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Utilization of AI-Based Motion Diffusion for Modest Wear-Based Design Transformation Wastra Nusantara

Agus Sunandar[(1)], Ajeng Atma Kusuma[(2)], Rizka Sarah Heydarina Fathima Ahsan[(3)], Sri Eko Puji Rahayu[(4)], Muhammad Hisyam Bin Zakaria[(5)]

[1,2,3,4]Faculty of Vocational Studies, Universitas Negeri Malang,
Jalan Semaran No 5, Kota Malang, Indonesia.
[5]Department of Fashion Design Faculty of Art & Design Universiti Teknologi Mara Shah Alam, 40450 Shah Alam, Selangor, Malaysia

Email: [1]agus.sunandar.ft@um.ac.id, [2]ajeng.kusuma.fv@um.ac.id, [3]rizka.ahsan.fv@um.ac.id, [4]sri.eko.ft@um.ac.id, [5]mdhisyam@uitm.edu.my

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Corresponding Author:
Name: Rizka Sarah Heydarina Fathima Ahsan
Email: rizka.ahsan.fv@um.ac.id

Abstract: Modest wear is a clothing trend with loose, closed, and comfortable cuts. This is not only synonymous with Muslim clothing but has also become an important component of the fashion industry around the world. By combining the Archipelago wastra such as batik, weaving, and songket, modest wear is growing rapidly in Indonesia as a representation of the richness of local culture. However, changing the traditional modest clothing style to the digital age is still difficult, especially with the adoption of modern technologies such as artificial intelligence. The purpose of this study is to use AI-Based Motion Diffusion to transform the design of Nusantara wastra-based modest clothing from 2D images to 3D dynamic animation visualizations. This technology can enrich cultural narratives, make products more attractive, and open up opportunities in the global market. However, collaborative efforts are needed to introduce and apply technology in the creative process because local designers do not understand it. Need analysis, design development, expert validation, and product refinement are all parts of the research conducted using Borg & Gall's research and development (R&D) model. After the data were collected through observation, interviews, and questionnaires, a qualitative descriptive analysis was performed. The results of the research are expected to produce a digital prototype of fashionable clothing based on Nusantara wastra that is innovative, adaptive, and competitive around the world through artificial intelligence-based motion animation. The focus of this research lies in the strategic need for the digital transformation of the Indonesian fashion industry, especially with the aim of introducing the archipelago to the global industry using artificial intelligence technology.

Abstrak: *Pakaian sederhana adalah tren pakaian dengan potongan longgar, tertutup, dan nyaman. Ini tidak hanya identik dengan pakaian muslim tetapi juga telah menjadi komponen penting dari industri fashion di seluruh dunia. Dengan menggabungkan wastra Nusantara seperti batik, tenun, dan songket, pakaian sederhana berkembang pesat di Indonesia sebagai representasi kekayaan budaya lokal. Namun, mengubah gaya pakaian sederhana tradisional ke era digital masih sulit, terutama dengan adopsi teknologi modern seperti kecerdasan buatan. Tujuan dari penelitian ini adalah untuk menggunakan AI-Based Motion Diffusion untuk mengubah desain pakaian sederhana berbasis wastra Nusantara dari gambar 2D menjadi visualisasi animasi dinamis 3D. Teknologi ini dapat memperkaya narasi budaya, membuat produk lebih menarik, dan membuka peluang di pasar global. Namun, diperlukan upaya kolaboratif untuk memperkenalkan dan menerapkan teknologi dalam proses kreatif karena desainer lokal tidak memahaminya. Analisis kebutuhan, pengembangan desain, validasi ahli, dan penyempurnaan*

produk adalah bagian dari penelitian yang dilakukan menggunakan model penelitian dan pengembangan (R&D) Borg & Gall. Setelah data dikumpulkan melalui observasi, wawancara, dan kuesioner, dilakukan analisis deskriptif kualitatif. Hasil penelitian diharapkan dapat menghasilkan prototipe digital pakaian modis berbasis wastra Nusantara yang inovatif, adaptif, dan kompetitif di seluruh dunia melalui animasi gerak berbasis kecerdasan buatan. Fokus penelitian ini terletak pada kebutuhan strategis transformasi digital industri fesyen Indonesia, khususnya dengan tujuan memperkenalkan nusantara ke industri global menggunakan teknologi kecerdasan buatan.

