Automated recognition and sorting of recycled textiles for sustainable fashion

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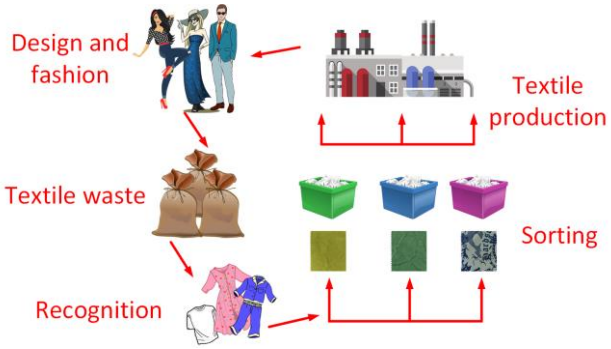
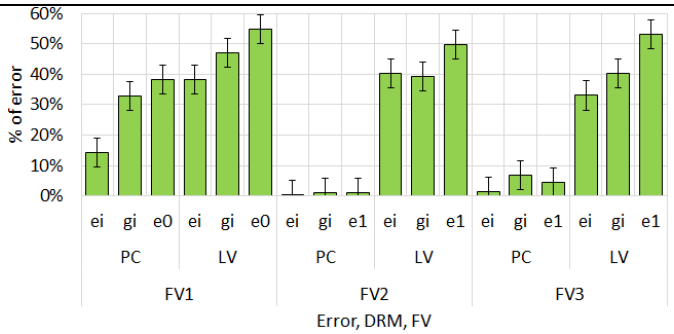
The application of the principles of sustainable fashion is one of the solutions to reduce the amount of waste from textile production and the use of such fabrics.
The identification of the types of fibers used in textile fabrics is important when sorting them for recycling. Spectrophotometric methods have effective application in this subject area.
In the present work, an analysis of known methods and approaches applied so far using the techniques of spectral analysis.
The proposed methods and procedures lead to improvement and facilitation of the process of classification of textile fibers in sorting and recycling of textile fabrics, in order to implement in automated systems.
The proposed analysis tools do not require high cost of the equipment and complex calculation procedures. They can be implemented in portable devices and microprocessor-based recognition systems.
It has been found that two principal components and two latent variables are sufficient to describe more than 95% of the variance in the data. This significantly reduces the amount of data used to analyze textile fibers by their spectral characteristics.
It has been shown that the accuracy of classification of textile fibers does not depend on the type of separation function of the classifier used. This accuracy depends on the features used, the method of reducing the data volume in the feature vector, and the type of classifier.
The obtained results can be used in the development of recognition systems for sorting textile fabrics depending on the composition of their fibers. Also, the proposed methods and tools can be used in the training of future specialists in the subject area.



Cycle for reuse of textile materials

Experimental set-up for obtaining microscopic images - general view. 1-personal computer with software; 2-microscope; 3-video camera; 4-measured sample



Averaged error values in a naïve Bayesian classifier
DRM-data reduction method; FV-feature vector

Rezuts from classification with k-Nearest Neighbors (kNN) and Discriminant Analysis (DA)

Classifier	kNN			DA-Linear			DA-Quadratic		
Error	e_i	g_i	e_0	e_i	g_i	e_0	e_i	g_i	e_0
S1-S2	25%	0%	0%	0%	0%	9%	0%	0%	9%
S1-S3	31%	0%	0%	0%	0%	9%	0%	0%	9%
S1-S4	43%	0%	0%	0%	0%	9%	0%	0%	9%
S1-S5	35%	0%	0%	0%	0%	9%	0%	0%	9%
S2-S3	31%	0%	0%	0%	0%	9%	0%	0%	9%
S2-S4	35%	0%	0%	0%	0%	9%	0%	0%	9%
S2-S5	35%	0%	0%	0%	0%	9%	0%	0%	9%
S3-S4	57%	36%	0%	0%	0%	9%	0%	0%	9%
S3-S5	35%	0%	0%	0%	0%	9%	0%	0%	9%
S4-S5	24%	0%	0%	0%	0%	9%	0%	0%	9%