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ENHANCING PATTERN DRAFTING AND FASHION ILLUSTRATION USING CORELDRAW AND A GRAPHICS TABLET

Chipambwa Walter, Chikwanya Evelyn V, Chisosa Fadzai D
Chinhoyi University of Technology, Department of Clothing and Textile Technology, Chinhoyi, Zimbabwe

Abstract: *The purpose of this study was to develop techniques for computer-aided design (CAD) in fashion using CorelDraw a vector graphics software and a graphics tablet to produce technical fashion packs. The study adopted a design-based action research method to develop digital fashion illustrations and patterns. The study sought to solve the problem common among fashion designers of integrating CAD in their operations. Results revealed that designers can create complex digital fashion illustrations easily by using the graphics tablet and CorelDraw. The techniques explored in this study can assist fashion designers and pattern makers in quickly expediting the process of digital pattern development at the least cost. Digital fashion illustrations provide a better and more accessible format for customer design communication. The steps described in the study can assist early career fashion illustrators to easily combine their traditional physical skills with technology so that they can communicate their design ideas with much ease. In conclusion, the study recommends that more effort be made to encourage technology adoption through digital drawing and illustration in the fashion industry.*

Key words: CorelDraw, fashion, illustration, design, pattern

1. INTRODUCTION

Fashion design is a multifaceted field that encompasses various aspects, from conceptualization to the final execution of garments. Fashion design has three components: style design, construction design, and process design (Xu et al., 2016). The key task in sketch design is drawing or illustrating the fashion idea either on paper or on the computer. Construction design involves the way the pattern is drafted whilst, process design refers to the way the illustrated and drafted ideas are converted in a production system. All these design processes in fashion are critical as they feed into each other in the garment manufacturing process loop. McQuillan (2020) states that pattern drafting and fashion illustration are important practices in the world of fashion design. These processes not only involve creating unique designs but also ensure that they can be accurately replicated in the manufacturing process.

Pattern drafting and fashion illustration have a long history dating back to ancient civilizations. According to Tortora and Eubank (2009), in ancient Egypt, Greece, and Rome, garments were often draped directly onto the body to create patterns. As civilizations developed, pattern drafting techniques evolved, with the Industrial Revolution bringing mass production to the fashion industry. Pattern-making in the early days of industrial manufacturing was a painstaking process involving tailors creating unique patterns according to the measurements and preferences of their clients (Virmani & Singh, 2024). Authors (Gill et al., 2024; Huang et al., 2012; Virmani & Singh, 2024) do cite that technology has changed the garment manufacturing process as, pattern-making processes have evolved to be more sophisticated and imaginative, utilising computer-aided design tools and 3D modelling to enhance pattern creation. The introduction of computers in the late 20th century led to further advancements in pattern drafting and fashion illustration, with software such as CorelDraw, Gerber, and Adobe Illustrator making the process more accessible and efficient.

According to Biliakovych et al. (2024), digital fashion is transforming conventional design, production, and marketing processes, offering the novel potential for innovation, interactivity, and personalisation. Digital tools such as virtual reality, artificial intelligence, computer graphics, blockchain technology, augmented reality, and 3D printing are continually being integrated with traditional fashion elements in the development of the fashion sector. Amos et al. (2017) and Oppong, Biney-Aidoo and Antiaye (2013) report that one such tool that has gained widespread adoption is CorelDraw, a vector-based graphic design software that has revolutionised the way designers approach pattern drafting and fashion illustration. Wang, (2020) highlights that the adoption of computer-aided design software such as CorelDraw has transformed the graphic art design industry, allowing designers to effectively translate their concepts into realistic digital graphics. According to Xu et al. (2016), CorelDraw can manipulate and edit vector-based images thus enabling designers to create intricate patterns and illustrations with greater precision and

efficiency than traditional hand-drawn methods. The use of CorelDraw in pattern drafting and fashion illustration has not only streamlined the design process but also opened up new avenues for creativity and innovation. Fashion illustration is more aligned with the artistic impression of the fashion idea whilst pattern drafting is an engineering-based process as it involves precise calculations. Sinha (2001) highlights that the generic design process in fashion product development involves the illustration of the fashion idea and sample development through pattern drafting. Xu et al. (2016) opine that the adoption of computer-aided design (CAD) in these two processes improves efficiency and effectiveness of product development. Fashion flats, also known as technical drawings or flat sketches, serve as the blueprint for garments, showcasing proportions, details, and construction (Hagen, 2017). Traditionally, fashion flats were created in 2D form using pen and paper, but with advancements in technology, designers now have the option to utilize 3D fashion flats (Datta & Seal, 2018). Historically, 2D fashion flats have been the industry standard for designers to visualize their creations. Fashion designers would sketch their designs on paper, meticulously detailing each element of the garment and providing measurements for accuracy. This process allowed designers to convey their vision to manufacturers and pattern makers, ensuring that the final product matched the initial concept. Key figures in the history of 2D fashion flats include Rene Gruau, a renowned fashion illustrator known for his elegant and expressive sketches that captured the essence of the garments he depicted. Gruau's work inspired generations of designers to use fashion flats as a fundamental tool in the design process.

