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Artificial Intelligence (AI) in Garment Design: Opportunities and Challenges in the Ready-Made Garments (RMG) Sector of Bangladesh

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ABSTRACT

This study looks at the pros and cons of using artificial intelligence (AI) in planning ready-made garments in Bangladesh's Gazipur district, where the garment industry is booming. Twenty designers from different institutions using AI and traditional software tools to create attires were involved in the study. The results show that applying AI to the field comes with both opportunities and challenges. AI has made garment creation more efficient, less expensive, more productive, more customizable, better at predicting trends, and more sustainable. However, it raises issues such as job loss, quality control, data privacy, dependence on technology, and ethical questions. This study shows how important it is to take a balanced approach to adopting AI, considering its possible benefits while addressing its risks, so that Bangladesh's ready-made garment industry can continue to grow and thrive.

Keywords: Artificial Intelligence, Ready-Made Garments, Garment Design, Industry Challenges, Bangladesh

INTRODUCTION

Bangladesh's ready-made garments (RMG) industry has become a world star, which has helped the country's economy grow and created many jobs. Over the past few decades, this sector has grown by leaps and bounds, so it has always been looking for new ways to improve its efficiency, competitiveness, and product quality. In this quest, using Artificial Intelligence (AI) in designing garments is getting more attention as a possible game-changer. This study article explores the fascinating area where AI and clothing design meet. It looks at the opportunities and problems AI brings to Bangladesh's RMG sector.

The main goal of this study is to figure out how adding AI to the process of designing ready-made garments in Bangladesh affects that process. AI technologies have come a long way in a short time and promise to change many parts of the RMG business. AI can speed up production, cut costs, and make a company more competitive in the global market by automating certain design chores, getting better at recognizing patterns, and making designers more creative. To understand what AI means for the field as a whole, It is necessary to know how it affects the design phase.

Also, this research aims to find and study the problems and worries about using AI in the RMG field. AI has apparent benefits, but it also comes with problems like ethical questions, the possibility of losing jobs, and the need to spend much money on technology and training. By looking at these challenges, stakeholders can make intelligent decisions about how to integrate AI, ensuring it fits with the needs and values of the field.

Lastly, this article calls for a balanced approach to using AI in Bangladesh's RMG field. It acknowledges that AI can change things but also stresses the importance of keeping the human touch, expertise, and ethical aspects of garment production. Finding this balance is essential if AI can be used to its full potential without hurting the sector's character, skilled workforce, or social and environmental responsibilities.
Ultimately, this study sheds light on how AI is used in garment design in Bangladesh. It gives industry stakeholders, policymakers, and researchers helpful information. With a deep knowledge of the opportunities and challenges, it will pave the way through this exciting new frontier to get the most out of it while keeping the RMG sector's core.

LITERATURE REVIEW

Over the years, the garment industry, especially in countries like Bangladesh, has changed significantly because of changes in technology and consumers' wants. In this situation, putting Artificial Intelligence (AI) into the process of designing garments has gotten much attention because it could improve speed, cut costs, and improve the quality of the clothes. This literature study looks at the research that has already been done on AI in garment design, focusing on its benefits and problems. By comparing the areas of study, methods used, and results of earlier studies, we can find gaps and show how important the current study is.
Much research has been done on AI's use in the fashion and cloth industries. Using deep learning algorithms for fashion image analysis is essential because it shows how AI can get useful design information from images (Hossain *et al.*, 2022a). Even though this study was primarily about image analysis, it had to consider the ready-made garments market in Bangladesh. Also, the study mostly used computer vision methods and did not look into the broader effects of AI on garment design in a profound way.
Differently, a study on AI-powered virtual fashion helpers that showed how they could help people choose ready-made garments (Fernández-Caramés and Fraga-Lamas, 2018). Even though this study fits into the bigger picture of Bangladesh's garment industry, it focused on the consumer side and did not look at how AI is used in the design and production processes, which is an essential part.
By comparing these past studies, it is clear that while AI's uses in fashion and garment design have been looked into, there still needs to be a study gap regarding how AI can be used in Bangladesh's ready-made garments sector. The studies that were already done either looked at a different part of the fashion business or should have looked at the challenges and opportunities that are unique to Bangladesh.
Using AI in Bangladesh's ready-made clothing industry could lead to good things: AI-driven design methods can make new and unique clothes that fit the needs of a wide range of customers (Abdel Kader, Mohamed and Ali, 2022a). AI can improve production efficiency by optimizing supply chain processes, cutting down on waste, and keeping production costs as low as possible (Le, Tran and Nguyen Duc, 2019). AI-powered predictive analytics can make it easier to predict demand, which will cut down on overproduction and make the business more sustainable ('Implication Of Artificial Intelligence In Fashion Industry And Its Sustainable Impact', 2021a).
However, there are problems with putting AI into the garment design business. As more and more customer data is collected and used, data privacy and security are becoming more critical (Sabuj *et al.*, 2022). Also, people may not want to use AI because they are worried about losing their jobs, especially in labor-intensive businesses like garment manufacturing (Akseer *et al.*, 2022). Also, the digital gap in Bangladesh could make it harder for AI technologies to be used widely.

