VIRTUAL MEMORIES: ARCHIVAL KNITWEAR THROUGH 3D MODELLING SOFTWARE AND NEW MEDIA

I. Sapuppo, M. Motta

Politecnico di Milano (ITALY)

Abstract

The need to adapt archival knowledge to new technologies has always been a crucial part of the transmission of said archives [1] furthered in recent years by the digital transition of knowledge and cultural change driven by industry 4.0 and 5.0 [2]. In this framework, knitwear archives have started to digitalize their pieces, but today there appears to be a lack of development in the virtualization of assets through 3D modelling software, under the impression that it is impossible to achieve realistic digital twins of knitwear clothes [3]. Trying to develop knitwear archival fashion with 3D modelling techniques paves the way for overcoming physical limitations in educational and informative fields, other than being in line with the history of knitwear, which has always been a pioneering innovation in the design process. This research aims to investigate the best method of virtualization of knitwear archival pieces through 3D modelling software, with the aim of using said digital twins for educational and promotional purposes. To do so, the research was conducted starting from the knitwear production of Gianfranco Ferre, preserved into Gianfranco Ferré Research Centre, exploring the crucial points of this production and the main focus to be transmitted through digital technologies. Data about pre-existent 3D fashion modelling software was acquired through first-hand research and the selection of pieces was virtualized combining previously set knowledge and new methods of utilization of software. The results, their possible improvements, and implications for the field have been interpreted with analytical critique. The research shows interesting developments for the virtualization of knitwear pieces with educational and promotional purposes, suggesting a method of use of non-specific software and a way to overcome physical limitations in the transmission of archival knowledge. Moreover, it is intended as an inspiration for further software development, in order to facilitate the future seamless virtualization of knitwear.

Keywords: Education, Knitwear, Virtualization.

1   INTRODUCTION

Traditional archives are undergoing dematerialization, transitioning from physical preservation to interactive and engaging virtual representation, supported by digital technologies and new media [4] This shift takes place thanks to the changes provoked by the widespread of the Industry 4.0 model in all aspects of culture and industries, that has normalized the use of new technologies like the digital twin and the exploitation of cyber and digital technologies [2]. This paradigm shift enables a more dynamic and engaging consumption experience, expanding the boundaries of access to archival knowledge [5]. The valorisation of a fashion brand's heritage through the preservation and utilization of its archives is crucial to stimulating the creativity of designers and scholars and narrating the brand's history to the public [6]. The use of digital technologies and the virtualization of archival material foster innovation in the knowledge consumption process, allowing for the reverse engineering of archive garments. This process involves acquiring information, simulating digital models, and rendering objects through augmented or virtual reality [7]. The spectacularization of informational content serves not only an aesthetic purpose but also aims to engage the audience and communicate the brand's heritage through edutainment [8], effectively blending entertainment and educational purposes. Digital technologies such as the creation of virtual garment models democratize access to the cultural heritage of fashion archives, transforming the archive into a knowledge space accessible to a wider audience [9]. The virtualization of archive garments ensures dynamic preservation over time, allowing users to interact with and explore the material in original ways. The rapid evolution of 3D models has revolutionized fashion production, permeating multiple aspects from creative ideas to artefact preservation. However, experimenting with 3D models in archives and fashion dissemination has encountered significant challenges, especially concerning knitwear garments, and examples of archival virtualization are scarce [10]. The complexity of 3D modelling often fails to fully capture the unique nature of knitwear, resulting in disappointing outcomes [3]. Nonetheless, there are initiatives seeking to overcome these limitations, with projects exploring advanced solutions for 3D modelling of knitwear garments. These efforts represent a step forward towards a more authentic digital representation of knitwear, promising a more compelling virtual

experience. In conclusion, although there are challenges to address, technological evolution and the determination of innovators promise significant progress in the future, opening new possibilities in the digital representation of fashion and archives. The objective of this research is to identify the most suitable 3D modelling software for virtualizing knitwear archive garments, assessing the possibility of obtaining satisfactory and high-quality results considering the challenges associated with 3D representation, with an emphasis on the potential of practice in fashion and archives and the exploration of advanced solutions to capture the complexity of knitwear through 3D modelling. This first objective is then followed by the intention of defining future scenarios of the use of the virtual archive for promotional and educational purposes.