The process of fashion illustration and pattern drafting is usually executed in two stages by different individuals in most industrial setups. However, with the advent of technology, these two processes can be integrated to reduce errors in garment development. The adoption of digital methods for illustration and pattern drafting enhances efficiency, accuracy, and sustainability, reducing production time and improving pattern-making precision (Afifi et al., 2024). Small fashion design companies often face challenges in purchasing access rights to use the software requisite for illustration and pattern making such as Gerber and Clo3D as they are highly-priced. Investment in such software also comes with minimum hardware requirements that make it difficult for small production setups or freelance fashion designers to invest in CAD. The overall effect of these challenges is a lack of investment in CAD for fashion or a lack of appreciation of digital tools in fashion design.

This study seeks to explore ways of integrating fashion illustration and pattern drafting using CorelDraw and a graphics tablet (XP Pen DECO 01-V2) to optimize time and increase efficiency in clothing production. Such a method will make it easier for fashion designers to quickly sketch ideas that can be drafted into patterns as the software is affordable and does not have many hardware requirements. The focus of this study seeks to benefit small-scale companies that are into mass garment production and design.

2. LITERATURE REVIEW

2.1 Fashion sketching

There are two methods of producing fashion sketches or illustrations. The first is the traditional method of drawing by hand commonly referred to as manual fashion illustration (Liu, Zeng & Bruniaux, 2019). The second method is through the use of design software such as Adobe Illustrator or CorelDraw which can be referred to as computer-aided drafting (Marin & Bocancea, 2024). Both methods require good skills in drawing. Once a sketch has been developed the fashion idea has to be turned into a pattern. This process can also be accomplished through two methods namely, traditional hands-on pattern-making process or computer-aided pattern drafting. Industry-specific software such as Gerber Accumark, Clo 3D, Richpeace, Browzwear, OptiTex, and Tukatech can be used for the development of pattern making, marker making, grading, and virtual prototyping in the fashion industry. According to Marin (2022) and Puri (2013), digital drafting of patterns using CorelDraw enhances efficiency and accuracy, and allows for virtual simulations, promoting a shift towards digitalization in clothing manufacturing compared to traditional manual methods. Liu et al. (2022) also support use of CorelDraw in digital pattern drafting as they argue that it offers innovative artistic design, spatial expression, and efficient art creation compared to traditional methods, expanding creative possibilities in fabric design with computer technology integration.

According to Jhanji (2017), CAD for fashion can be divided into three major groups as shown in Table 1. Oppong, Biney-Aidoo and Antiaye (2013) noted that CAD has incredible tools that improve creativity and visualization of designs. CAD can make a design from scratch with colour and textures, these satisfy a creative's mind and artwork. In agreement with Chen, (2016) the use of CAD software greatly improves the working speed and efficiency as it avoids the effects of human error as compared to the manual operation

that takes much time resulting in wasted time (Amos et al., 2017). Authors (Dwivedi & Dwivedi, 2013; Tabraz, 2017) report that CAD software enables a garment to drape on a 3D scan image, which enables customers to see how the garment looks and fits before they purchase it. The virtual fit model on a 3D scan image reduces the cost and time involved in creating a physical sample or prototype. One of the key advantages of using CorelDraw for pattern drafting is the software's ability to precisely measure and scale design elements, ensuring accurate pattern development and fit.

Table 1: CAD for fashion design

		Examples	Attributes
1	CAD based software	Gerber, Clo 3D, Tukatech	Expensive, specialised,
2	Scaled down CAD software	Wild Ginger, Telestia creator	Less expensive, small companies, design houses
3	Vector graphic software	Adobe Illustrator, CorelDraw	Cheap, easy to train

Burke and Sinclair, (2015) affirmed that some designers in the fashion sector are using CorelDraw to draw mannequins and produce designs. Fashion designers construct a geometric jointed mannequin using the CorelDraw basic shape drawing tools, (ellipse, rectangle, and polygon tools) along with the trim and weld shaping options.

2.2 Application of CorelDraw in Fashion Design

Wang (2020) reports that CorelDraw has become an essential tool in fashion design education and the fashion industry at large, as it offers numerous advantages for creating detailed garment designs. One of its key strengths is that it enables clear visualisation of style structures, stitching, and fabric details, making it valuable for both students and professionals. According to Na'am, Achmadi and Ihsani (2021) integration of CorelDraw and Adobe Illustrator in fashion design curricula helps students develop technology-based skills necessary for Industry 4.0. CorelDraw is a vector-based software that allows one to create fashion illustrations that can be easily printed in different formats even when they are scaled thus providing numerous solutions quickly to the field of fashion design. Vector-based software allows high-quality output and maintains quality, which is critical for fashion presentations and marketing materials (Sugiarto et al., 2021). According to Datta and Seal (2018) traditional pattern drafting involves the manual creation of patterns, while digital pattern drafting with CorelDraw offers flexibility, efficiency, and accuracy in garment design, grading, and marker making in the garment sector. In the same vein (Puri, 2013) states that digital pattern drafting using software like CorelDraw saves time, offers more options, and enhances accuracy compared to traditional manual methods.