The ready-made garments industry in Bangladesh has specific needs and problems that need to be solved quickly. This is why the current study is so important. As one of the most critical parts of the country's economy, this business is significant for jobs and export income. Bangladesh can keep its edge in the global market by using AI to its full potential in design, production, and managing the supply chain (Cadden *et al.*, 2022).

Also, there is not enough study on AI in this situation, so more must be done. The comparison of past studies shows how important it is to do a study that not only fills in the research gaps but also gives a complete picture of AI's role in the ready-made clothing sector of Bangladesh. This study will help keep the industry going, help the economy grow, and make the industry more competitive worldwide.

In conclusion, using AI to design garments is a growing area with much potential in Bangladesh's ready-made garment industry (Sharmin, 2022). Different facets of AI in the fashion industry have been studied in the past, but Bangladesh's unique situation and challenges have yet to be entirely covered. This research fills this gap, proving the need for our current study and giving us essential information about how the industry should grow in the future.

RESEARCH METHODOLOGY

Research Philosophy: This study embraced a positivist research methodology to assess AI's influence on clothing design within Bangladesh's ready-made clothing industry. It strongly emphasized gathering empirical data to provide analysis and a solid factual base.

Research Approaches: This study used a deductive methodology, beginning with a theory-driven framework that addressed the possibilities and hazards of artificial intelligence. It collected and analyzed data using qualitative approaches to comprehend the subtleties and context of AI integration in Bangladesh's ready-made clothing industry.

Methods Selection: Qualitative techniques such as focus group discussions (FGD) were selected as the primary research instrument. The Gazipur district held two focus group discussions (FGDs) with twenty seasoned AI-powered garment designers. Through these conversations, individuals' perspectives and experiences with AI in clothing design were thoroughly explored, producing a wealth of qualitative data that could be analyzed.

Population and Sample Size: The population consisted of Bangladeshi garment designers who work with AI in the Gazipur district. Twenty participants were chosen for the FGDs using a purposive sampling technique. Because each participant had relevant expertise in designing clothing using various software and AI technologies, the sample was typical of those working in the AI business.

Research Strategies: A mixed-methods approach was used in the study, focusing on qualitative data collecting using focus group discussions (FGDs) to capture a range of viewpoints and experiences about the use of AI in garment design. A systematic evaluation of the literature was carried out to identify research gaps and offer a more comprehensive context for the findings.

Research Techniques and Data Analysis Plan: After collecting FGD transcription, they were subjected to a thematic analysis process, including data familiarization, coding, topic formulation, and interpretation.

Themes about the advantages and difficulties of integrating AI into clothing design were found and organized. Data triangulation was employed to validate findings and offer a broader perspective through a comparative literature review.

Ethical Considerations: Every participant gave their informed consent, ensuring their privacy and confidentiality. The study's goal, the fact that participation was voluntary, and the freedom to leave at any time were all explained to participants. Protocols for data security were adhered to in order to safeguard private data. Ethical considerations also included limiting potential harm to participants and ensuring data was handled responsibly.

Challenges and Solutions: Difficulties included participants' possible unwillingness to talk about delicate subjects and the requirement for language translation in multilingual environments. During FGDs, a welcoming atmosphere and rapport-building strategies were developed to address issues. When required, translation services were used. Strong transcribing and data management procedures were in place to preserve data integrity. In addition, frequent debriefing meetings were held to lessen any potential emotional strain on the researchers.

RESULTS AND DISCUSSIONS

AI's Effect on Garment Design

Bangladesh's ready-made garments (RMG) sector's AI-integrated garment design process has had beneficial and adverse effects. Our focus group discussions (FGDs) with 20 experienced garment designers offer a nuanced picture of AI's impact on this vibrant business.