INTRODUCTION

Modest wear is a fashion trend for women or men who use a more closed, loose and non-transparent style. Modest wear is not always Muslim clothing, this clothing can be worn by anyone with a more closed skirt, modest and comfortable to use. Modest wear has grown to become one of the important segments in the global fashion industry, with a projected market value of USD 311 billion by 2024 (Mostafa & Alanadoly, 2023). In Indonesia, the development of modest wear cannot be separated from cultural wealth, including the use of Nusantara wastra such as batik, weaving, and songket, which are integral parts of strengthening national cultural identity. However, challenges arise when traditional modest wear design transformations must adapt to digital technologies to meet the needs of a dynamic global market (Yuniastuti & Pratama, 2023).

AI-Based Motion Diffusion is one of the latest AI innovations that can generate realistic and natural motion from static data such as 2D images (Zhang & Liu, 2024). The diffusion model uses the diffusion principle, or diffusion model, to add sound to the data and then learn how to remove that sound to reshape the quality data. AI-Based Motion Diffusion is used in various creative fields, such as animation, video production, and digital design, as well as in the fashion industry to mimic the movement of fabrics or fashion models (Liu & Fu, 2024). One of the advantages of motion diffusion compared to conventional methods is that it can produce animations with natural movements without the need for many continuous drawings of each pose. This allows for creative processes and produces better results (Wang, 2024).

With models such as animation and Stable Video Diffusion, it is possible to create short videos from still images with smooth and expressive motion quality (Y. Cao et al., 2024). Motion diffusion is essential for the development of technology-based fashion design because it allows designers to digitally show how the design of clothes created fits with body movements (Yuan, 2024). AI-Based Motion Diffusion also aids digital transformation in the creative industry by giving designers the opportunity to showcase their work in a more interactive format and capture the attention of markets around the world (Tsaiyi et al., 2025). The ability to integrate visual aesthetics and motion technology makes it an innovative tool that pushes new boundaries in the world of digital design and animation.

Modest wear is a fashion that prioritizes loose, closed, and comfortable cut clothing and considers aesthetic aspects and fashion trends that are currently popular (Kamiliyana et al., 2024). In its development, modest wear not only follows the demand for Muslim fashion and culture but also becomes part of the fashion industry in the world. Due to its vast cultural diversity, Indonesia has many traditional textiles or wastra of the archipelago, such as songket, batik, and weaving, which are important inspirations for the development of modest clothing (Gumulya & Meilani, 2022).

Wastra Nusantara is a representation of cultural values, life philosophies, and ethnic identities that are inherited from generation to generation, which are not just textile products but have philosophical meanings contained (Ningsih & Widjaja, 2021). The use of wastra in modest wear design is a tangible form of cultural preservation as well as creative innovation in the sustainable fashion industry. Combining traditional styles and modern designs, designers can create fashion that is not only unique in each region of origin but also competitive in the global market (Indriani et al., 2024).

Parallel to these developments, Artifical Intelligent (AI) has begun to reshape the fashion industry, offering tools for design innovation, visualization, and market expansion. Among these tools, AI-based motion diffusion enables the transformation of static 2D designs into dynamic 3D animations, providing a more immersive and realistic representation of fashion products (S. Cao et al., 2023). This technology provides new opportunities in digitizing the archipelago's wastra, transforming 2D designs into dynamic 3D visualizations, increasing the attractiveness of fashion products in the era of global digitalization (Anantrasirichai & Bull, 2021, Ahsan et al., 2025).

However, despite the growing interest in both modest wear and AI applications, a significant research gap remains at the intersection of these domains especially concerning the use of motion diffusion technology to showcase wastra Nusantara based designs. Local fashion designers, particularly small and medium enterprise (SME) practitioners, often lackk exposure to or literacy in AI tools, limiting their ability to leverage digital advancements (Ismah, 2024). Previous studies have explored AI in fashion design broadly (Hur, Eunsuk; Cassidy, 2019; Kurniah et al., 2023). Diffusion models, for example, are models that are based on artificial intelligence that allow us to explore cultural forms, textures, and narratives further (Liang et al., 2019; Rizzi & Casciani, 2024) and the cultural significance of wastra (Cahyaningrum et al., 2025; Kusuma et al., 2025), but few have addressed the integration of motion diffusion AI with traditional textile-based modest wear in a way that is accessible to local designers

As a solution, this study offers a method of using AI-based Motion Diffusion to change the design of fashionable clothing based on Nusantara wastra. The main focus is to combine local wisdom with modern technology to produce digital fashion products that are not only attractive but also adaptive to market developments around the world. Thus, it is hoped that it can preserve Indonesia's cultural diversity in the digital era while increasing the competition of Indonesian modest wear.