As digital technology continues to advance, the field of fashion illustration design has experienced a profound transformation, with CorelDraw providing the necessary technical support and creative freedom for designers to explore new avenues of expression. One of the key advantages of CorelDraw in fashion design is its ability to digitize the garment design process. The software's arbitrariness in drawing settings, unit and ratio adjustments, and file format interchangeability make it an ideal choice for digital clothing design (Trivedi, 2015). Designers can effortlessly create detailed clothing effect charts, accurately depicting the intricate stitches, fabrics, and patterns that define their designs. This digital approach not only streamlines the design process but also allows for greater experimentation and iteration, enabling designers to refine their concepts with ease. A study by Wiana (2017) concluded that there is a strong correlation (81%) between proficiency in CorelDraw and the quality of designs produced by students, highlighting its effectiveness in educational settings. Integration of computer image technology with CorelDraw has improved visual communication in fashion design, leading to more artistic and visually appealing clothing. This approach has shown a marked increase in the effectiveness of design presentations compared to traditional methods (Meng, Mok & Jin, 2012). While CorelDraw offers numerous advantages, some designers may still prefer traditional methods for their tactile and hands-on approach, which can foster creativity in ways that digital tools may not replicate.

3. METHODOLOGY

This study used the design-based action research technique. Design-based research method allows one to design, develop, and test the product or model and its applicability in responding to a design situation. According to Keskin and Kuzu (2015), design-based action research consists of four interactive phases. These phases include analysis of practical problems, developing of solutions, iterative cycles of testing and refinement of solutions in practice, and finally reflections and documentation for design principles. The four phases are similar to the design thinking process, a methodology popular in situational design problems. Townsend, Kent and Sadkowska (2019) highlight that action research allows for participatory co-design methods that foster collaborative creativity and information sharing among stakeholders. Design-based action research methodology is practical and iterative as it seeks to influence the practical decision-making process and offer possible solutions that can be evaluated. This method leads to a deeper knowledge of the underlying issues and their causes, with the researcher and the users collaboratively developing potential solutions. Additionally, it enables a more adaptable approach in both design and delivery, which may support co-design methods that generate value (Manzini, 2015). The researchers developed an instructional manual to use for drafting patterns using CorelDraw and illustration using a graphics tablet.

4. MATERIALS

CorelDraw is commonly used by creatives as it offers many advantages to designers. Just like any other software program CorelDraw also requires one to have a certain skill level for them to be able to use the software in designing. The software is easily compatible with many personal computers and has flexible subscription rates. Table 2 highlights the critical resources used for this study.

Table 2: Equipment and materials used in the project

Requirements	Purpose
Personal Computer-PC	Processing and displaying the graphic output
CorelDraw Graphics Suite 2022 v24	Vector based program used to develop graphic illustrations
Mouse	A necessary tool used to move cursor
XP Pen Deco 01 V2 Graphics Tablet	A graphic tablet used for hand drawing or hand rendered digital illustrations etc.
Open Broadcaster Software-OBS	A software program used to capture screen or record whilst developing the processes

5. RESULTS

5.1 Workspace design

To launch CorelDraw 2022 the following procedures were done, click on the start menu of the taskbar (at the bottom left corner of the screen), move cursor and select CorelDraw 2022, and double-click on CorelDraw 2022 to display. When CorelDraw 2022, is launched the application window opens and has a drawing page with various commands as shown in Figure 1. The title bar displays the title of the currently selected drawing. The toolbox is a docked bar with tools for creating, filling, and modifying objects in the drawing. The drawing page is the printable rectangular area inside the drawing window where one can do their illustrations.