2   METHODOLOGY

The first section of this research focused on defining the action context of the Gianfranco Ferré Research Center, to identify possible developments for archive virtualization and digitization. The Gianfranco Ferré Research Center aims to integrate the historical and cultural richness of the Ferré Foundation with digital innovation, contributing to shaping the future of creative and cultural industries through interdisciplinary research. It offers access to over 3000 archival garments through a digital platform exclusively available on-site, but its static and elitist approach could benefit from more advanced and inclusive software solutions to promote effective democratization of access to knowledge in the fashion field. The study of these garments, their cataloguing, and preservation was conducted by the undersigned and fellow master's students in Design for the Fashion System at Politecnico di Milano. During this phase of the research, the condition of the knitwear garments and the potential repercussions of their virtualization were analysed, including ensuring the preservation of the garments' condition over time, as well as finding new and interesting ways to experience them (fig. 1).
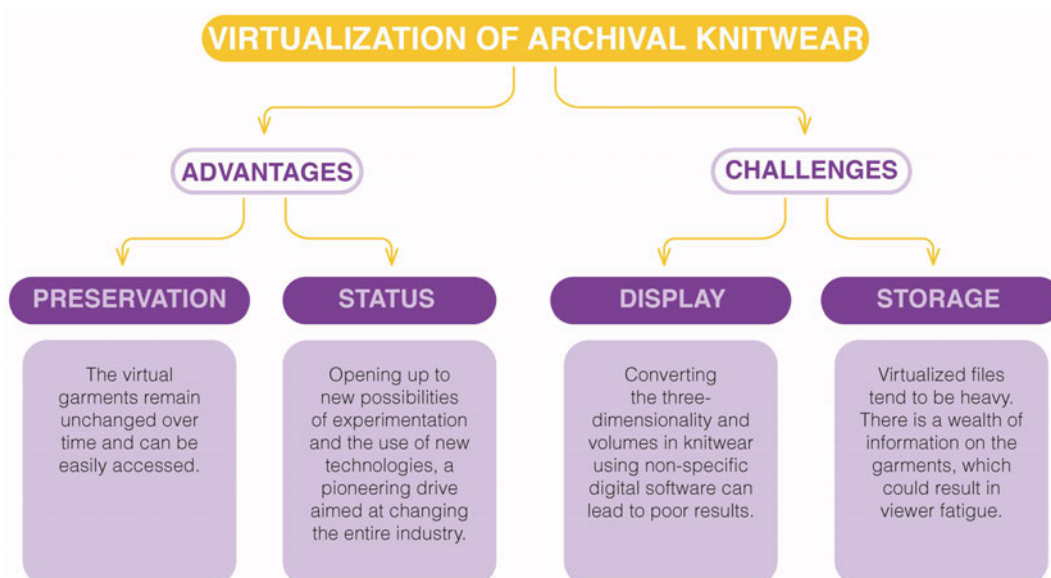

Figure 1. Advantages and challenges in virtualizing archival knitwear

Through field research on the organization of the Gianfranco Ferré Research Center and desk research on knitwear archives such as Missoni, Deanna, and Spadafora, fundamental parameters for knitwear archiving were defined, divided into those related to immaterial inspiration (description, collection, context, family of garments) and material aspects (stitch pattern, stitch description, size, material, category). This phase was followed by a desk research analysis conducted on software such as Shima Seiki APEX, Clo3D, Marvelous Designer, and Optitex [11-14], according to the parameters described in tab. 1, to identify the most suitable digital representation software.

