value chain but, unless companies scale up and strengthen their digital capabilities in the recovery phase of the crisis, they will suffer in the longer term. Consumers will continue to demand more in this space and brands must act fast to deliver."[5]

The report also stated that since digital channels can be less profitable than traditional physical retail, brands need to prioritize digital growth and create an over the top customer experience. This means that brands must differentiate themselves from competitors if they want to truly emerge. The solution can be AR and VR. Furthermore, it is possible to say that fashion has two main components: an impalpable one, which refers to the cultural significance of fashion and the ability that fashion has to incarnate desires and imagination, and a material one, that refers to the physicality of fashion items, and concerns materials and fabrics, quality, seams, and so forth. While online shops with pictures of garments can convey the impalpable side of fashion of a clothing piece, VR and AR can do much more and evoke more tactile and sensory experiences. VR and AR create what we could define a sensory and aesthetic

1. Jason Bloomberg, "Neiman Marcus: maintaining the personal touch in a digital world", *Forbes*, 2017, https://www.forbes.com/sites/jasonbloomberg/2017/11/21/neiman-marcus-maintaining-the-personal-touch-in-a-digital-world/.
2. Bloomberg, "Neiman Marcus: maintaining the personal touch in a digital world".
3. Maghan McDowell, "Fashion and beauty brands are taking AR more seriously",*Vogue Business*, 2020, https://www.voguebusiness.com/technology/forced-cancellations-remote-working-jumpstart-virtual-vr-ar-fashion-technology.
4. Greg Ippolito, "Engagement Marketing 101",*Marketing Daily*, 2012, https://www.mediapost.com/publications/article/171988/engagement-marketing-101-redux.html.
5. *Business of Fashion*, "The state of fashion: Coronavirus Report", 2020, https://www.businessoffashion.com/articles/intelligence/the-state-of-fashion-2020-coronavirus-update-bof-mckinsey-report-release-download.

experience as intended by Baumgarten, so as an embodied pleasing sensory experience related to the way human perceive the world. Baumgarten's aesthetic theory can be summarized as an approach that sees aesthetic as a way of knowing and perceiving the world through senses.[6] In AR and VR we fully live an experience which is based on our senses and perceptions. But how can we truly engage in this kind of experience? Technically speaking, according to Marino and Marfia, an aesthetic experience through VR and AR is reached thanks to two main factors: Immersiveness and Presence.[7] According to Mon-Williams Immersiveness is fundamental since without it we could experience symptoms such as nausea and headache.[8] These symptoms usually occur when our senses are overwhelmed and confused by a medium. According to the afore mentioned study by Marfia and Matteucci Immersiveness requires:

• A continuous environment where a person may freely move and look around.

• Consistent elements that a user may understand in terms of size, color and interaction patterns.

• An interactive scene where objects respond to the delivered stimuli, providing physical feedback (e.g., haptic interfaces) when, for example, touched.

• A coherent plot, which may support the development of user engagement.

This means that Immersiveness is in fact the replication of our reality in a virtual environment. In fact, a continuous environment, interactivity, a plot, and consistent elements are the structure of our own reality. To be truly involved in a virtual world, it is necessary to recreate the premises how we perceive ourselves and other objects, and this can be done through both intellectual and sensory stimulation. In other words:

> "A stirring narrative in any medium can be experienced as a virtual reality because our brains are programmed to tune into stories with an intensity that can obliterate the world around us … The experience of being transported to an elaborately simulated place is pleasurable in itself, regardless of the fantasy content. We refer to this experience as immersion. Immersion is a metaphorical term derived from the physical experience of being submerged in water. We seek the same feeling from a psychologically immersive experience that we do from a plunge in the ocean or swimming pool: the sensation of being surrounded by a completely other reality, as different as water is from air, that takes over all of our attention, our whole perceptual apparatus … in a participatory medium … immersion implies learning to swim, to do the things that the new environment makes possible … the enjoyment of immersion as a participatory activity."[9]

Presence, according to the International Society for Presence, is a psychological and sensory stage in which human beings live a technological generated experience, but part of the human perception fails to recognize the role of technology related to the experience itself.[10] To give an example, if we are involved in a virtual reality experience, we of course know that it is not reality. Nonetheless, we feel so engaged that, after a span of time, part of us forgets that the experience is only fictional, and this leads to a high level of engagement in the activity. Furthermore, our senses can't completely distinguish a real stimulus from an AR/VR one. Jerald listed four main components for achieving Presence:

• The illusion of being in a stable spatial place, in which people can interact with the surrounding objects.