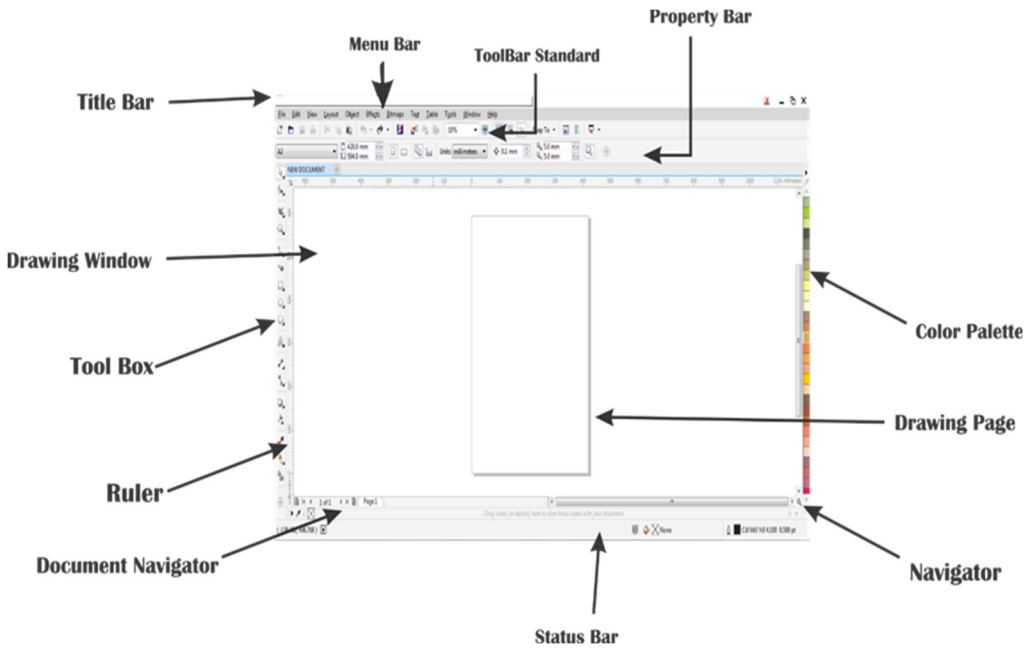

Figure 1: CorelDraw Graphics Suite 2022 v24

5.2 Developing techniques for a hand-rendered illustration

Drawing straight into a computer platform, such as CorelDraw, eliminates the need to scan hand drawn ar twork. Hand-drawn illustrations in digital graphics have a distinct and authentic appearance that distinguishes them from vector or digitally created images. This work focuses on the technique of using a graphics tablet as it produces more accurate and authentic drawings on the screen than the mouse or any other pointing device. The graphic tablet (XP pen Graphic Tablet) is recommended for beginners as it also provides a more ergonomic method of input that can reduce the repetitive strain injury caused by traditional hand drawing illustration methods. The freehand tool and the artistic media tool (CorelDraw toolbox) were used to produce detailed hand-rendered illustrations together with the graphics tablet, which has a digital pen (representing a pencil) and a digital tablet (representing a drawing pad).
Figure 2 shows the imported silhouette that was traced and illustrated on the drawing page. The inspiration for the design is also shown in the drawing window. The freehand tool on the toolbox bar was used to trace the design on top of the silhouette, using it as a guide to design as well as body shape. Freehand tool has an outline width on the property bar that can be adjusted or increased, on this illustration it was increased after tracing out the design, the silhouette was moved next to the design so as to demarcate the design, and the silhouette is shown in Figure 2.

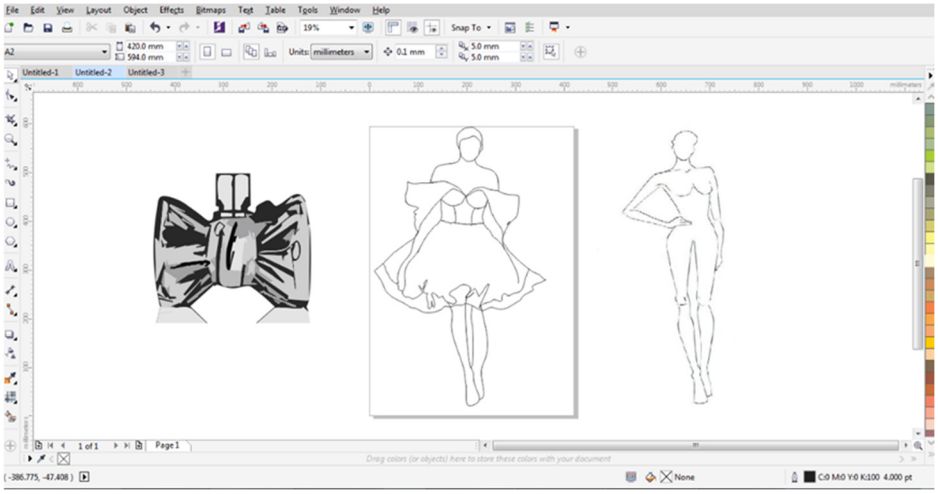

Figure 2: Preview of sketched design alongside the inspiration and the silhouette

5.3 Adding colour details to the design

This stage requires extra attention to detail as the techniques make extensive use of the artistic media tools that is the brushstroke tool and the colour palette. On the toolbox, the artistic media tool is located next to the freehand tool and the colour palette is on the right side of the centre drawing page. After clicking on the artistic media tool, the brushstroke is found on the property bar where the user changes to any artistic brush of choice. The brushstroke was used to add colour on top of the freehand tool lines, as well as to add complicated strokes to the design to produce the effect shown in Figure 3. On the toolbar, there is a fill tool which had a drop bar with two different types of fill options. The process was achieved through the following:

1. Move the cursor to the colour palette tool and add colour from the inspiration.
2. Add colour to the skin areas using the smart fill tool
3. Click on the artistic media tool, move the cursor to the property bar, and change the tool to brushstroke (using the graphic tablet).
4. Use the brushstroke to add lines and some designs on the garment
5. Click on the fill tool and select the mesh fill tool on the drop bar. Select the skirt part of the dress using the mesh fill tool and add colour to it.
6. Drag the inspiration close to the finished design.