Table 1. Parameters in software's analysis

PARAMETER		PARAMETER	
REALISTICITY	Ability to achieve a realistic final outcome	ONLINE MANUAL	Possibility to download a user manual
ACCURACY	Level of precision in details and textures	POPULARITY	Derived from the count of visits obtained in a month
KNITWEAR RELATION	Specificity for knitwear garments or lack thereof	FREE TRIAL	The possibility to try the program for free
REAL-TIME VIRTUALIZATION	Possibility to observe the work in real-time	COMUNITY	The presence of an online community that allows for the exchange of opinions and advice
ADDITIONAL LIBRARIES	The ability to download additional libraries	SYSTEM REQUIREMENTS	Minimum system requirements needed
ECONOMIC ACCESSIBILITY	Software's purchase price	COMPATIBLE FILES	What files can be imported and exported
INTUITIVITY	How basic functions can be mastered	SPEED DOWNLOAD	Time required to install the software

The methodology to effectively narrate archive garments through the potential of digital technology was then identified, considering the notion that the consumption of knowledge within fashion archives is not limited to a celebration of the past, but extends to fuelling creative rediscovery and progress [6]. One way to address the problem of selecting garments to create efficient and impactful narrative forms is through the adoption of the archetype notion to create detailed communication systems within the fashion archive. In the words of the philosopher Carl Gustav Jung, the archetype is a "*primary or primordial mental representation concerning the collective unconscious of every culture or historical period*" [15]. Archetypes, therefore, are nothing more than symbolic categories that everyone possesses in their own unconscious, which help form collective cultures and mentalities and drive individual subjects towards their inner evolution. The substantial difference between Jung's philosophical archetype concept and that of the fashion archetype is its materiality. In fact, while the concept of a philosophical archetype is confined solely to the human unconscious, and its material manifestations proposed by Jung are merely simplifications; on the other hand, the fashion archetype, as an exemplification of tangible matter, cannot be separated from its material declination and its concrete form. The adoption of the archetype concept to narrate archival material proves particularly effective for work within the Gianfranco Ferré Research Center. This is because the work of the Fashion Architect, even more than that of his colleagues and contemporary designers, is always based on the re-elaboration of archetypal models, further developed in the concept of the white shirt, iconic of the designer. As for Ferré's knitwear production, it is not possible to identify a recurring garment on which the designer focuses his research and experimentation. On the other hand, knitwear garments are intrinsically linked to the concept of matter, dear to the designer, precisely because of their more tactile and three-dimensional nature. For this reason, the pilot study was conducted on four knitwear garments connected to four different interpretations of matter described by Ferré in his Fashion Lectures: *pure, reinterpreted, invented, and alchemical* (fig. 2) [16]. The various definitions of matter previously explained thus identify themselves as different categorizations to derive a narrative through archetypes that are effective, impactful for the user, and relevant to the reference raw material. The study of the garments followed five steps. The first analysis was thematic, regarding the collection year and theme, the connection to Ferré's material theme, and the analysis of the material present within the Research Center. This was followed by the photographic mapping of the garment, technical analysis including the type of model, its details, and the reconstruction of the stitch pattern. Finally, the pattern of the garment was reconstructed, thanks to the measurements taken during the photographic mapping.
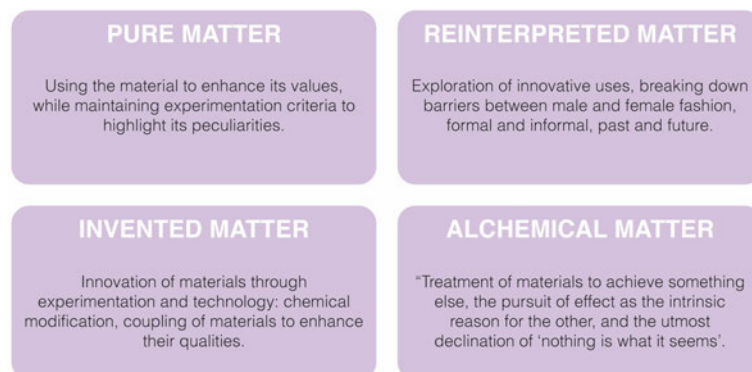
PURE MATTER

Using the material to enhance its values, while maintaining experimentation criteria to highlight its peculiarities.

REINTERPRETED MATTER

Exploration of innovative uses, breaking down barriers between male and female fashion, formal and informal, past and future.

INVENTED MATTER

Innovation of materials through experimentation and technology: chemical modification, coupling of materials to enhance their qualities.

ALCHEMICAL MATTER

"Treatment of materials to achieve something else, the pursuit of effect as the intrinsic reason for the other, and the utmost declination of 'nothing is what it seems'.

