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Review paper
ISSN 0351-9465, E-ISSN 2466-2585
https://doi.org/10.5937/zasmat2203291D

Zastita Materijala 63 (3)
291 - 299 (2022)

Application of artificial neural network in determining the fabric weave pattern

ABSTRACT

The weave pattern (texture) of woven fabric is considered to be an important factor of the design and production of high-quality fabric. Traditionally, the recognition of woven fabric has a lot of challenges due to its manual visual inspection. The approaches based on early machine learning algorithms directly depend on handcrafted features, which are time-consuming and occurs more errors. Hence, an automated system is needed for classification of woven fabric to improve productivity. Along with the rapid development of computer vision, the automatic and efficient methods for woven fabric classification are desperately needed. The prediction of fabric weave pattern Fabric is done by acquiring the high-quality images of the fabric. Then the acquired images are subjected to weave classification algorithm. The output of the processed image is used as an input to the Artificial Neural Network (ANN) which uses back propagation algorithm to calculate the weighted factors and generates the desired classification of weave patterns as an output. In this review paper discussed about the study on the various neural network that are used for prediction of fabric weave pattern.

Keywords: *Artificial Neural Network (ANN), Fabric pattern, fabric pattern prediction, Classification of fabric pattern, Back propagation algorithm.*

1. INTRODUCTION

The interlacing of the warp ends and weft picks which are referred to as weave. A weave repeat can be shown in the form of square or grid paper designs. Woven fabrics are the highly structured materials, the properties like appearance, handle and mechanical which will create an impact in structures .An accurate identification of structural characteristics will provide a tool for the evaluation of fabric appearance and quality control. The analysis is made in the fabric to determine the fabric pattern. The real time data processing and the automatic method are employed for the detection and discrimination in the place of the manual measurement. In terms of traditional method to analyze the fabric structures is done by manual operation with the help of microscope which is the tedious time consuming process. But the automatic identification of a fabric pattern is desirable and reduces labor cost and time consumption. Artificial Neural Network which are referred to as a non linear statistical data model that replicate the role of a biological NNs .Here they commonly used a statistical approach to study and utilize in the practice.ANN is now increasing the attractive, efficient and also successful in achieving the recognition of fabric patterns[1]. ANN is suitable for real time problems which is nonlinear in nature. And have parallel processing ability. The neural networks can handle classification problems with high accuracy. An application of ANN is increasing in textile industry.

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Paper received: 03. 03. 2022.
Paper accepted: 26. 03. 2022.
Paper is available on the website: www.idk.org.rs/journal

2. LITERATURE REVIEW

Digital image processing

The weave types are analysed by using the two dimensional transformation pattern of the reflected image. By using the image processing system, data collection and analysis are done. The schematic diagram of image processing system is shown in figure 1. The structural unit observed in the unit cell obtained by warp yarns and filling yarns in the Fourier space[2]. Harness of the weave is determined by counting the number of power spectra present in the unit cell. Structural unit is equivalent to the fourier power spectrum arrangement of the reflected image rotated by 90 degree. Figure 2 shows the Geometrical arrangement to obtain the images of the woven fabric.