• The illusion of self-embodiment to give users the feel of having a body, not necessarily theirs, within the virtual world.

6. Gustavo Marfia et al., "Some remarks on aesthetic and computer science", 2018, P.4-5. DOI:[10.7413/18258646059]https://www.researchgate.net/deref/http%3A%2F%2Fdx.doi.org%2F10.7413%2F18258646059.

7. Marfia et al., P.16.

8. Mon-Williams in Marfia et al., 17.

9. Murray, H.G. in Marfia et al., 17–18.

10. Lombard, M. in Marfia et al., 18.

• The illusion of physical interaction, with background sound, a sense of three-dimensionality of space and things, vibration of controllers and specific haptic devices to increase touchability.

• The illusion of social communication thanks to the communication through avatars, since people are naturally prone to communication.[11]

This explanation allows to better understand how VR and AR interact with us. A research conducted by Leanza and Balconi underlined how AR and VR experiences don't engage only in a psychological way with us, but also bodily: after watching commercials with Oculus spectators were shown to have an increase in the prefrontal cortex theta activity and greater SCL (Skin Conductance Level) in response to virtual reality commercials.[12]

Virtual reality and augmented reality for events and showrooming

Since Covid-19 broke out in march 2020, many things have changed. Fashion had to rethink its stance. The first thing that had to change, of course, was Fashion Week. Fashion weeks attract every year a multitude of fashion professionals, celebrities, designers, and fashion lovers. It is not hard to understand why, during the pandemic, the usual catwalks, photoshoots and crowds in Piazza Duomo couldn't take place. The first fashion week that was challenged by the virus was Paris Fashion Week. Most buyers, editors, and designers kept up with the schedule despite the fear. But according to Binkley, the general panic for Covid19 overshadowed the fashion week itself. She wrote:

> "The fixation on coronavirus, both the health concerns and the sweeping impact it's had on the luxury market, detracted attention from some excellent collections and several topics that have otherwise been top of mind in fashion lately. Talk of sustainability, a rampant discussion throughout New York Fashion Week, died to nearly a whisper."[13]

The fashion world emerged in all its resilience. But still, the efforts to maintain a physical fashion week in Paris debilitated the meaning of the week itself. Shortly after, Tokyo Fashion Week was canceled. It seemed that the fashion world had to reinvent the most important event of the year, and it decided to do it through technology. This summer took place the first all digital European fashion week: London Fashion Week. LFW decided to drop the men's catwalks and decided to create a mixed gender show, and to showcase on a digital platform new designs, virtual showrooms, podcasts and short films.[14] But are videos and podcasts enough?

> "The fashion show form has lasted for decades precisely because it works so well — in real life. There have been occasional attempts at change, mostly via"movies" that come off like music videos, but they have never been that successful. Generally that's because they prioritize mood and concept over being able to see the telling detail, or material essence, of a garment. And it's in that detail and essence that individual desire lies. There's an opportunity now to provide a different solution. What it demands though is not just recreating events, but rethinking them entirely".[15]

According to Friedman, what is lacking to digital fashion weeks is the sensory approach: the chance to see details in fabrics and decoration, the possibility to touch and interact with garments. So, a new

11. Jerald, J. in Marfia et al., 18.

12. Federica Leanza et al., "Consumer Neuroscience: TV commercials vs. virtual reality commercials", Poster, in Abstract Book of the 6th Meeting of the Federation of the European Societies of Neuropsychology, *Federation of the European Societies of Neuropsychology*, Maastricht 2017. P. 13. http://hdl.handle.net/10807/113414

13. Christina Binkley, "In Paris unceirtanty overshadows sustainability and diversity", *Vogue Business*, 2020, https://www.voguebusiness.com/fashion/paris-fashion-week-autumn-winter-2020-coronavirus-uncertainty-overshadows-sustainability-diversity.