Figure 2. Ferré's categorization of matter

3   RESULTS AND DISCUSSION

The desk research on digital modelling software yielded results aimed at highlighting the peculiarities of each program and choosing the most suitable for developing digital models of archival knitwear. According to the parameters previously outlined (tab.1), this analysis narrowed down the field to two among those under examination: Apex Shima Seiki and Clo3D (fig. 3 and 4). The comparison between the two software options saw the latter triumph in the selection for virtualization. Despite Shima Seiki's software being more suitable for the specific virtualization of knitwear, the program is designed to be a tool for programming electronic knitting machines, which brings with it a series of usage complications that are not conducive to the purpose of this paper. Furthermore, in the perspective of urging fashion archives to use 3D modelling programs to virtualize their garments, and consequently using digital models for promotional and instructional purposes, it was decided to opt for the software with greater ease of use and economic accessibility, as Clo3D proved to be. Additionally, it was chosen to proceed with the creation of the textures necessary for high-quality virtualization of knitwear garments through the Adobe 3D Substance Sampler software, which manages to reconcile ease of use and realistic rendering through the use of AI technologies and a texture creation system based on images.
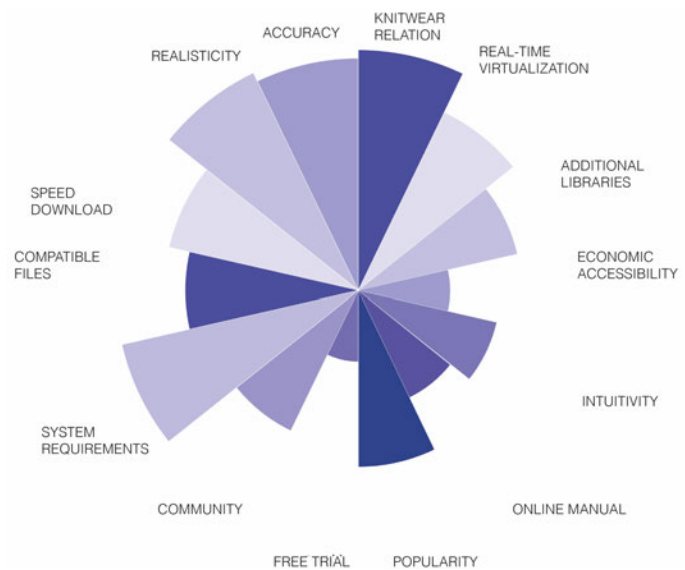

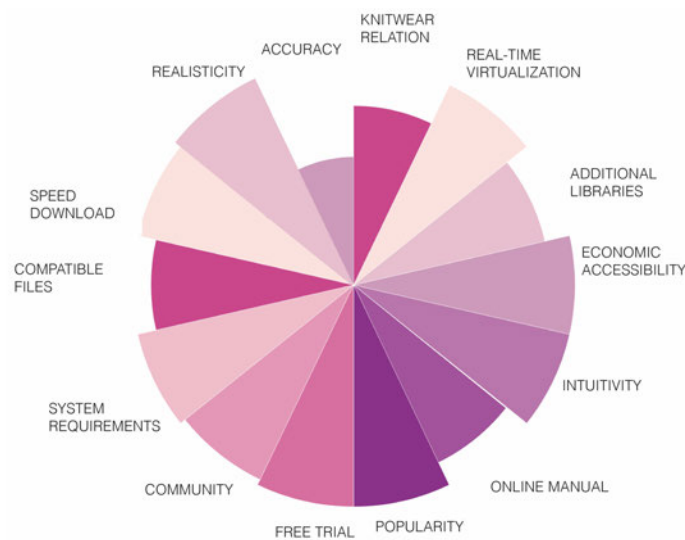*Figure 3. Apex Shima seiki analysis*

Figure 4. Clo3D analysis

Following the selection of the virtualization program to be used, the four archetypal garments of the pilot study were selected according to the methodology outlined. In the context of this article, only one of the chosen cases will be reported as a case study, that of the sweater belonging to the F/W 1985 collection (fig. 5).

