



Understanding Fashion in the Metaverse: A Topic Modeling Approach

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Background and Significance. The metaverse is defined as “... immersive three-dimensional virtual worlds where people interact with each other and their environment, using the metaphor of the real world but without its physical limitations” (Owen, 2011, p. 74). The global market size of the metaverse was \$47.48 billion in 2022, and is expected to grow up to \$678.8 billion by 2030 (Strategic Market Research, 2022), while the global digital fashion market is expected to grow to \$50 billion by 2030 (Jana, 2022). With the accelerated growth of metaverse industry since the pandemic, fashion brands are involved in multiple metaverse platforms depending upon their status, such as gaming platforms (e.g., Roblox, Fornite, Minecraft, The Sandbox, Decentraland) by established brands, marketplaces (e.g., BNV, UNXD) by high fashion brands and start-ups, and minting platforms (e.g., Digitalax, The Fabricant Studio, DressX, The Artisant) by independent designers and fashion amateurs (Gonzales, 2022). Digital fashion products are sold in the metaverse, including clothes worn by avatars, clothes rendered on pictures and in videos (i.e., non-fungible tokens, NFTs), and virtual clothes with physical counterparts in virtual venues (e.g., digital twin stores) in the metaverse (Gonzales, 2022).

An appropriate approach to determine the public’s interests in certain topics (in our case, fashion in the metaverse) is to analyze user-generated content on social media (Krumm et al., 2008). When investigating dominant topics in social media, Twitter is a suitable social media platform because tweets are short; thus, each tweet with a maximum of 280 characters was assigned to one topic at a time using a topic modeling analysis (Ridhwan & Hargreaves, 2021). Although some studies have analyzed Twitter data extracted during the major four fashion weeks (e.g., Kim & Lee, 2022), it is essential to examine data from a longer period to understand the public’s interests in fashion in the metaverse fully. Thus, the purpose of this study was to explore dominant topics about fashion associated with the metaverse discussed on Twitter through a topic modeling approach. To guide this study, a conceptual framework was created based upon four key concepts of the metaverse: (1) content and experiences; (2) platforms; (3) infrastructures and hardware; and (4) enablers (Elmasry et al., 2022). A previous study on consumers’ responses to the news articles regarding the meta fashion (Shin et al., 2023) supported the three key themes of the metaverse: Content and experiences (e.g., digital content and production, fashion brand & entertainment), platforms (e.g., metaverse platform), and infrastructures and hardware (e.g., AR/VR) (Shin et al., 2023).

Methods. A total of 187,510 tweets that contained four keywords (i.e., fashion, clothing, wearable, and apparel) in conjunction with the term “metaverse” were crawled for three years from January 1 2019 to December 31, 2022. We followed the recommendations of Ridhwan and Harfreave study (2021) to clean and preprocess the tweets. Duplicate tweets, numbers, web links, extra spacing, punctuation, hashtags, and stop words were removed, as well as our keywords.

After cleaning and preprocessing, 38,165 unique words were extracted from 84,742 tweets. Two stages of topic analyses were performed. First, a sequence of Latent Dirichlet Allocation (LDA) topic analyses was conducted (from 2 to 30 in increments of 2) to obtain the coherence scores and determine the optimal number of topics. Sixteen topics with the highest coherence score of .45 were selected. Second, the Gibbs Sampling Dirichlet Multinomial Mixture (GSDMM) model (Yin & Wang, 2014) was used to assign one topic to each tweet. Then, the 16-topics GSDMM model with the dimensionality reduction method (t-SNE) was visualized using a pyLDAvis visualization (Figure 1).

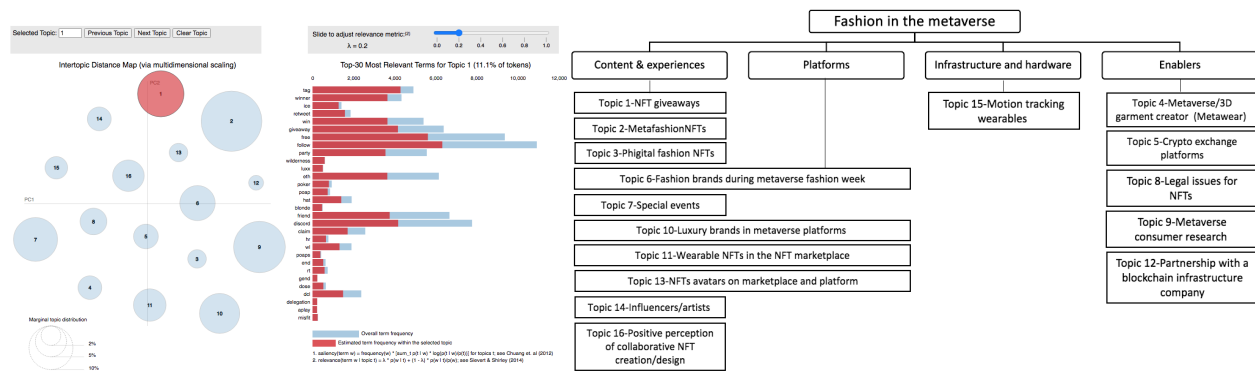


Figure 1. Image of pyLDAvis’ visualization of the 16 topics-GSDMM model (left) and a conceptual framework with 16 topics and 4 themes (right)

