Reverse Engineering For Textile Manufacture Using Artificial Intelligence Methods: A Review"

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Abstract:

Modern artificial intelligence technology is developing quickly, and as it integrates gradually. The use of artificial intelligence technologies in the textile business, together with the spinning sector make the manufacture of textiles ever more accurate, quick, and efficient. By collecting and analyzing big data, artificial intelligence systems can improve production processes, reduce costs, improve quality, and increase productivity. AI methods that can identify patterns in photos have performed remarkably well in object recognition, materials, and image processing in particular in recent years. These algorithms provide precise and quick data-driven solutions, which successfully improve operations' efficacy and efficiency. Textiles can provide valuable information that can be extracted using AI techniques like computer vision, deep learning, and machine learning, which are used to analyze images, videos, and other sorts of data. Reverse engineering is the process of dissecting a system or product to determine its design and functionality. Reverse engineering is a method that can be applied in the textile industry to analyze and dismantle existing textile products in order to make them better or more identical. This article reviews discusses artificial intelligence techniques used in reverse engineering processes within textile production.

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- 1- Dwivedi, Yogesh K., Laurie Hughes, Elvira Ismagilova, Gert Aarts, Crispin Coombs, Tom Crick, Yanqing Duan et al. "Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy." International journal of information management 57 (2021): 101994.
- 2- Valavanidis, Athanasios. "Artificial Intelligence (AI) Applications." Department of Chemistry, National and Kapodistrian University of Athens, University Campus Zografou 15784 (2023)..
- 3- Xu, Yongjun, Xin Liu, Xin Cao, Changping Huang, Enke Liu, Sen Qian, Xingchen Liu et al. "Artificial intelligence: A powerful paradigm for scientific research." The Innovation 2, no. 4 (2021).
- 4- Wan, Jiafu, Xiaomin Li, Hong-Ning Dai, Andrew Kusiak, Miguel Martinez-Garcia, and Di Li. "Artificial-intelligence-driven customized manufacturing factory: key technologies, applications, and challenges." Proceedings of the IEEE 109, no. 4 (2020): 377-398.