14. London Fashion Week Website, accessed 09/2020, https://londonfashionweek.co.uk/schedule/88/london-fashion-week-digital-overall-highlights.

15. Vanessa Friedman, "Is this the future of the fashion show?", *NY Times*, 2020, https://www.nytimes.com/2020/05/02/fashion/coronavirus-digital-fashion-show.html.

approach is needed. The answer could be VR and AR. As we already said, VR and AR can recreate deep involvement and engagement. The chance to be submerged in a digital environment, and to interact with elements could be the answer to the problem that Friedman posed: "It's not about using XR to take us away from people; it's more about how the development of these platforms will connect us in ways we could never have anticipated."[16]

Companies like ORDRE could change the world of fashion events and shows forever. The company, founded in 2014 by Simon and Kirsten Lock, aims to facilitate the technological evolution of fashion brands:

> "The impact of the digital revolution, increased retailer competitiveness and other global economic factors have created significant disruption to traditional business channels. Fashion week schedules continue to be in a state of flux and the ability for retail buyers to be able to constantly travel to attend physical showrooms spread around the world, presents a range of logistical and cost related challenges."[17]

The services that the ORDRE company offers are numerous and avantgarde. An example is the virtual catwalk. ORDRE can create an avantgarde virtual reality fashion show: the company is able to provide VR headsets to buyers within the retail network to allow them to watch from a front row seat fashion shows and presentations from anywhere in the world.[18] This of course from the comfort of their own homes. The usefulness of this service is remarkable, especially when travel it is not always possible or recommended such as the case of the Covid19 pandemic. Another service that ORDRE can provide is the 360° degrees virtual showroom allows fashion brands to recreate collection in a realistic manner. Buyers can see details of fabrics and silhouettes, but also manipulate the 3D models to spin, zoom and review every part of the garment.[19] This interactivity and realism allows buyers to truly live and appreciate the collection and garments. But this possibilities shouldn't be limited to just showrooms and catwalks.

VR and AR for e-commerce websites

With the closure of many shops and the quarantine during the pandemic, fashion customers had to shop online. But even buying online was deemed as difficult, since health restriction delayed packages and it wasn't safe to go to the post office to send back unwanted items. Usually the main reason for the return of a package is the wrong fit, and VR and AR could be a valid solution to reduce unnecessary trips. Seeing a product in VR or AR not only would be useful for size testing, but can be also used to show products in a more realistic way, leading the customers to buy more and with less uncertainties. An example is the GAP AR app. Called the GAP "DressingRoom", the augmented reality app lets customers try on clothes anywhere using a Google Tango-enabled device: customers can customize an avatar based on your body type and size and see how the different pieces of clothing will look on them from different angles; furthermore if they're satisfied with the item, they can buy it straight from the app.[20] Furthermore, a study on how shopping with augmented reality influences positively brand responses by Smink, Frowijn, van Reijmersdal, van Noort and Neijens compared the effects of images and AR on customers. Customers were shown pictures of clothing on a model, on a model with their face, and through AR. Results were encouraging, in fact:

> "Results suggest that AR enhances perceived informativeness and enjoyment of the shopping experience, as opposed to both non-AR product presentations. Consequently, perceived informativeness leads to a cognitive process which enhances purchase intention and

16. Matthew Drinkwater in Maghan McDowell, "Forced cancellations jumpstart virtual fashion shows",*Vogue Business,* 2020 , https://www.voguebusiness.com/technology/forced-cancellations-remote-working-jumpstart-virtual-vr-ar-fashion-technolog