Based on the description above, research was conducted with the following goals: (1) To apply AI-based motion diffusion technology in transforming 2D design of wastra Nusantara-inspired modest wear into 3D dynamic visualizations, and, (2) To empower local designer in Malang, Indonesia, by introducing and integrating this technology into their creative processes.

In response to the identified gap and the need for technological adoption in local creative industries, this study aims to develop a digital design model that integrates AI-based motion diffusion with Nusantara wastra elements to enhance creativity, digital literacy, and market competitiveness among modest wear designers in Malang. The expected output is an innovative and adaptive digital prototype that not only serves as a practical design tool but also contributes to the strategic digital transformation of the Indonesian modest fashion industry, strengthening its positioning the global market while preserving cultural heritage.

METHOD

Data Collection Techniques

Data were collectes in Malang City, Indonesia, from a group of 20 fashion designers who are members of the IFC (Indonesian Fashion Community) Chapter Malang. The data collection process was conducted through a multi-method approach to ensure comprehensive insight:

1. Participant pbservation: researchers were directly involved in observing the designers workflows, from the initial sketching process to the final design stages. This provided contextual understanding of their conventional methods, challenges, and the potential points for technology integration.
2. In-depth interviews: semi-structures interviews were conducted with the designers to identifity practical difficulties in the design process, gauge their understanding and use of AI-based technology, and explore the frequency and manner of wastra Nusantara usage in their designs.
3. Questionnaries: A structured questionnaire was administered to quantify the designer’s technological literacy, interest in AI adoption, and the time efficiency of their current methods.

Qualitative Data Analysis

The qualitative data gathered from observations and interviews were analyzed using a descriptive qualitative analysis approach. The process involved:

1. Data Reduction: The raw data from transcripts and field notes were summarized and categorized into key themes, such as “design process challenges”, äwareness of AI”, and “Perceptions of digital transformation”.
2. Data Display: Organized and compressed information was displayed in the form of narrative texts and flowcharts to allow for clear identification of patterns and trend.
3. Conclusion Drawing and Verification: Initial conclucions were drawn from the displayed data and then verified through triangulation, cross checking findings from the three different data collection methods (observation, interviews, and questionnaires) to ensure validity and reliability.

Expert Validation and Final Product Form

The preliminary digital prototype, which consisted of 3D motion animations generated from 2D wastra-based designs, underwent a rigorous expert validation process. The validation involved one professional modest wear designer with expertise in both traditional textiles and contemporary fashion design. The validator assessed the prototype based on the following criteria:

1. Aesthetic Quality: The visual appeal, color harmony, and composition of the animated design
2. Functional Accuracy: The accuracy of the clothing’s shape, proportions, and how well the animation represented real- world fabric drape and movement.
3. Cultural Integrity: The faithfulness of the digital output to the original wastra Nusantara motifs and the preservationa of the cultural meaning.
4. Technical Feasibility: The clarity and effectiveness of the prompts used in AI tools (ChatGPT and HeyGen) to consistently produce desire outputs across ten different test designs.

The final product of this R&D process is a validated digital prototype of a wastra Nusantara-based modest wear collection, presented in the form of short 3D motion diffusion videos (MP4 format). These videos showcase the designs in a dynamic, runway-like presentatition, demonstrating a practical and innovative model for digital fashion visualization.

Integration of R&D and Qualitative Approach

The study emphasizes the synergetic relationship between the R&D framework and the qualitative approach. The R&D model provided the structural backbone for systematically developing a practical product- the digital prototype. Concurrently, the qualitative methods (observation, interviews, and descriptive analysis) were integral to every stage, from identifying user needs and contextual challenges in the initial phases, to interpreting feedback and refining the product during the development and validation stages. This combination ensured that the developed prototype was not only technologically sound but also deeply rooted in the real-world context and needs of local designers

RESULTS AND DISCUSSION

Observation and Interview Results

In the early stages of this study, observations and interviews were conducted to find out the extent of knowledge and use of Artificial Intelligence technology in the fashion design process. This observation and interview were carried out on fashion designers in Malang City, especially designers who are members of IFC Chapter Malang, as many as 20 people. The observation made was to directly observe the activities, behaviors and work processes of IFC Chapter Malang designers when making modest wear designs starting from the sketch process to the final stages of the design process. Observations and interviews were conducted with the aim of identifying practical difficulties experienced in the design making process, understanding the

extent of the use of Artificial Intelligence-based technology and how often Indonesian wastra is used in the design made.

