USE OF DEEP LEARNING FOR PREDICTION OF PHYSICAL PROPERTIES OF DENIM GARMENT

Ebru Çalışkan[1], İbrahim Erdem Kalkan[2], Onur Balcı[3], Cenk Şahin[4] , Yusuf Kuvvetli[5],

[1] Baykan Denim R&D Center 2nd Organized Industrial Zone Yeşilyurt / Malatya, e-mail: ebru.caliskan@baykandenim.com
[2] Çukurova University Department of Industrial Engineering Sarıçam / Adana, e-mail: iekalkan@cu.edu.tr
[3] The University of Kahramanmaraş Sütçü İmam Textile Engineering Dep. 12 Şubat / K.Maraş, e-mail: obalci@ksu.edu.tr
[4] Çukurova University Department of Industrial Engineering Sarıçam / Adana, e-mail: cenksahin@cu.edu.tr
[5] Çukurova University Department of Industrial Engineering Sarıçam / Adana, e-mail: ykuvvetli@cu.edu.tr

Abstract: For denim garments producers, conducting design activities such as product development, improving the washing process, and translating them into actual production with minimum waste and cost, without bottlenecking routine production, and within short-term deadlines, is an important need. Looking at the common finishing processes used in denim, bleaching (sodium hypochlorite & potassium permanganate), stone washing, and ozone stand out. Among these processes, the bleaching is considered to be the one with the highest number of variables and the greatest impact on the product's value addition. The use of artificial neural networks (ANNs) in predicting the effects of processes applied to fabrics is encountered in studies. Farooq et al. employ an ANN system to predict the phenomenon of color change for different colors and shade percentages [1]. Mandal et al. model the relationships between measured fabric properties (such as thickness, weight, fabric count) and thermal protective performance and thermo-physiological comfort performance using an ANN to analyze garment performance [2]. Elkateb includes a study on predicting output properties of woven fabrics with ANNs across different characteristics [3]. In this study, the proposed ANN prediction model will equip businesses with an agile and thus more efficient approach to digitized bleaching and R&D process.

This study aims to predict the possible changes in the physical properties of the denim garment after the bleaching process, depending on process valuables and fabric properties to prevent production-related fabric defects. In this study, the prediction model has been developed using collected data to predict the output of physical properties of denim garment. In the current state, an ANN is used for modeling with the 50 collected data points. Measured tear strength (in the warp-weft direction), fabric weight (gr/m2), elasticity (%), and growth (%) have been predicted after the treated bleaching process. The process features of the model are the number of bleaching cycles, total process time, and concentration of sodium hypochlorite (representing the total amount of chemical used). The bleaching number indicates how many times the same bleaching process is replicated to reach the desired visual effect. In addition, the constructional fabric properties as yarn count, weaving pattern and density, the GSM of raw fabric, and physical properties of fabric as tear strength (cN), fabric weight (gr/m2), elasticity (%), and growth (%) are accepted as inputs of the models. Finally, the fabric images are added to the model passing through a Convolutional Neural Network (CNN) structure to obtain visual features. Before the bleaching application stone washing and laser fading processes were applied to the fabrics at the same condition in order to get the suitable ground effect for the denim. Figure 1 shows the designed model. Mean absolute error is used as the loss function, and adaptive momentum is used as the optimizer.

Keywords: *denim, bleaching, effect, deep learning*

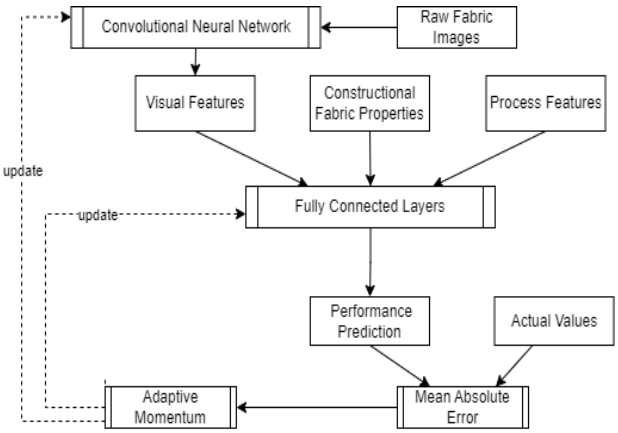

Figure – 1. Model Schema

ACKNOWLEDGEMENT*: This study includes the outputs of research project supported by TÜBİTAK. The authors would like to thank the institution for their support.*

REFERENCES

[1] A. Farooq, F. Irshad, R. Azeemi, N. Iqbal, "Prognosticating the shade change after softener application using artificial neural networks," *Autex Research Journal,* cilt 21, no. 1, pp. 79-84, 2020.

[2] S. Mandal, N.U.S. Mazumder, R. Agnew, I. G. Grover, G. Song, R. Li, "Using Artificial Neural Network Modeling to Analyze the Thermal Protective and Thermo-Physiological Comfort Performance of Textile Fabrics Used in Oilfield Workers' Clothing," *Int. J. Environ. Res. Public Health,* cilt 2021, no. 18, p. 6991, 2021.

[3] S. N. Elkateb, "Prediction of Mechanical Properties of Woven Fabrics by ANN," *Fibres & Textiles in Eastern Europe,* cilt 30, no. 4, pp. 54-59, 2022.