- 5- https://builtin.com/artificial-intelligence
- 6- Bullon, Juan, María Angélica González Arrieta, María Ascensión Hernández Encinas, and María Araceli Queiruga Dios. "Manufacturing processes in the textile industry. Expert Systems for fabrics production." (2017).
- 7- Servi, Michaela, Roberto Magherini, Francesco Buonamici, Yary Volpe, and Rocco Furferi. "Integration of artificial intelligence and augmented reality for assisted detection of textile defects." Journal of Engineered Fibers and Fabrics 19 (2024): 15589250231206502.
- 8- Ian Mackie, Introduction to Artificial Intelligence Second Edition(Springer International Publishing, Gewerbestrasse 11, 6330 Cham, Switzerland, 2017).
- 9- Østerlund, Carsten, Mohammad Hossein Jarrahi, Matthew Willis, Karen Boyd, and Christine T Wolf. "Artificial intelligence and the world of work, a co-constitutive relationship." Journal of the Association for Information Science and Technology 72, no. 1 (2021): 128-135.
- 10-BABU, Mr V. SOWRI, and KRISHNA BANANA. "A STUDY ON NARROW ARTIFICIAL INTELLIGENCE-AN OVERVIEW."
- 11-Goertzel, Ben. "Artificial general intelligence: concept, state of the art, and future prospects." Journal of Artificial General Intelligence 5, no. 1 (2014): 1.
- 12-Bahman Zohuri. Artificial Super Intelligence (ASI) The Evolution of AI Beyond Human Capacity. Current Trends in Engineering Science (CTES), 3(7), 1-5, 2023.
- 13- Alpaydin, Ethem (2010). Introduction to Machine Learning. MIT Press. p. 9. ISBN 978-0-262-01243-0.
- 14-https://www.sas.com > SAS Insights > Analytics Insights
- 15-Ayushi Chahal, Preeti Gulia . Machine Learning and Deep Learning. International Journal of Innovative Technology and Exploring Engineering (IJITEE), 8(12), 1-6, 2019.
- 16-P. Kuang, W.-N. Cao, and Q. Wu, "Preview on structures and algorithms of deep learning," in 2014 11th International Computer Conference on Wavelet Actiev Media Technology and Information Processing(ICCWAMTIP), Chengdu, China, 2014, pp. 176–179.
- 17-L. Deng, "Deep Learning: Methods and Applications," Found. Trends® Signal Process., vol. 7, no. 3–4, pp. 197–387, 2014.
- 18-Mohaiminul Islam, Guorong Chen, Shangzhu Jin. An Overview of Neural Network. American Journal of Neural Networks and Applications. 5(1), 7-11, 2019.
- 19-Longfei Zhou, Member, IEEE, Lin Zhang and others. Computer Vision Techniques in Manufacturing. IEEE Transactions on Systems Man and Cybernetics Systems,1-13,2022.
- 20-Dr. M.John Basha1,* Dr.S.Vijayakumar2 J.Jayashankari and others. Advancements in Natural Language Processing for Text Understanding. E3S Web of Conferences 399, 04031 (2023).
- 21-Girish Kumar jha, "Artificial Neural Networks and its applications" international journal of computer science and issues 2005.
- 22-Jatin Borana. Applications of Artificial Intelligence & Associated Technologies. Proceeding of International Conference on Emerging Technologies in Engineering, Biomedical, Management and Science [ETEBMS-2016], 5-6 March 2016.
- 23-Mr. Vinayak Pujari1, Dr. Yogeshkumar Sharma 2 and Mr. Omkar Burate. Application in Artificial Intelligence. "Emerging Advancement and Challenges in Science, Technology and Management " 23rd & 24th April, 2021 39-44.
- 24-Gwendo John Oloo. Trends and Insights on Tools Used for the Development of Expert Systems: A Systematic Review of Research Articles (2018-2022) . International Journal of Engineering Applied Sciences and Technology,8(1), 331-347,2023.
- 25-Rajab Asaad, R. Review on Deep Learning and Neural Network Implementation for Emotions Recognition . Qubahan Academic Journal, 2021, 1(1), 1–4.
- 26-https://www.javatpoint.com/application-of-ai
- 27-Mr. Tesfay welamo1, Professor Deng1Sanpeng. Application of Artificial Intelligence in Textile Industry. Journal of Emerging Technologies and Innovative Research (JETIR),8(10), 49-64, 2021.