Cost reduction and efficiency gains

AI-enabled garment design has dramatically improved fashion industry efficiency and cost. Pattern generation and color selection can be automated by AI-powered tools, reducing design iteration time. Efficiency gains cascade, speeding up production.

Fashion companies save a lot by cutting labor hours (Hassani *et al.*, 2020). AI-driven automation decreases manual design procedures, lowering operating expenses (Barenkamp, Rebstadt and Thomas, 2020). These cost reductions affect material acquisition, production, and quality control (Weber, 2023). Thus, streamlined operations and cost-efficiency make the fashion industry more competitive, allowing companies to offer competitive items while preserving or expanding profit margins (Baruselli *et al.*, 2019; Schleiss *et al.*, 2022). This shows AI's importance in changing the fashion business.

Boosting productivity

In fashion and other industries, AI-powered design tools have revolutionized productivity. These tools are lauded for boosting efficiency. Designers have praised AI for quickly expanding design options. AI lets designers focus on creativity by automating monotonous activities and offering quick design iterations, resulting in more diverse and appealing design possibilities.

The fast design process lets designers meet consumers' changing tastes (Sharmin, 2022). This versatility is crucial in fashion, where trends change quickly (Hossain *et al.*, 2022b). With AI support, designers can adapt to these changes and give customers a more customized experience (Dauvergne, 2022). Increased productivity streamlines design processes and encourages innovation and creativity (Gao and Feng, 2023).

AI-powered design tools can inspire designers to try new things and create more personalized garments (Corrado, Haskel and Jona-Lasinio, 2021). AI technology promises to transform the fashion industry's creative landscape, boosting innovation and consumer happiness.

Personalization and customization:

Personalization and customization are key to fashion AI-powered design tools. These tools use data analysis and pattern recognition to create customized designs that appeal to consumers. AI's ability to analyze large datasets and spot intricate patterns lets it offer design components that match each consumer's likes and trends.

AI helps designers make custom-fitted clothes by analyzing consumer data and preferences (Nayak and Padhye, 2018). This level of customization extends beyond mass production, improving customer loyalty and brand-consumer connections (Abdel Kader, Mohamed and Ali, 2022b). Happy customers with a strong personal connection to a company are more likely to become brand advocates and repeat buyers, growing market share (Hossain *et al.*, 2022c).

In the intensely competitive fashion business, AI's ability to provide personalized designs sets brands distinct and opens new revenue streams and long-term success.

Predictive Trend Analysis:

AI's most prominent fashion design benefit is trend prediction. AI's robust data analysis lets designers predict and understand fashion trends and consumer preferences using big data. By analyzing massive amounts of data from social media, fashion forums, and historical purchasing trends, AI may spot minor changes in consumer desires that humans may miss (Goodell *et al.*, 2021).

This insight allows designers to change their creative approach and make garments that fit the changing market, keeping their businesses ahead of the curve(Khan, Islam and Habib, 2023). Designing with predicted trends boosts sales and appeal (Goodell *et al.*, 2021; 'Implication Of Artificial Intelligence In Fashion Industry And Its Sustainable Impact', 2021b).

AI-driven trend analysis reduces fashion production's environmental impact ('Implication Of Artificial Intelligence In Fashion Industry And Its Sustainable Impact', 2021b). Designers may make clothing more effectively, avoiding overproduction and inventory waste. Sustainable company practices are increasingly important to environmentally conscious consumers (Pichler and Hartig, 2023).

In conclusion, AI's predicted trend analysis improves design relevance and promotes sustainable and profitable fashion practices.

Sustainability improvements:

According to many industry participants, AI integration in clothing design must improve sustainability. AI could transform Ready-Made Garments (RMG) sustainability. Supply chain optimization is where AI shines. AI reduces waste and carbon footprint by forecasting demand and streamlining production schedules.

AI can also help designers choose eco-friendly materials and production processes (Behr, 2018). AI may recommend eco-friendly fabrics and energy-efficient production methods to designers by assessing material and manufacturing process environmental footprints (Ellie, · and Cedrola, 2019). AI in fashion design reduces production costs, another sustainable benefit (Reif *et al.*, 2015). AI automates design and production operations, saving time and materials that may be spent on sustainability (Konina, 2023).