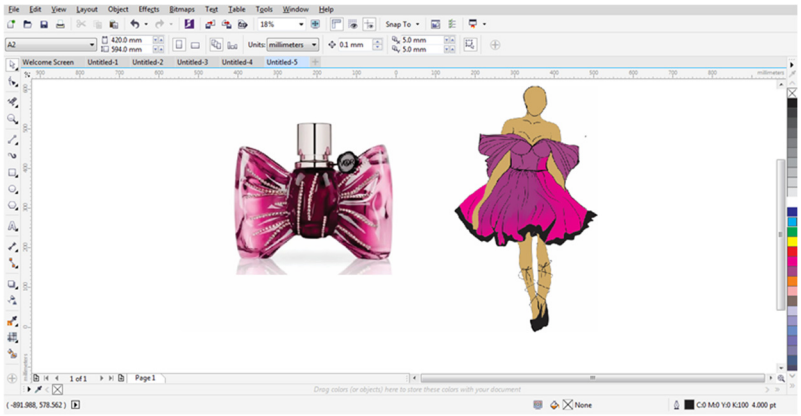

Figure 3: Adding colour to the design to match inspiration.

The illustration shown in Figure 4 was achieved through the following steps:

1. Click on the freehand tool.
2. Use the direct drawing technique to draw the outline sketch of a shirt.
3. Use the pick tool to select the artistic media tool.
4. Move the cursor to the property bar and click on the brushstroke media to highlight the freehand tool marking.
5. Use the graphic table for free-hand movement wearing the glove.

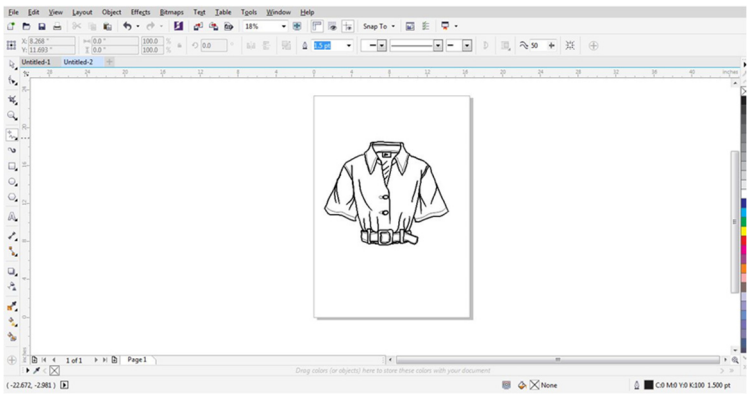

Figure 4: Shirt illustration in CorelDraw using a graphics tablet

5.4 Pattern drafting using CorelDraw

Before drafting a pattern there is a need for an illustration guide of a design that guides the pattern maker of the design to draft the exact pattern for the design. The illustration in Figure 5 was hand-drawn using the graphics tablet using the tools in CorelDraw. CorelDraw default tools were used for corset pattern development. Tools such as pick tool, rectangle tool, dimensional tool, text tool, shape tool, two point line tool were used in the development of the pattern.

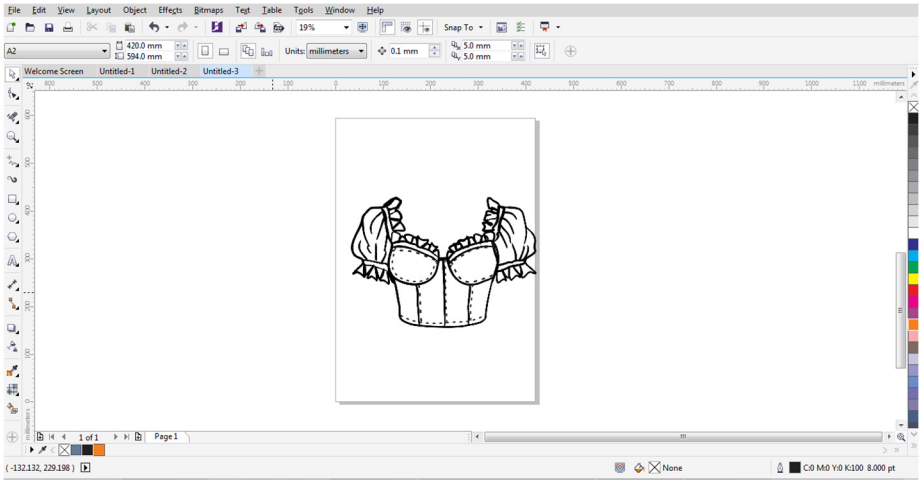

Figure 5: Female corset top design illustration

The pattern below can be used to make different types of corset tops. A corset top pattern development process began by changing the working paper size to A2 and drawing units to inches. A2 paper size was selected because it fits the corset top pattern well. The y-axis and x-axis ruler were used to guide the correct positioning of lines. At this stage, a female block full scale was used to develop a corset top of size 8. The measurements that were used for the development of the corset top of this pattern are:

- waist -24
- bust- 34
- bust point- 4
- bustier length- 14

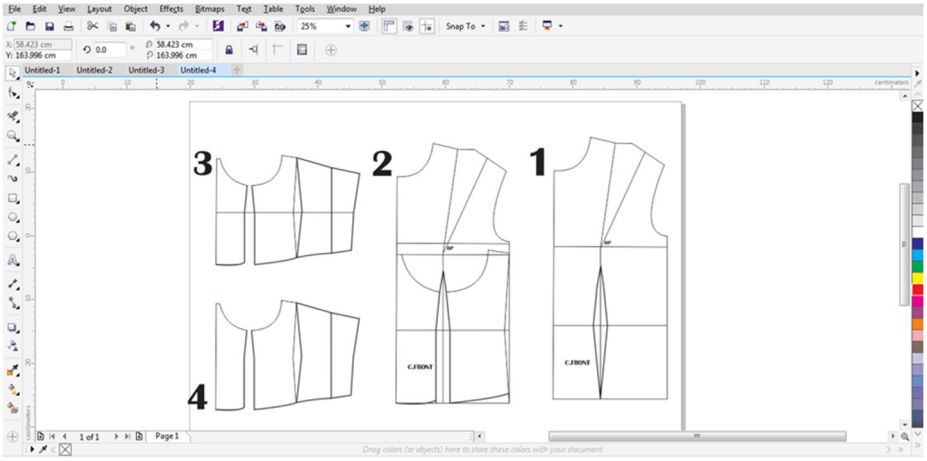

Figure 6: Pattern development of a female corset top

5.5 Developing technical pack for garment design

A technical pack or tech pack in short is similar to a standard sewing pattern envelope used in most garment manufacturing companies that produce and sell commercial patterns. A tech pack can be used as a blueprint of the final garment. The technique consists of designing from an illustration design to a pattern

ready for laying out and cutting. The artistic media tool was used to draw complicated strokes to show the garment's position and to show a realistic draping feel on the garment. The graphics tablet allowed natural drawing motion thus assisting in the drawing of complicated shapes with ease unlike as compared to the mouse. Figure 7 shows the commercial envelope that was designed using hand-rendered illustrations that were achieved using the graphic tablet as well as CorelDraw software. The envelope was made easier to design because of the techniques introduced in the study as well as the flexibility of the graphics tablet.

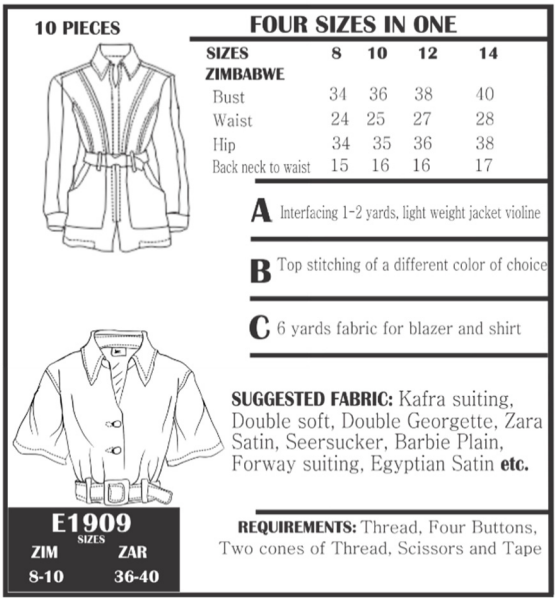

Figure 7: Commercial Sewing Pattern Envelope

6. DISCUSSION

The study explored various digital illustration techniques for fashion illustration using CorelDraw and the graphics tablet. The study sought to manipulate some CorelDraw tools to develop unique techniques that can be used to produce similar results that can be achieved through the use of commercially available fashion CAD software such as Gerber. Using the graphics tablet improved the manipulation process of the various tools within CorelDraw. The digital pen on the graphics tablet allowed the users to create unique design details that would have been hard to create using CorelDraw only. The study explored various application areas of CorelDraw in the fashion design process from illustration to the final commercial garment tech pack. Traditional methods of pattern drafting are time-consuming and may lack precision (Afifi et al., 2024; Liu et al., 2022), as they do not always account for the body-to-pattern relationship effectively, leading to fit issues. In contrast, digital drafting using CAD significantly enhances efficiency by reducing production time and increasing accuracy, allowing for more complex designs and better fit through automated processes. Moreover, digital methods such as the ones illustrated in this study facilitate innovative design possibilities, enabling the integration of various visual elements and textures that traditional fashion illustration methods cannot easily replicate.