- 28-Monica Puri Sikka, Alok Sarkar and Samridhi Garg. Artificial intelligence (AI) in textile industry operational modernization. Research Journal of Textile and Apparel.28(7), 1-17, 2022.
- 29-Bu, H.-G., Wang, J. and Huang, X.-B. (2008), "Fabric defect detection based on multiple fractal features and supportive vector data description", Engineering Application of Artificial Intelligence, Vol. 22.
- 30-Rahman, Md Fashiar, Jianguo Wu, and Tzu Liang Bill Tseng. "Automatic morphological extraction of fibers from SEM images for quality control of short fiber-reinforced composites manufacturing." CIRP Journal of Manufacturing Science and Technology 33 (2021): 176-187.
- 31-M.J. Abghary, M.S. Johari, and S. Hassanzadeh, "Effects of OE spinning parameters on cotton rotorspun yarn hairiness", Indian J. Fibre Text. Res., vol. 41, no. 2, pp. 129-137, 2016.
- 32-Steadman, R. G. "Cotton testing." Textile progress 27, no. 1 (1997): 1-63.
- 33-STJEPANOVIC, ZORAN, and Anton Jezernik. "Optimisation of cotton fibre blends using AI machine learning techniques."
- 34- Yau-Ren Shiau, I-Shou Tsai, Chih-Shiang Lin .Classifying web defects with a backpropagation neural network by color image processing Text. Res. J., 70 (7) (2000), pp. 633-640
- 35-Adel El-Geiheini, Sherien ElKateb, Manal R. Abd-Elhamied. Yarn Tensile Properties Modeling Using Artificial Intelligence. Alexandria Engineering Journa, 59(6) 4435-4440,2020.
- 36-Li, Zhisong, Ping Zhong, Xin Tang, Yu Chen, Shu Su, and Tianbao Zhai. "A new method to evaluate yarn appearance qualities based on machine vision and image processing." IEEE Access 8 (2020): 30928-30937.
- 37-Marco Vinicio Cevallos Bravo, William Marcelo Ponce Iturralde. Artificial Intelligence in the Management of Textile Companies: A Contextual Analysis. Open Journal of Business and Management. 12, 945-960,2024.
- 38-Li, C., Li, J., Li, Y., He, L., Fu, X., & Chen, J.. Fabric defect detection in textile manufacturing: a survey of the state of the art. Security and Communication Networks, 2021.
- 39-Deageon Kim and Dongoun Lee . Fabric Defect Detection Based on Artificial Intelligence. International Journal of Intelligent Systems and Applications in Engineering. , 11(5s), 01–07 |,2024.
- 40-Rasheed, Aqsa, Bushra Zafar, Amina Rasheed, Nouman Ali, Muhammad Sajid, Saadat Hanif Dar, Usman Habib, Tehmina Shehryar, and Muhammad Tariq Mahmood. "Fabric defect detection using computer vision techniques: a comprehensive review." Mathematical Problems in Engineering 2020, no. 1 (2020): 8189403.
- 41-Renzo Shamey, Tanveer Hussain. Artificial intelligence in the colour and textile industry. Review of Progress in Coloration and Related Topics. 33(1),33 45, 2008.
- 42-Amelio, Alessia, Gianluca Bonifazi, Francesco Cauteruccio, Enrico Corradini, Michele Marchetti, Domenico Ursino, and Luca Virgili. "DLE4FC: a Deep Learning Ensemble to Identify Fabric Colors." In SEBD, pp. 13-21. 2023.
- 43-Senbiao Liu1, Yaohui Keane Liu2, Kwan-yu Chris Lo1,3 and Chi-wai Kan. Intelligent techniques and optimization algorithms in textile colour management: a systematic review of applications and prediction accuracy. Fashion and Textiles. 11:13, 1-38,2024.
- 44-Vinesh Raja, University of Warwick, UK. Reverse Engineering An Industrial Perspective. Chapter 1 Introduction to Reverse Engineering. 1-8,
- 45-Ivana Špelić. Applying 3D scanning and CAD reverseengineering for clothing thermal analysis. Špelić, Cogent Engineering.1-22,2021
- 46-Kuo C-FJ, Lee C-J. A back-propagation neural network for recognizing fabric defects. Textil Res J 2003; 73: 147–151. Crossref. ISI.
- 47-Kuo W, Li D, Zhu L, et al. A new approach for image processing in foreign fiber

detection. Comput Electron Agric 2009; 68: 68-77. Crossref. ISI.