17. ORDRE, "About" section on official website, accessed 09/2020, https://www.ordre.com/en.

18. ORDRE, "About"section on official website, accessed 90/2020, https://www.ordre.com/en.

19. ORDRE Official Website Homepage, accessed 09/2020, https://www.ordre.com/en.

20. Liz Nunan,"Gap Tests New Virtual Dressing Room", *GAP Inc.* 2017, https://www.gapinc.com/en-us/articles/2017/01/gap-tests-new-virtual-dressing-room

> willingness to share personal data with the brand, while perceived enjoyment leads to an affective process which enhances attitude towards the brand. At the same time, AR is perceived as more intrusive, but against expectations, this does not lead to any negative effects."[21]

Data disclosure has been a hot issue in the last years, but it is interesting to notice how customers are more prone to give those kind of information to brands if they value the experience as worth it. Also, the study underlined how AR and VR can enhance the positive attitude towards a fashion brand. Another study showed how implementing AR in e-commerce platforms helps customers to feel a higher level of perceived ownership. Perceived ownership can be described as: "The sensation that something is"mine". [...] Perceived ownership translates itself into a reluctance to give up an object, as psychologically owning it is comparable to actual ownership, thus resulting in a higher valuation of the object."[22]

The aforementioned study by Brengman, Willems and Van Kerrebroeck showed that the perceived ownership is higher if customers used AR based apps, and this also leads to higher chances of purchase. Furthermore:

> "This study also demonstrates that allowing users to examine products marketed online in more detail by digitally touching them generates perceived ownership which appears to be generally more pronounced for products with material properties (i.e. requiring sensory information). Therefore, it is suggested that retailers should especially implement AR technology for products that require more than only written or visual information, but need to be inspected more thoroughly. This could particularly be interesting for retailers selling apparel."[23]

But with virtual reality not only one could see a virtual garment, but an entire fitting room or store. A study made by Donatiello, Morotti, Marfia and Di Vaio demonstrated how virtual reality fitting rooms can be used for fashion gamification.[24] The test group was made by fashion students, which are, according to authors, more difficult to satisfy as fashion customers. They tested what was called by authors as "Fashion Island", a prototype of a virtual reality fitting room, where members of the group as avatars could point, see, try garments in a peaceful environment like the one of an island in open sea. The results were promising, in fact most of the members of the test group found the experience pleasant and playful, and confirmed the authors' hypothesis of the use of virtual reality as an effective method to obtain gamification. A company is trying to make this studies into a daily reality: Obsess. The company is able to create virtual reality shops accessible even from the phone. From shops to showrooms for buyers, Obsess can bring fashion retail to the virtual world and this isn't all: the company also offers AR experiences for marketing, such as pop-up AR stores in the middle of the city.[25] From Tommy Hilfiger to Farfetch, the list of Obsess' clients is long and the service is high quality and easy to use. Using words from the Obsess website:

> "As retail foot traffic reduces due to the current health crisis, Obsess is enabling brands to invite customers to shop their stores 'remotely'. Right on their phones, while still getting the full brand experience. Utilizing proprietary VR technology, Obsess creates HD-quality

21. Anne Roos Smink et al."Try online before you buy: How does shopping with augmented reality affect brand responses and personal data disclosure", 2019. https://www.researchgate.net/deref/http%3A%2F%2Fdx.doi.org%2F10.1016%2Fj.elerap.2019.100854.

22. Pierce and Kahneman in Malaika Brengman et al."Can't touch this: the impact of augmented reality versus touch and non touch interfaces on perceived ownership",*Virtual Reality*, 23, 272–273 (2019), https://doi.org/10.1007/s10055-018-0335-6.

23. Malaika Brengman et al in Malaika Brengman et al. P. 278.

24. Lorenzo Donatiello et al."Exploiting Immersive Virtual Reality for Fashion Gamification", 2018. P. 19-21, https://doi.org/10.1109/PIMRC.2018.8581036

25. Obsess Official Website Homepage, accessed 09/2020, https://obsessar.com/.

> virtual versions of retail stores that are accessible and shoppable from anywhere in the world. Your virtual store could be up and running in 2 weeks."[26]

It is amazing to see how with modern technology it is possible to create an entire virtual showroom or shop in only two weeks. The ease of use of those new applications and also the short time span needed to create functional VR spaces is promising and a sign that VR and AR are being integrated in the fashion media ecosystem and Covid19 is serving as a proper accelerator.