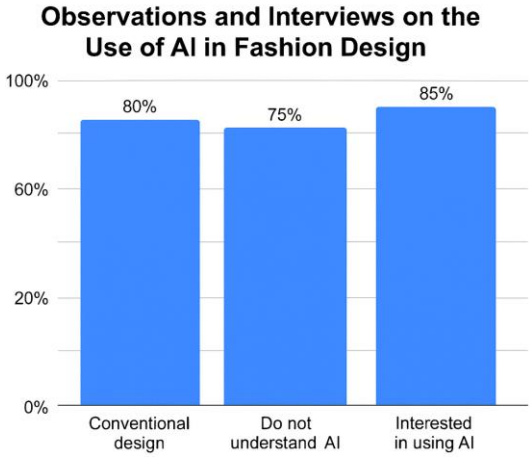

Figure 1. Observastion and Interviews Chart

The results of obsessiveness and interviews with 20 designers who are members of the IFC Malang Chapter show that the majority still rely on conventional methods such as sketching and manual coloring. As many as 75% of respondents have not used AI in design creation, although as many as 85% expressed a high interest in learning about it. This indicates a gap between technological developments and the readiness of MSME actors with current market needs (Mansir & Fatimah, 2021).

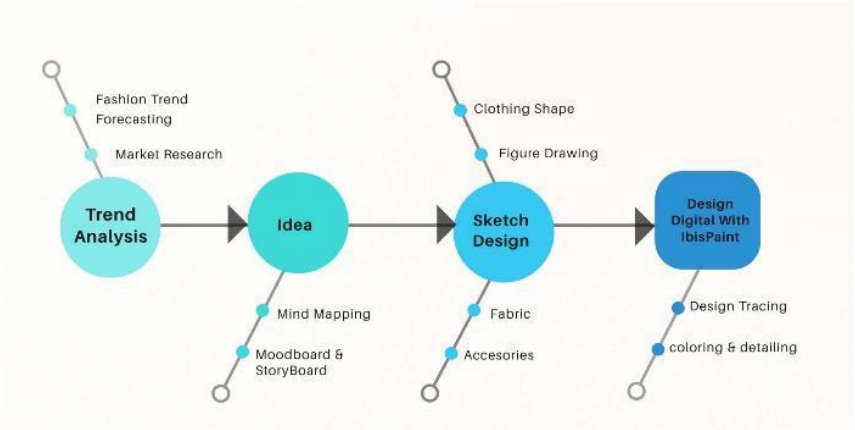

Figure 2. Conventional Design Creation Flow

Figure 2 shows a flow diagram of the process of making fashion designs made from Indonesian wastra which is on average carried out by IFC Chapter Malang designers. The initial stage in making a design is trend analysis which is usually adjusted to a trend forecasting book, market research is carried out to find out the products that are selling well in the market. Trend analysis is also carried out as the foundation of creative ideas which are then developed through mind mapping, moodboard and storyboarding. The next step is to make a sketch design manually, including figures, fashion shape elements, material details to accessories or complements used. The final step is to digitize the design using the Ibispaint application, with a tracing process from the sketch design that has been made to the process of finishing, coloring, shading and placement of Indonesian wastra material motifs.

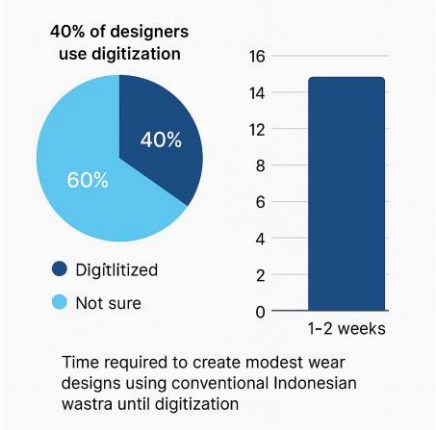

Figure 3. Respond Designer Ude Digitization

Not all designers carry out the digitization process, of the 20 respondents who stated that they used digitization as many as 8 people, which means that only 40% of the total number of respondents. Interviews conducted with 20 respondents found that 14 people stated that the time needed to make modest wear designs made from conventional Indonesian wastra until the digitization process took 1 to 2 weeks. The length of this time is influenced by the details of the process that must be carried out from the search for ideas to the finishing process.

Conversion Results of 2D to 3D Motion Diffusion Design

In this study, it can be concluded that 40% of respondents make modest wear designs in digital form using the Ibispaint program found on mobile phones and tabs. The 2D design is made complete along with the colors and motifs of the Indonesian wastra used. The average time it takes to create a 2D digital design in Ibispaint is 3 hours per design. If calculated from the trend analysis process to the design finalization process, the average time required is 14 days. Figure 2 explains the flow of the design making process starting from trend analysis to the digital drawing process carried out by the respondents.