Figure 5. Gianfranco Ferré, PaP 1985

Thematic analysis has highlighted how the F/W 1985 collection presents itself as a bold fusion of greys and blacks with more vibrant and saturated tones, creating a fascinating balance between sobriety and eccentricity. Ferré's architectural and volumetric approach emerges distinctively in knitwear, where the design is conceived in 360° degrees. The traditional ribbed edges of the knitwear take on a prominent role, becoming structural elements that extend disproportionately and connect the various pieces of the collection. The bright purple sweater is the perfect testament to the concepts encapsulated within the collection. This is because the construction of its shape is a clear reference to the theme of reversal: in fact, the front of the sweater has the same shape as what would canonically be a back. The reversed use of front and back, but also the reinterpretation of the rib stitch on the bias, place the garment fully within Ferré's concept of 'reinterpreted material,' as these design choices are inspired by the recoding of established rules. The photographic mapping of the garment (fig. 6) allowed for analysis at a technical level, highlighting how the knit structure is treated as if it were fabric. The placement of the pieces was done on the bias to create the herringbone pattern with the ribs, which have a 2/1 ratio. The shape of the sweater is very wide, thanks also to the kimono cut of the sleeves. It features an opening on the back, which is constituted only by a small part of the back of the sleeves, to which two high 2:1 ribbed edges have been applied via a serger machine that is also applied—folded—along the entire bottom edge of the sweater. It was then possible to reconstruct the pattern directly within the Clo3D software and proceed with the virtualization process. The virtualization process was not without challenges, due to the nature of the previously analysed software and its relation with knitwear. The more apparent one was acquiring the optical properties of a knitwear garment, a problem that was solved with the use of imported textures created in Adobe Substance 3D Sampler and subsequentially imported into Clo3D and applied on patterns. It was also necessary to manually change the physical properties of the material on Clo3D, because there is no default material capable of giving a realistic impression of knitwear. Finally, there was a specific focus given to details, such as the texture typically given by carded yarn, obtained by giving and regulating the "fur" effect in the material on Clo3D, and the swelled edges, achieved by turning on the "elastic" effects on the digital seams. These devices were fundamental in leading to satisfactory results (fig. 7) combining ad hoc choices for virtualized knitwear and the use of textures created on Adobe Substance 3D Sampler.

Figure 6. Photogrammetry of the garment

Figure 7. Virtualization's results

Once the virtualization of the garments was completed, a digital platform was created, as a pilot example of how such virtualizations could be used for dissemination and educational purposes. The platform was designed with the goal of maintaining a quality of images that could do justice to the corresponding physical garments, containing all the information obtained through the reverse engineering of the same, and maintaining a structure that is both impactful and simple for user navigation. The entire experience within the platform is aimed at discovering Gianfranco Ferré's knitwear in the most in-depth way possible, thanks to the use of different views of the analysed garments, a mix of static and moving images, and the presence of technical information and inspiration and contextualization. The objective was to exploit the potential of digital platforms to create an accessible, customizable experience devoid of carefully selected and selectable information to avoid information overload. Furthermore, great importance is given to the user's ability to deepen and modify their experience according to their level of interest and knowledge regarding the subject, expertise and needs in terms of knitwear details and technicalities, thanks to numerous interactive but clear prompts that allow for viewing different information about the garments to the user's liking (fig. 8-9).
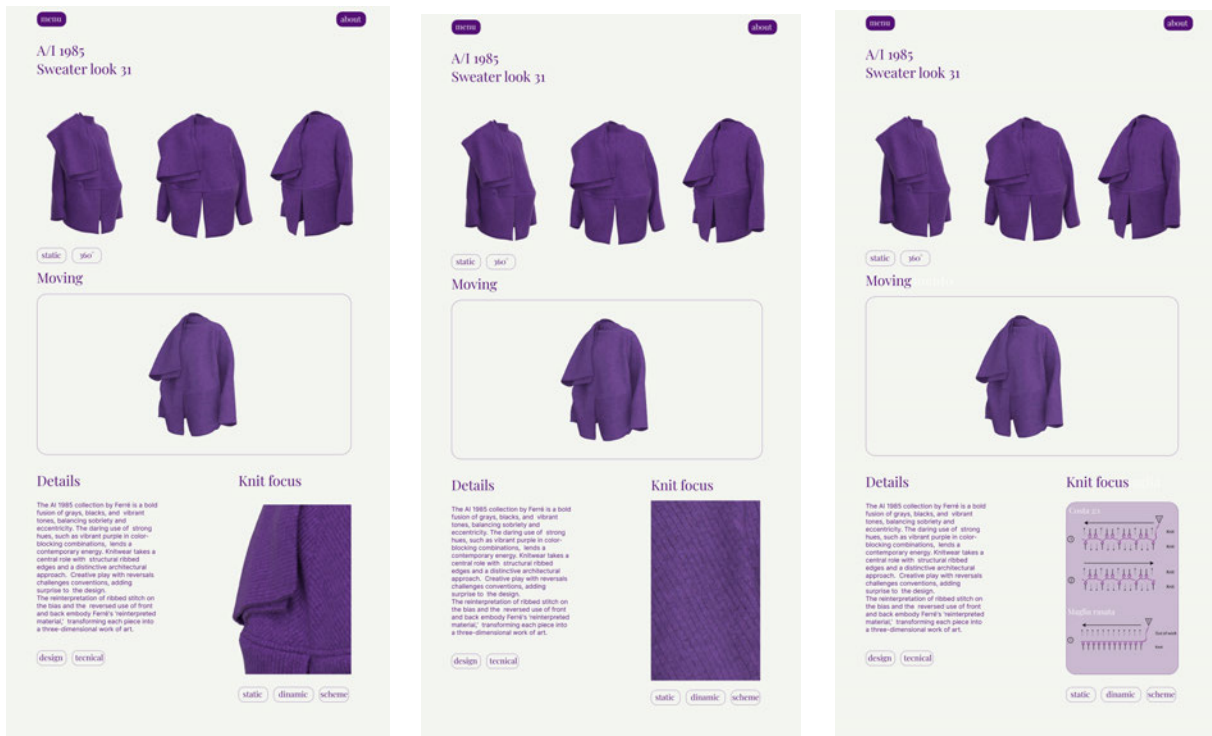
Figure 8. Screenshots taken from the digital platform.