Artificial intelligence

Artificial intelligence was created many decades ago. The potential of this incredible invention was unlocked only recently and still today we can difficultly imagine the true outcome of the revolution that artificial intelligence is bringing to us. The key to understand why this is happening only now is data. Today the amount of data gathered by enterprises is enormous. Indeed, we talk about big data. Data is fundamental for artificial intelligence for learning, training and perfecting. From the web, to social media, to apps we have an infinite quantity of material to feed to artificial intelligence. Thanks to this advanced technology, we are able to analyze data like never before. In particular, the shift of paradigm from offilne to online and the digitazion of fashion practices generated an immense quantity of data. It is possible to find patterns and trends, to easily monitor users' opinions, to automatize tasks, to profile users and give them a customized experience.When it comes to fashion, it is impossible not to see how this industry could benefit from artificial intelligence. Fashion lives of social media, fast trends, fast manufacturing, retail. The entire fashion value chain could be disrupted and modernized by artificial intelligence. But this is not a choice anymore. Fashion customers are not only consumers but also creators. Trends are bubbling up from streets, blogs, social media. And furthermore, today clothes are cheaper then ever. This leads to volatile trends and fast paces in the fashion industry. While people bought 60% more garments in 2014 than in 2000, they only kept the clothes for half as long, and fashion companies went from an average offering of two collections per year in 2000 to five in 2011, with the Zara's record of 24 collections per year.[27]In this period of uncertainties, it is important for fashion brands to harness all this information and to use it as a warhorse and not as a weakness. Artificial intelligence can be used to predict future trends according to what kind of garments are posted on social media or to opinions written on brands' profiles. It could also be uses to profile users and even to automatize fashion manufacturing, making it easier for fashion brands to create last minute collections or items and to keep up with the production even with Covid19 restrictions or similar. But the key issue will be to reinforce and implement new technologies such as AI on e-commerce websites since they are becoming everyday more relevant as shopping channels, especially during and after the pandemic: the global e-commerce sales are projected to touch $4.8 billion by the year 2021 and Gartner predicts that around 80% of all customer interactions will be directly managed by AI technologies by 2020.[28] This means that, potentially, AI could be integrated in every single phase of fashion production, from design to sales, and modernize the entire supply chain.

AI for fashion design and trend prediction

Before artificial intelligence, there were traditional forecasting agencies. Agencies such as MSGM served as a guide for fashion companies to better understand the new trends affecting the general public and how to implement them through colors, fabrics, shapes. But with AI, each company and designer is

26. Obsess Official Website Homepage, accessed 09/2020, https://obsessar.com/.

27. Morgan Mc.Fall-Johnsen, "The fashion industry emits more carbon than international flights and maritime shipping combined. Here are the biggest ways it impacts the planet",*Business Insider,* 2019, https://www.businessinsider.in/science/news/the-fashion-industry-emits-more-carbon-than-international-flights-and-maritime-shipping-combined-here-are-the-biggest-ways-it-impacts-the-planet-/articleshow/71640863.cms

28. Countants, "How Artificial Intelligence is transforming the E-commerce Industry", *Medium*, 2019, https://medium.com/@Countants/how-artificial-intelligence-is-transforming-the-e-commerce-industry-countants-scalable-custom-73ae06836d35.

able to predict trends influencing their personal audience autonomously. The more probable shift that will involve forecasting companies will be that their practices will focus more and more on the use of data. An example is Heuritech. Heuritech is a fashion trend forecasting agencies which relies only on the use of artificial intelligence and their own deep neural network: among their clients it is possible to find Louis Vuitton, Wrangler, Paco Rabanne, Adidas, Dior, Jimmy Choo and Lee.[29] They developed an image recognition technology to analyze fashion images that come from social media, in particular from Instagram and Weibo, and they do it with different steps that here will be briefly explained:

• Audience definition: the first step is to define the audience that needs to be analyzed. According to Heuritech, their approach is holistic. They look for accounts that have interest in fashion and then collect random samples to create panels of users.