Practically using CorelDraw allows for the precise drafting of patterns, which can be tailored to specific materials. Using CorelDraw also improves the ability to visualise and adjust patterns in real-time at a lower cost thus leading to more efficient garment design processes and improved end products similar to the findings highlighted by (Wang, 2020). Integration of technologies such as CorelDraw is critical especially for small garment manufacturing companies as it improves their product quality. CorelDraw has the ability to utilise methods that generate patterns from user-uploaded images or style drawings, ensuring that the final products match customer expectations. While CorelDraw offers robust tools for pattern drafting, challenges remain in ensuring consistency across different drafting methods, which can affect garment fit and overall design integrity. Challenges such as software integration and user accessibility must be addressed to ensure practical application in CorelDraw. The use of graphics tablets as described in this study offers an opportunity to simply improve the design output.

7. CONCLUSION

Digital fashion illustration and pattern drafting are important in the fashion design sector as they bring numerous benefits to the industry. For small companies that face financial challenges in investing in CAD systems for fashion, using the alternative of CorelDraw can be an option that is worthwhile as it has fewer financial implications. Every fashion aspect or art aspect begins with a design which makes the designing process an important component in the industry. One thing that makes designing difficult for other designers is the manual way of illustrating designs, it takes time and some are not familiar with idea development with no inspiration, but with the use of vector graphic software and the digital tablet, illustration is made easier for the designer. The digital outputs illustrated in this study reveal that using a graphics tablet and CorelDraw allows the user to create complex designs and pattern drafting whilst the user feels like they are doing it manually through hand-rendered illustrations. Businesses can adopt the methods described in this study to develop their digital patterns and illustrations with much ease at a lower cost. These digital outputs can then be easily and efficiently communicated to the production team and or clients and make the process of prototype development quicker.

8. REFERENCES

Afifi, S. R. I., Qurashi, W. A.-R. & Gabr, B. G. (2024) Digital Transformation in Swimwear Pattern-Making: A Comparative Study of Traditional Vs. Digital Methods using Adobe Illustrator. *Journal of Art, Design and Music*. 3 (1). Available from: doi: 10.55554/2785-9649.1028

Amos, E., Osei-Poku, E., Ahiabor, P. & Peligah, Y. S. (2017) Exploring Digital Techniques for Fashion Illustration. *ADRRI Journal of Arts and Social Sciences.* 15 (5), 2343–6891.

Biliakovych, L., Derman, L., Oborska, S., Naumenko, O. & Vovk, A. (2024) Genesis, Features and Prospects for the Development of Digital Fashion. *Preservation, Digital Technology & Culture*. 53 (1), 5–14. Available from: doi: 10.1515/pdtc-2023-0043

Burke, S. & Sinclair, R. (2015) Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) of Apparel and other Textile Products. In: Sinclair, R. (ed.) *Textiles and Fashion: Materials, Design and Technology (1st ed.)*. Cambridge, Woodhead Publishing Limited.

Chen, F**.** (2016) The role of computer aided design in fashion design teaching exploration. In: Lin, J. (ed.) *Proceedings of the 2016 4th International Education, Economics, Social Science, Arts, Sports and Management Engineering Conference (IEESASM 2016), 13-14 August 2016, Yinchuan, China*. Atlantis Press. pp. 175-177.

Datta, D. B. & Seal, P. (2018) Various approaches in pattern making for garment sector. *Journal of Textile Engineering & Fashion Technology*. 4 (1), 29–34. Available from: doi: 10.15406/jteft.2018.04.00118

Dwivedi, A. & Dwivedi, A. (2013) Role of computer and automation in design and manufacturing for mechanical and textile industries: CAD/CAM. *International Journal of Innovative Technology & Exploring Engineering*. 3 (3), 174–181.

Gill, S., Al Houf, H., Hayes, S. & Conlon, J. (2024) Evolving pattern practice, from traditional patterns to bespoke parametric blocks. *International Journal of Fashion Design, Technology and Education*. 17 (2), 144–161. Available from: doi: 10.1080/17543266.2023.2260829

Hagen, K. (2017) *Fashion Illustration for Designers* (2nd ed.). Long Grove, Waveland Press.

Huang, H. Q., Mok, P. Y., Kwok, Y. L. & Au, J. S. (2012) Block pattern generation: From parameterizing human bodies to fit feature-aligned and flattenable 3D garments. *Computers in Industry.* 63 (7), 680–691.

Jhanji, Y. (2017) Computer-aided design—garment designing and patternmaking. In: Ian Smith (ed.) *Automation in Garment Manufacturing* (The Textile Institute Book Series). Elsevier Ltd, pp. 253-290.

Keskin, N. O. & Kuzu, A. (2015) Development and testing of a M-learning system for the professional development of academics through design-based action research. *International Review of Research in Open and Distributed Learning*. 16 (1), 193–220. Available from: doi: 10.19173/irrodl.v16i1.1613.