Figure 9. QR Code of the digital platform's beta version

Thanks to a platform like this, the immense and valuable heritage contained within an archive like that of the Gianfranco Ferré Research Center breaks free from the static and elitist schemes typical of canonical archives and enters the context of dynamic and augmented archives of the future [9].

4   CONCLUSIONS

This study has delved into the challenge of realistically representing archival knitwear using 3D modelling software. Despite the challenges, this study highlights the potential of alternative solutions in the field of knitwear virtualization and paves the way for further research and development in this rapidly evolving sector. These developments aim to encourage future designers to always seek alternative solutions to solve possible issues in the virtual translation of garments. Furthermore, starting from the premise of preserving and valorising the heritage of the Gianfranco Ferré Research Center, efforts were made to overcome the limitations of existing software to achieve satisfactory results. Moreover, it has been acknowledged that a multifaceted approach is necessary to disseminate and transmit virtualized garments, including the use of online platforms. Although the digital platform created within this study has not yet been tested, its mere existence opens the door to a future of possible fruitful experimentation and democratization of knowledge with consequences on dissemination and teaching. In fact, the use of digital platforms, accessible at any time simply through an internet connection, would allow anyone

to experience a type of knowledge that would otherwise remain limited to the realm of physical consultation in the archive, thus expanding the learning opportunities for the general public.

Lastly, the same strategy could be implemented for educational purposes, stimulating students' desire to learn about fashion through the potential of the online platform in an easy, interactive, and personalized manner. This could possibly fuel the desire to learn more about the topics presented within the platform, which constitute a carefully selected part of a much larger and grander heritage. By exploring the intersection of technology and fashion heritage preservation, this study not only contributes to the advancement of virtualization techniques but also underscores the importance of leveraging digital platforms for educational purposes. Through the democratization of knowledge and the enhancement of learning experiences, future generations of designers and enthusiasts can gain deeper insights into the rich history and craftsmanship encapsulated within archival garments. In conclusion, the exploration of virtualization techniques for archival knitwear represents a significant step towards preserving, disseminating, and democratizing fashion heritage. By embracing innovative technologies and educational strategies, we can ensure that the legacy of iconic designers like Gianfranco Ferré continues to inspire and educate generations to come.

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