• Image analysis: images are collected from panel accounts and categorized. After that trendy products with key trend components are detected. To be sure that a product is truly a trend, the volume of images found with the product is analyzed to ensure the reliability of data.

• Predict the trend: they use algorithms to predict the behaviour of a trend up to a year in advance and to predict early signals of fashion trends in subcultures and edgy influencers, then use another algorithm to unify all the forecasts on fashion items that have been traced.

• Inform fashion brands: the last step is to publish the results of trend prediction on a platform called The Suite, from where fashion designers and merchandisers can take inspiration and informed decisions on their next products.[30]

It seems that in the next future, design choices will be more and more data driven and designers will more and more create garments according to the digital trends and patterns analyzed and discovered by AI.

AI for manufacturing

The main aim of implementing AI technologies in garment manufacturing would be to automatize some of the activities, developing a more efficient production. As previously said, the automation could be a precious resource in uncertain times like the one of the Covid19 pandemic. During the Coronavirus crisis fashion production and selling was halted. In fact, due to health reasons, it was almost impossible to open factories and to receive merchandising from production hubs. A solution for this type of crisis could be the automation or semi-automation of production with robotics and AI, but this could also shift the locations of production, moving it from countries like Vietnam and Bangladesh to the countries where fashion brand are located:

> "From a lead firm perspective, Industry 4.0 unlocks new labour-saving technologies which could potentially reduce reliance on low-skilled, low-cost labour in manufacturing. This has implications for the global geography of production, as value chains can be expected to become more regional in nature, moving closer to key final consumer markets in China, the European Union, Japan and the United States."[31]

The tasks that can be automated in manufacturing are numerous. Wong et al. created a stitching and classifying technique based on wavelet transform and BP neural network. Five classes of stitching defect like pleats, puckers, tension, skipped-stitches and holes were analyzed and classified: results demonstrated

29. Heuritech website, "Success stories" section, accessed 09/2020, https://www.heuritech.com/success-stories

30. Heuritech website, "How Heuritech forecasts fashion trends thanks to AI", 2020, https://www.heuritech.com/blog/articles/how-heuritech-forecasts-fashion-trends-thanks-to-artificial-intelligence/

31. Adnan Serič et al. "Managing COVID-19: Could the coronavirus spur automation and reverse globalization?", *Green Industry Platform,* 2020, https://www.greenindustryplatform.org/blog/managing-covid-19-could-coronavirus-spur-automation-and-reverse-globalization.

that the method was very accurate in detecting and classifying stitching defects.[32] Zhang et al. developed an automated inspection model based on genetic algorithms and neural network to detect and classify colored texture fabric defects also suitable for garment-stitching defects.[33] But AI moved even further: today it is possible to evaluate and quantify garments' sensory comfort, thermal properties and appearance with algorithms. Indeed, Pavlinic and Gersak presented an intelligent system for predicting garment appearance quality: authors highlighted that the system can be used in engineering predictions and garment design, while representing an objective technology of measuring and evaluating garment appearance quality.[34] Al-Rashidi et al. used a neural network to predict the thermal insulation values of children's school wear in Kuwait classrooms: results showed that the ANN was able to give an accurate prediction of the insulation value.[35] According to Abd Jelil the main advantage of using AI- based technologies like automated systems in manufacturing resides in the fact that are not, indeed, human: "The main advantage of using an automated visual inspection system is that it does not suffer from limitations of humans, such as exhaustion, while offering the potential for robust defect detection, leading to reduced cost and time-wasting". But even with all of these advantages in the use of AI in manufacturing production, AI-based technologies aren't widely used. According to Abd Jelil the reasons are multiple. The costs are still high for implementing AI in manufacturing, there still is a lack of confidence in AI- based systems and the scarce insight of how neural network work leads to a "black box situation".Furthermore, according to Abd Jelil, there also is a more human cause:

> "AI interference in human roles can cost jobs for a considerable share of our manpower. Hence, critics might lobby against extended AI implementation. Cultural resistance to change also high on the list of practical challenges provided by respondents will be a tougher nut to crack for many apparel companies."[36]

This means that, even if AI advantages are high and undeniable, the limitations are also high. From seaming, to stitching, to defect detection up to aesthetic evaluation workers would need to adapt to the presence of AI and automation of tasks. For an apparel company this means not only an investment in terms of money, but also in terms of human effort. Some jobs could be totally automated, eliminating what can be defined as human fallacy. The question is if this is ethically correct, since the same technology that could protect companies and workers from the effects of Covid19 could eventually exacerbate the unemployent crisis created by epidemic. For these reasons there could be a resistance to the introduction of these technologies. But it can be also possible to have a different perspective on AI. Could AI-powered technologies create better working conditions and ensure the respect of sanitary rules? The question is if it could be possible to develop a transparent fashion manufacturing, where AI could be not a substitute to workers, but a resource. According to Bak, it would be possible to unite the advantages of blockchain and AI, with technologies such as video analytics which involve facial recognition, movement detection and so forth, enabling a strict control of fashion brands over production sites and so guaranteeing to customers and workers the certainty of the respect of safety measures:

> "In China, facial recognition is being used to take attendance in schools. In a factory setting, facial recognition could serve a similar purpose. It could tell if the same garment worker is working longer hours than allowable under local labour laws. In a factory setting, knowing how many people are on the floor could help check for compliance for fire regulations, and tracking movement could indicate whether workers are getting appropriate breaks along with the number of hours they're working in a day."[37]

32. Wong and Leung in Rahdia Abd Jelil, "Review of Artificial Intelligence Applications in Garment Manufacturing", P. 102, In: Thomassey S., Zeng X. (eds) "Artificial Intelligence for Fashion Industry in the Big Data Era. Springer Series in Fashion Business". *Springer,* Singapore.

33. Zhang et al. in Abd Jelil, P. 98.

34. Pavlinic and Gersak in Abd Jelil, P. 116.

35. Al-Rashidi et al. in Abd Jelil, P. 115.

36. Rahdia Abd Jelil. in Abd Jelil, P. 118.

37. Gina Bak, "Fashion, Blockchain, & AI, … Oh My!", *Medium*, 2019. https://medium.com/swlh/fashion-blockchain-ai-oh-my-afc161db3fdf.

These same technologies could be used also to guarantee the respect of sanitary rules and social distancing in production sites. This also applies to warehouses, where AI could be used both for monitoring the safety of workers and to automatize tasks. In the future it could be possible to completely automatize the sorting system by using AI to reduce mistakes and human fatigue in fashion warehouses. The pioneer in this field is of course Amazon:

> "Several types of robots are currently"employed" at Amazon fulfillment centers. Palletizers are robotic arms with grippers that identify and grab totes from conveyor belts and stack them on pallets for shipping or stowing. Another type of robotic arm, the robo-stow, lifts pallets of inventory to different levels in fulfillment centers or places them on drive units to be carried to their next destination. Currently, Amazon has 100,000 drive units in locations around the globe as well as six robo-stows and 30 palletizers".[38]

Another leader in the field is Uniqlo, which is heading towards full warehouse automation at its flagship warehouse in Tokyo. Uniqlo has partnered with a Japanese startup that develops industrial robots called Mujin to create a new two-armed robot able to pick up and box clothes, enabling the Tokyo factory which has until now replaced 90% of its workers with robots, to be completely automated.[39]