Figure 4. Creation of 2D digital designs using Ibispaint

The process of developing modest wear designs made from Indonesian wastra from 2D design to 3D motion diffusion was carried out with the help of "HeyGen" artificial intelligence technology. This research shows that the design can be improved in visual value and marketability through digital innovation. The process begins with creating a 2D design using the Ibispaint application as seen in figure 4, which is then refined with the help of ChatGPT to produce a more realistic image, with the help of a detailed prompt according to the concept. The image that has been refined with ChatGPT is then converted to HeyGen to turn into a moving image as if a model

is walking on the runway, in addition to being able to include audio both sound and music. The design will look clearer and more realistic and of course the visual appearance is much better compared to the output from Ibispaint. The video will be saved in MP4 format and the design can also be edited again according to the designer's needs. The time it takes to convert a design from 2D to 3D motion diffusion is quite short, averaging 6 minutes depending on the speed of the internet connection and the device used. The process of converting 2D designs into 3D motion diffusion is shown in Figure 5.

Figure 5. 2D to 3D Motion Diffusion Design Conversion Process

Digitalization in the fashion world is a necessity in the era of the creative industry 4.0, especially to increase the efficiency, quality and competitiveness of products. Previous research explained that digital transformation can accelerate the production process and expand the market reach of local fashion designers (Ismah, 2024). In addition, the use of artificial intelligence technology can produce more attractive and realistic design visualizations as evidenced by the process of converting 2D designs into 3D shapes in this study (Wang, 2024). This is also in line with the findings of Wulandari et al., that the use of AI in graphic design is able to create a more immersive and attractive visual experience for consumers (Hidayat et al., 2025).

3D Motion Diffusion Design Validation

Design validation is carried out to assess the suitability between the design visualization results from HeyGen in the form of motion images and the initial design prepared by the designer. This process is important to ensure that from 2D design to 3D form, the motion image is not only technically accurate, but also still displays the identity of the design made, both in terms of aesthetics and cultural value, especially in the use of Indonesian wastra.

The validation process involves an expert, a professional designer in the field of modest wear. The validator assesses various aspects, including the accuracy of the shape and proportions of the clothing, the suitability of the colors and motifs used, and the suitability of movements and visual expressions resulting from HeyGen technology. In addition, detailed elements such as fabric falls, fabric folds and accessories combinations are also thoroughly analyzed. Validation is also carried out to test the prompts used, carried out by involving ten different designs and then tested and degenerated using the same prompt, then the results are analyzed.

The validation results showed that most of the resulting 3D designs were in accordance with the initial concept. The visual look is more realistic and more attractive without having to change the original concept from the designer. The appearance of the design starting from the figure, shape, color, motif to the texture of the materials used looks clearer and more realistic like the finished product photos. The results of the prompt test to ten different designs also produced a suitable design, not changing the initial concept, only changing the visuals to be more realistic.

The design validation in this study was carried out by modest wear professional designers and showed that almost all of the AI-generated designs were in accordance with the initial concept. The aesthetic aspects, colors, motifs, and visual proportions correspond to the initial concept, while the visuals are displayed more beautifully and attractively. This is in line with other research that emphasizes that the combination of technology and traditional art such as wastra can create added value in fashion design (Evitasari et al., 2023).

Wastra Nusantara as a cultural heritage is a visual identity in the form of fabric owned by Indonesia and is very diverse. Combining wastra with digital technology can increase cultural value and strengthen the existence of local products in the international market (Yuniastuti & Pratama, 2023). Therefore, Indonesian designers can expand their creative space and market by creating wastra-based digital prototypes.

CONCLUSION

This research shows that the use of artificial intelligence technology, especially HeyGen AI, can change the design of fashionable clothes based on the archipelago from static 2D forms to dynamic and attractive 3D animations. The results of observations and interviews show that most MSME designers in Malang City still use conventional methods and do not understand artificial intelligence technology in making designs, but they have a high interest in learning it. The results of the design validation conducted by experts concluded that the 3D animation visualization remained true to the original concept and increased aesthetic value, visual expression, and marketing potential. By using applications such as digital and artificial intelligence technology, time is saved up to 98%. In addition to providing effective design solutions, this technology integration is also a strategic effort to preserve local culture through digital-based Nusantara wastra fashion design. Therefore, modest wear digital design prototypes based on artificial intelligence technology can serve as a transformation model for fashion design that is innovative, effective, and relevant to the needs of the creative industry of the future.

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