Results. The sixteen topics were labeled according to the unique keywords shown in each topic (Figure 1). Based upon the conceptual framework, we categorized each topic into the four main themes. In the theme of content and experiences, MetafashionNFTs (e.g., 3D art pieces) was the topic mentioned most frequently (17.8%), followed by NFT giveaways (11%), and special events (e.g., summits, workshops, panel discussions) (10.2%). Positive perceptions of collaborative NFT creation and design (6.6%), influencers/artists (2.8%), and phigital (i.e., physical + digital) fashion NFTs (1.5%) were also included. There were four crossover topics between two themes: content and experiences and platforms. Tweets on luxury brands (e.g., Gucci, Ralph Lauren, Burberry, Louis Vuitton) (8.4%) and fashion brands in the metaverse (e.g., Tommy Hilfinger, Estee Lauder, Selfridges) during the metaverse fashion week (8.1%) were mentioned often on metaverse platforms (e.g., The Sandbox, Roblox, Decentraland). For certain marketplaces (e.g., Sator) or platforms (e.g., Meta), wearable NFTs (e.g., tank tops, sneakerheads) (5.9%) and NFT avatars (1.9%) were mentioned. With respect to hardware, Sony’s motion tracking wearables were mentioned (2.5%). Regarding enablers of the metaverse in the fashion industry, approximately 13% of tweets were related to metaverse consumer research followed by legal issues for NFTs (e.g., trademark filing for Hermes’ metabirkins, 3.5%), crypto exchange platform (e.g., Huobi and Gate, 2.9%), metaverse/3D garment creator (i.e., Metawear, 2.5%), and

a fashion company's (i.e., RYU apparel Inc.) partnership with a blockchain based company (e.g., DealBox, 1.0%).

Discussion and Conclusions. This study applied topic modeling to explore dominant topics on fashion in the metaverse on Twitter. The data were understood best when classified into 16 topics that were found under the four key building blocks of the metaverse (Elmasry et al., 2022). This study provided meaningful insights for the fashion communication literature through an empirical analysis of topics and themes expressed on Twitter. This study offered practical insights to understand the public's interests in fashion brands' marketing strategies and types of digital fashion products sold in metaverse platforms and supporting services. Future studies should consider applying sentiment analysis to each topic to determine whether it was discussed positively, negatively, or neutrally, which will be more reflective of consumers' opinions about their experiences in certain metaverse platforms and responses to certain brands' digital fashion products and marketing strategies.

References

- Blei, D. M., Ng, A. Y., & Jordan, M. I. (2003). Latent dirichlet allocation. *The Journal of Machine Learning Research*, 3(Jan), 993–1022.
- Elmasry, T., Kahn, H., Yee, L., Hazan, E., ... Zimmel, R. W. (2022). *Value creation in the metaverse: The real business of the virtual world*. McKinsey & Company, <https://www.mckinsey.com/capabilities/growth-marketing-and-sales/our-insights/value-creation-in-the-metaverse>
- Gonzalez, P. (2022). *Digital fashion in the metaverse*. [Master's thesis], Politecnico di Milano.
- Jana, R. (2022 April 11). *The metaverse could radically reshape fashion*. Wired. <https://www.wired.com/story/extreme-fashion-metaverse/>
- Owens, D., Mitchell, A., Khazanchi, D., & Zigurs, I. (2011). An empirical investigation of virtual world projects and metaverse technology capabilities. *ACM SIGMIS Database: The DATABASE for Advances in Information Systems*, 42(1), 74-101.
- Ridhwan, K., & Hargreaves, C. A. (2021). Leveraging Twitter data to understand public sentiment for the COVID-19 outbreak in Singapore. *International Journal of Information Management Data Insights*, 1(2), 100021.
- Shin, J. Y., Suk, J., & Chung, J. E. (2023, February). Consumer responses to fashion in the metaverse: A text-mining analysis on online news comments. In *Advances in Information and Communication: Proceedings of the 2023 Future of Information and Communication Conference (FICC)*, Volume 1 (pp. 12-24). Springer Nature.
- Yin, J., & Wang, J. (2014). A dirichlet multinomial mixture model-based approach for short text clustering. In *Proceedings of the 20th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining* (pp. 233-242). ACM.