AI for e-commerce websites

During and after the pandemic, the shift to online shopping was exacerbated. Artificial intelligence can be efficiently implemented in e-commerce websites to enrich the shopping experience. Different fashion brands are today using the subscription model for their business to give each customers a highly customized experience and to gain precious insights on their garments. The most interesting approach is the AI-powered targeted subscription. This type of service resembles a personal stylist service, as in the case of StitchFix, where the customer does not know which products they will receive and a major part of this service is indeed predicting what they will like.[40] The products are recommended to customers according to their answers to survey questions and feedbacks on products they already received. This kind of services uses algorithms able to decipher customer's preferences and to confront them to reduce the amount of items that users go through to find something they like. The most sophisticated approach is the user-based approach, where recommendations are based on users similarities. This type of service is already widely used, as in Amazon and Netflix, but it is also being employed in fashion e-commerce websites. A champion in channeling data and AI for fashion e-commerce is indeed StitchFix, who uses user style quizzes and sophisticated algorithms to predict user's necessities and to tailor the service. Another use of AI in fashion e-commerce platforms can be chatbots. Artificially intelligent chatbots are built to interpret natural language used by humans and can give answers to inputs that are not exactly pre-defined. According to Leanne Luce, specialized chatbot services will become the norm for fashion brands looking for AI-assisted product discovery, product care, and customer service.[41] Today customers use their Iphone to navigate on e-commerce websites, and chatting has become the most popular method of communication, especially for younger generations. Ubisend studied the users' reception of chatbots and retrieved promising data: 47% of consumers would buy items from a chatbot, 35% of consumers want to see more companies using chatbots and 57% of consumers are interested in chatbots for their immediacy.[42] For what concerns fashion chatbots, ASOS's Enki is probably

38. Amazon website, in About Amazon Staff, "What robots do (and don't do) at Amazon fulfillment centers", https://www.aboutamazon.com/amazon-fulfillment/our-innovation/what-robots-do-and-dont-do-at-amazon-fulfillment-centers#:~:text=The

39. Mary Hanbury, "Uniqlo's robots have already replaced 90% of its human workers at its flagship warehouse, now they've cracked the difficult task of folding T-shirts", *Business Insider*, 2019. https://www.businessinsider.in/tech/news/uniqlos-robots-have-already-replaced-90-of-its-human-workers-at-its-flagship-warehouse-now-theyve-cracked-the-difficult-task-of-folding-t-shirts/articleshow/72954478.cms.

40. Leanne Luce, *Artificial Intelligence for Fashion: How AI is Revolutionizing the Fashion Industry,*2019, *Apress,* P. 92.

41. Luce, P. 23-24.

42. Ubisoft website, "2020 Chatbot Statistics - All The Data You Need", 2017, https://blog.ubisend.com/optimise-chatbots/chatbot-statistics.

the most famous.

Conclusions

Every time a new technology appears, it is almost impossible to predict what paths it will follow. We saw it with internet and social media, that started as inventions even detracted by parts of the general public. Today we couldn't live without them. For now it is hard to tell if AR, VR and AI will all follow the same path. What is clear is that they are entering our lives and our methods of creating, selling, experiencing. During the pandemic AR, VR and AI invited fashion brands to expand their horizons, and the fashion world should take this chance to create and drive innovation. In particular, VR and AR have the potentiality to become a widespread technology in the last steps of the value chain, especially for online retail issues such as virtual fit, and the gamification of the shopping experience. It can be said that VR and AR could be the future of online shopping platforms, and will be extremely resourceful in the quest of recreating a sensory shopping experience online. AI is an agent of drastic change in all the compartments of today's society, and of course in the fashion field, and it can be implemented in all or most steps of the value chain. Forecasting companies and designers will rely more and more on artificial intelligence to achieve accurate and fast predictions. AI automation could become a central issue after the Covid19 pandemic especially from the health and work safety point of view. Furthermore, paired with blockchain, AI could ensure an almost total transparency in the production and logistics compartment. Finally, the use of AI is and will be extremely successful in online retail, where artificial intelligence is leading in pursuing customization and an excellent customer experience. This of course will empower even more the strength of e-commerce platforms, already enforced by the shift which happened during the pandemic.

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