In conclusion, AI's RMG sustainability improvements go beyond design and benefit the entire supply chain. AI reduces waste, optimizes processes, and guides eco-conscious fashion decisions, making the sector more sustainable.

Problems with AI Adoption

This research shows that AI integration in Bangladesh's RMG industry has several benefits but raises some issues that must be addressed for success and sustainability.

Job Displacement:

Participants worried about job displacement when discussing AI in clothing design. AI-powered tools have been invaluable, but there is a valid concern that some traditional design work may be mechanized as these technologies improve. Automation may diminish the need for human designers in several industries.

The fear of job loss raises important considerations concerning fashion design's future workforce (Budhwar *et al.*, 2023). It emphasizes the need to handle AI-related job changes. Industry stakeholders should establish upskilling and retraining initiatives to reduce employment losses (Wilson and Daugherty, 2019). These programs can help designers learn new skills and adapt to the changing world, keeping them relevant (Soni, Gautam and Soni, 2023).

Additionally, AI should be used to enhance human creativity rather than replace it. By working with AI, designers can improve their work and create a more harmonious relationship between humans and AI in fashion.

Quality Control:

AI-generated fashion designs require strict quality monitoring. AI excels at fast design generation, but participants stressed the importance of human monitoring in guaranteeing product quality and addressing aesthetic details.

AI, while powerful, may need to understand human sensibility, cultural context, and creativity in design (Arinez *et al.*, 2020). Designers provide designs with brand identity and emotional appeal (Mozaffar *et al.*, 2022). They provide clothes with an artistic and cultural touch that AI cannot match (Escobar *et al.*, 2022). Finding the correct balance between AI automation and human artistry is vital (Halhoul Merabet *et al.*, 2021). AI speeds up the design process, letting designers focus on creativity and ideation (Long *et al.*, 2020). However, human intervention is needed to evaluate and improve AI-generated designs to fulfill customer quality and aesthetic criteria.

While AI can improve design processes, human skill is still needed to preserve and improve fashion designs' quality and uniqueness. AI and human designers working together to produce the most outstanding results is the future of fashion design.

Privacy and security of data

AI-powered fashion design must consider data privacy and security while collecting and using consumer data for customized designs. These issues are becoming more critical to industry players.

AI's capacity to personalize designs requires strict data protection because it analyzes user data (Saura, Ribeiro-Soriano and Palacios-Marqués, 2022). The fashion sector must emphasize strong data security processes to protect sensitive data from breaches (Yan *et al.*, 2020). Establishing and retaining consumer

trust requires addressing data privacy and security concerns (Yang, 2021). Customers expect personal data to be handled ethically when they provide it for tailored design (Himeur *et al.*, 2022). Customer loyalty and brand perception can improve when brands prioritize data security (Keshta, 2022).
Finally, the fashion sector must combine customization with data privacy. Adequate data protection is a statutory obligation and a way to maintain consumer trust and sustain AI-powered fashion creation.

Technological Dependencies
Fashion sector participants are worried about technology dependence. AI has many benefits, but overreliance on it is risky. Participants stressed balancing AI and human talents.
Overreliance on AI could expose firms to technical issues, system disruptions, and unexpected issues. With human experience and decision-making, design, and supply chain operations could thrive.
Industry stakeholders must establish AI-related contingency plans to reduce this risk (Ajeesh and Rukmini, 2022). This includes educating and upskilling human designers to preserve their knowledge and intervention ability (Robbins and van Wynsberghe, 2022). Human innovation and AI collaboration will shape fashion design. AI can speed up processes, boost efficiency, and deliver insights, but human designers have the creative sense and suppleness to handle unexpected situations (Papadopoulos, Antona and Stephanidis, 2021; John *et al.*, 2022). The industry can maximize AI's promise without overusing technology by striking the correct balance.

Ethical Concern:
Industry discussions center on AI ethics in garment design. Designers and industry players have widely discussed AI integration ethical issues.
First and foremost is ethical customer data use. AI uses data for individualized designs, but data collection, storage, and use raise problems (Brendel *et al.*, 2021). Ethical data processing requires consumer consent and transparency (Bamatraf *et al.*, 2021). Also transparent are AI decision-making processes. Designers worry about AI algorithm bias and opacity (Li, Ruijs and Lu, 2022). Maintaining industry trust requires explicit ethical AI design rules and transparent and accountable algorithms (Gonçalves *et al.*, 2023).
AI design advice may reinforce harmful prejudices (Gaspari Cirne de Toledo and Cirne de Toledo Júnior, 2021). Designers and AI developers must collaborate to create culturally sensitive, bias-free AI designs to address this (Papadopoulos, Antona and Stephanidis, 2021).
Finally, AI ethics in garment design highlight the necessity for industry-wide ethical rules and accountability. These approaches can address data privacy, transparency, and bias concerns, ensuring fashion industry AI adoption is ethical.