- 48- Kuo M, Escofet J, Millán MS. Weave-repeat identification by structural analysis of fabric images. J Appl Opt 2003; 42: 3361–3372. Crossref. PubMed. ISI.
- 49-KuoGao WD, Liu HJ, Xu BJ, et al. The automatic recognition for weft array parameter. Cotton Manuf Technol 2002; 30: 28–29.
- 50-Z. Xu, Y. Zhao, Z. Deng, and L. Chen, "Research actuality on automatic measure method of fabric density," Progress Textile Sci. Technol., vol. 6, pp. 3–5, 2005.
- 51-Kazım Yildiz, Volkan Yusuf Şenyürek, Zehra Yildiz, Mustafa Sabri Özen. A New Approach to the Determination of Warp-Weft Densities in Textile Fabrics by Using an Image Processing Technique. Journal of Engineered Fibers and Fabrics. 9(1),2014.
- 52-https://www.slideshare.net/slideshow/01concept-of-fabric-analysispdf/254972427
- 53-Erdo `gan Aldemira, Hakan Özdemirb and Zekeriya Sarı. An improved gray line profile method to inspect the warp-weft density of fabrics. The Journal of The textile institue. 1-14,2018.
- 54-Zeydan, Mithat. "Prediction of fabric tensile strength by modelling the woven fabric." Woven Fabric Engineering 155 (2010): 925-933.
- 55-Techniková, L., & Tunak, M. (2013). Weaving density evaluation with the aid of image analysis. Fibres & Textiles in Eastern Europe, Nr 2(98), 74–79.
- 56-Mamun, Abdullah Al, M. M. Nabi, Fahmida Islam, Mahathir Mohammad Bappy, Mohammad Abbas Uddin, Mohammad Sazzad Hossain, and Amit Talukder. "Streamline video-based automatic fabric pattern recognition using Bayesian-optimized convolutional neural network." The Journal of The Textile Institute (2023): 1-14
- 57-Hosseini Ravandi, S. Abdolkarim, and Koichiro Toriumi. "Fourier transform analysis of plain weave fabric appearance." Textile Research Journal 65, no. 11 (1995): 676-683.
- 58-Le, Bach, David Troendle, and Byunghyun Jang. "Detecting fabric density and weft distortion in woven fabrics using the discrete fourier transform." In Proceedings of the 2021 ACM Southeast Conference, pp. 108-113. 2021.
- 59-Maroš, T., & Aleš, L. (2004). Applying spectral analysis to automatic inspection of weaving density. In 16th International Conference Structure and Structural Mechanics of Textiles, Liberec, Çek Cumhuriyeti.
- 60-Pan, R., Gao, W., Li, Z., Gou, J., Zhang, J., & Zhu, D. (2015). Measuring thread densities of woven fabric using the fourier transform. Fibres & Textiles in Eastern Europe, 23,1(109), 35–40.
- 61-Jing, J., Liu, S., Li, P., Li, Q., Liu, S., & Jiang, M. (2014). Automatic density detection of woven fabrics via wavelet transform. Journal of Information & Computational Science, 11(8), 2559–2568.
- 62-Islam, Shariful, Sutapa Chowdhury, and Shilpi Akter. "The experiential analysis of woven fabric for reproduction." Journal of Textile Science and Technology 4, no. 1 (2018): 18-48.
- 63-Tsai, D. M., Chang, C. C., & Chao, S. M. (2010). Micro-crack inspection in heterogeneously textured solar wafers using anisotropic diffusion. Image and Vision Computing, 28(3), 491–501.
- 64- Cybulska M. Analysis of Warp Destruction in the Process of Weaving Using the System for Assessment of the Yarn Structure. Fibres & Textiles in Eastern Europe 1997; 5(4): 68–72.
- 65-Wu Y, Pourdeyhimi B, Spivak M. Texture Evaluation of Carpets Using Image Analysis. Textile Res. J.1991; 61(7): 407-419.
- 66-Jasińska, Izabela. "Assessment of a fabric surface after the pilling process based on image analysis." Fibres & Textiles in Eastern Europe 17, no. 2 (2009): 73.
- 67-Ebraheem Shady, Khadijah Qashqary, Mounir Hassan, Jiri Militky. Image Processing Based Method Evaluating Fabric Structure Characteristics. FIBRES & TEXTILES in Eastern Europe. 20(95), 86-90,2012.
- 68-Muhammad Ather Iqbal Hussain , Babar Khan, Zhijie Wang and Shenyi Ding . Woven Fabric Pattern Recognition and Classification Based on Deep Convolutional Neural Networks. Electronics . 9, 1048, 1-12,2020.

69-He, K.; Zhang, X.; Ren, S.; Sun, J. Deep residual learning for image recognition. In Proceedings of the 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Las Vegas, NV, USA, 27–30 June 2016; pp. 770–778

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