Liu, K., Zeng, X. & Bruniaux, P. (2019) Associate Design of Fashion Sketch and Pattern. *IEEE Access*. 7,

48830–48837. Available from: doi: 10.1109/ACCESS.2019.2906261

Liu, Y., Liang, C., Xu, H., Wang, F., Hao, Y., Dong, J., Dong, Y., Guo, D., Sun, T. & Yu, P. (2022) Digital Art Pattern Design Based on Visual Material Colouring Intelligent Programming System. *Mathematical Problems in Engineering*. 1–10. Available from: doi: 10.1155/2022/2450074

Manzini, E. (2015) *Design, When Everybody Designs: An Introduction to Design for Social Innovation. Cambridge*, The MIT Press.

Marin, I. & Bocancea, V. (2024) Developing a zero-waste pattern drafting method suitable for mass production. *Industria Textila.* 75 (2).

Marin, I. E. (2022) Research regarding new sustainable methods of garment pattern drafting. *Journal of Textile Engineering & Fashion Technology*. 8 (4), 140–143. Available from: doi: 10.15406/jteft.2022.08.00312

McQuillan, H. (2020) Digital 3D design as a tool for augmenting zero-waste fashion design practice. *International Journal of Fashion Design, Technology and Education*. 13 (1), 89–100. Available from: doi: 10.1080/17543266.2020.1737248

Meng, Y., Mok, P. Y. & Jin, X. (2012) Computer aided clothing pattern design with 3D editing and pattern alteration. *Computer-Aided Design*. 44 (8), 721–734.

Na'am, M. F., Achmadi, T. A. & Ihsani, A. N. N. (2021) Optimizing the Skills of Clothing Design Teachers and Students in Clothing Design Using the Coreldraw and Adobe Illustrator Programs to Respond to Industry 4.0. In: Sutopo, Y., Prastiyanto, D. & Kusumawardani, R. (eds.) *Proceedings of the 2nd Vocational Education International Conference (VEIC 2020), 27th August 2020, Semarang, Indonesia*. European Alliance for Innovation. p. 14.

Oppong, J., Biney-Aidoo, V. & Antiaye, E. (2013) Evaluating the Benefits of Computer Aided-Design (CAD) in Fashion Education, the Case of Accra Polytechnic. *Journal of Education and Practice*. 4 (21), 73–79.

Puri, A. (2013) Efficacy of Pattern Making Software in Product Development Institute of Apparel Management (IAM) (under the aegis of Apparel Export Promotion Council (AEPC)). *Cloud Publications International Journal of Advanced Quality Management*. 1 (1), 21–39.

Sinha, P. (2001) The mechanics of fashion. In: Hines, T. & Bruce, M. (eds.) *Fashion Marketing: Contemporary Issues* (1st ed.). London, Routledge.

Sugiarto, E., Kurniawati, D. W., Febriani, M., Fiyanto, A. & Imawati, R. A. (2021) Computer-based art in folklore illustration: Development of mixed media digital painting in education context. *IOP Conference Series: Materials Science and Engineering*, *March*. IOP Publishing. pp. 032017.

Tabraz, M. (2017) Importance of Fashion CAD (Computer Aided Design) Study for Garment Industri of Bangladesh. *International Journal of Scientific & Technology Research*. 6 (10).

Tortora, P. G. & Eubank, K. (2009) *Survey of Historic Costume* (5th ed.). New York, Fairchild Books

Townsend, K., Kent, A. & Sadkowska, A. (2019) Fashioning clothing with and for mature women: a small-scale sustainable design business model. *Management Decision*. 57 (1), 3–20. Available from: doi: 10.1108/MD-12-2016-0942

Trivedi, V. (2015) Innovation in computer aided garment designing. *Internactional Journal of Recent Research Aspects*. 2 (4), 25–29.

Virmani, R. & Singh, J. (2024) Evolution and Innovations in Pattern Making Techniques for Enhanced Garment Construction: A Comprehensive Review. *International Journal For Multidisciplinary Research*. 6 (1), 1–7. Available from: doi: 10.36948/ijfmr.2024.v06i01.13666

Wang, T. (2020) Graphic Art Design Based on Computer Graphics Software. *Journal of Physics: Conference Series*. 1533 (3). Available from: doi: 10.1088/1742-6596/1533/3/032019

Wiana, W. (2017) Application Design Of Interactive MultimediaDevelopment Based Motion Graphic On MakingFashion Design Learning In Digital Format. *International Journal of Scientific & Technology Research*. 6 (5), 102–108.

Xu, J., Mok, P. Y., Yuen, C. W. M. & Yee, R. W. Y. (2016) A web-based design support system for fashion technical sketches. *International Journal of Clothing Science and Technology*. 28 (1), 130–160. Available from: doi: 10.1108/IJCST-03-2015-0042