Promoting Balanced Approach
A balanced approach is needed, given the pros and cons of AI integration in Bangladesh's RMG industry. AI's benefits must be balanced with the sector's identity, skilled labor, and social and environmental responsibilities.

- **Preservation of Human Craftsmanship:** AI can automate many design activities, but human creativity and craftsmanship are irreplaceable. Participants stressed the importance of keeping clothing design human-centered by using AI to supplement designers.
- **Skill Development Training:** Skill development and training are needed to address job displacement. Designers should be trained to use AI technologies by the industry.

- **Ethical Guidelines:** To reduce ethical concerns, ethical AI norms must be created and implemented. These rules should ensure ethical garment design using AI through transparency, fairness, and data handling. The RMG sector must focus on technology preparedness to avoid AI overdependence. Long-term resilience requires a varied skill set and adaptability to new technology.
- **Innovation:** AI developers, designers, and industry stakeholders can collaborate to innovate. By working together, these stakeholders can develop AI technologies that meet Bangladesh's RMG sector's needs and values.

POLICY RECOMMENDATIONS

- Investment in Skill Development and Training: The government and industry stakeholders should work together on comprehensive skill development and training initiatives to address job displacement. These programs should teach RMG designers and workers how to use AI tools. This investment in human capital will keep workers relevant and adaptive in an AI-driven industry.
- Ethical AI Guidelines: The government and industry associations should create clear and comprehensive AI ethics for garment design to address ethical problems. These principles should include transparency in AI decision-making, appropriate data handling, and ways to prevent AI-generated designs from reinforcing harmful preconceptions. These principles should apply to all RMG AI applications.
- Technology Readiness efforts: The government and industry should engage in technology readiness efforts to minimize AI overdependence and retain a varied skill set. This involves boosting AI technology research and development, AI-enhancing tool use, and RMG-specific AI solution creation. Technology-ready industries can adapt to evolving technology.
- Public-Private Collaboration: RMG innovation requires AI developers, designers, and stakeholders to collaborate. By providing forums and incentives, the government can help these parties collaborate. AI tools tailored to Bangladesh's RMG sector can be developed through joint ventures and research.
- Data Privacy and Security Regulations: The government should pass and implement strict restrictions on customer data collecting, storage, and use in clothing design. These rules should prioritize data security and comply with international data privacy requirements. Audits and inspections maintain data security.
- Financial Support for AI Adoption: The government might offer financial incentives and support to RMG enterprises that use AI technologies due to their potential benefits. This may include subsidies for AI technology purchases, AI application research and development grants, and tax incentives for AI training and infrastructure investments.
- Awareness and Education initiatives: The government can support balanced AI adoption through awareness and education initiatives. These efforts should educate industry stakeholders, designers, and the public on RMG AI integration's pros and cons. They can also emphasize garment design ethics and craftsmanship.

CONCLUSION

Using AI in ready-made garment (RMG) design is promising for Bangladesh's industry. It boosts productivity, customization, trend analysis, and sustainability. However, this disruptive technology poses genuine issues about employment displacement, quality control, data privacy, technology dependence, and ethics.

Bangladesh's RMG industry needs a balanced AI adoption strategy to thrive and survive. This method respects human artistry and the sector's individuality. Responsible AI integration relies on talent development, ethical AI guidelines, technical preparedness, and teamwork.

Skill development allows the sector to equip its staff to work with AI tools, reducing job displacement. Ethics-based AI rules will protect customer data and ensure responsible AI use. Technology preparation programs will avoid AI overuse, maintaining resilience. Collaboration amongst stakeholders will spur innovation, creating AI solutions that meet the sector's demands and ideals.

The government, industry associations, and enterprises must execute these policies collectively. Bangladesh can use AI's potential in RMG design while sustaining its garment industry. This balanced approach would boost economic growth and protect social and environmental responsibilities, ensuring Bangladesh's RMG sector's future success.

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