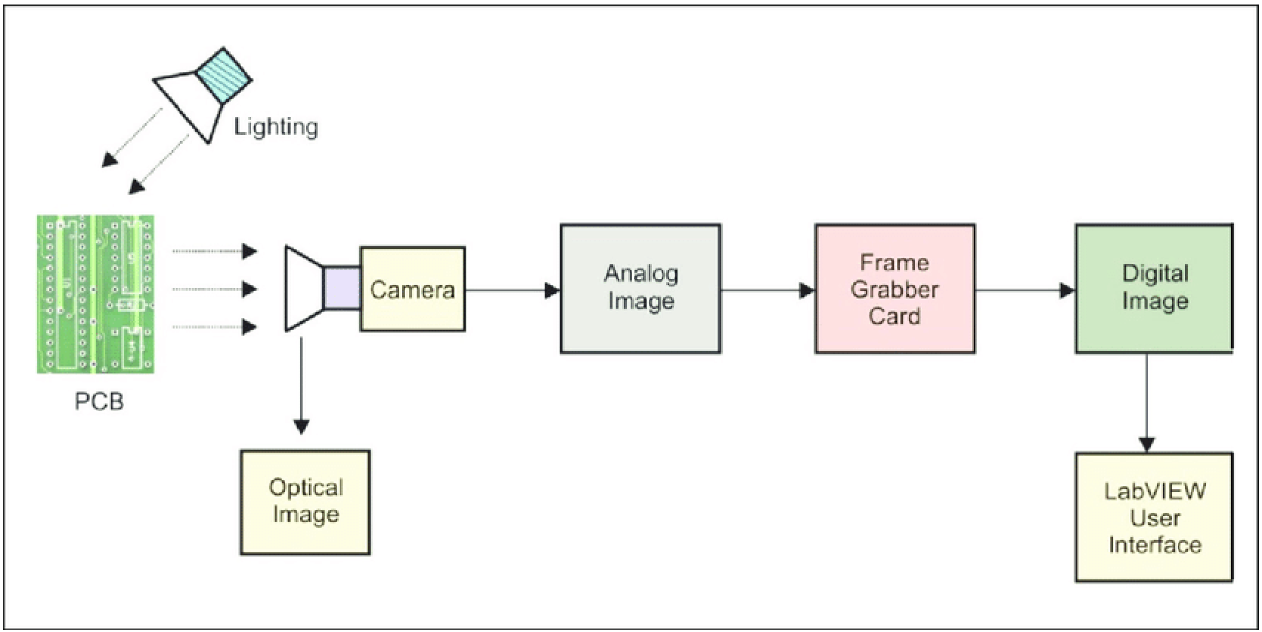

Figure 1. Schematic diagram of image processing system

Slika 1. Šematski dijagram sistema za obradu slike

The numerical results of the fourier transform summarized by:

The structural unit of weave type is observed in the cell associated in the neighbouring two warp and filling yarns.

The number of the harness, n is given by counting the number of light spots, t, present in the unit cell. The relationship is given as

$N = t + l.$

The structural unit, texture pattern is obtained by tilting the fourier transform pattern clockwise 90 degree.(Kinoshita et al 1987)

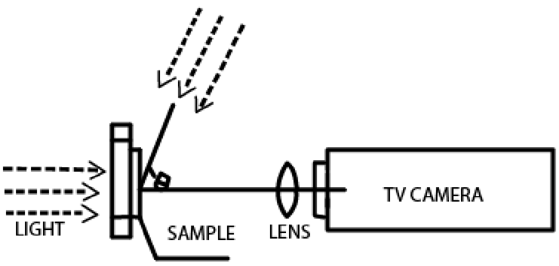

Figure 2. Geometrical arrangement to obtain the images of the woven fabric

Slika 2. Geometrijski raspored za dobijanje slika tkanog materijala

Optical coherence tomography (OCT)

Identification of weave pattern of the fabric is done manually or automatically. Automatic fabric recognition method will minimize the procedural time and error rate because it can perform successive measurements at high speeds and with great repeatability and quality. The fabric pattern is automatically predicted by employing the complex algorithms and technique. Here they apply spectral domain coherence tomography imaging technique for the identification of checked and colored woven fabric repeat automatically[3]. This can be achieved by employing an in-house written JAVA code extracts the weave pattern from the tomography images.

The automatic identification of weave pattern of checked and coloured fabrics can be performed by employing optical coherence tomography. OCT is utilized to recognize commonly used 2/2 twill and plain weave pattern of checked and colored woven fabric automatically. Figure 3 depicts the OCT Experimental setup.

This method was quick and successful due to the colored independence and high resolution of the OCT imaging, which proves the technique, can be used for the automatic identification of weave patterns of checked and coloured fabrics. The weave matrix was generated from the four successive OCT scans corresponding to 2/2 twill weave pattern (shown in figure 4).The traits which make the adoption of the method in automatic inspection systems in the textile industry feasible.

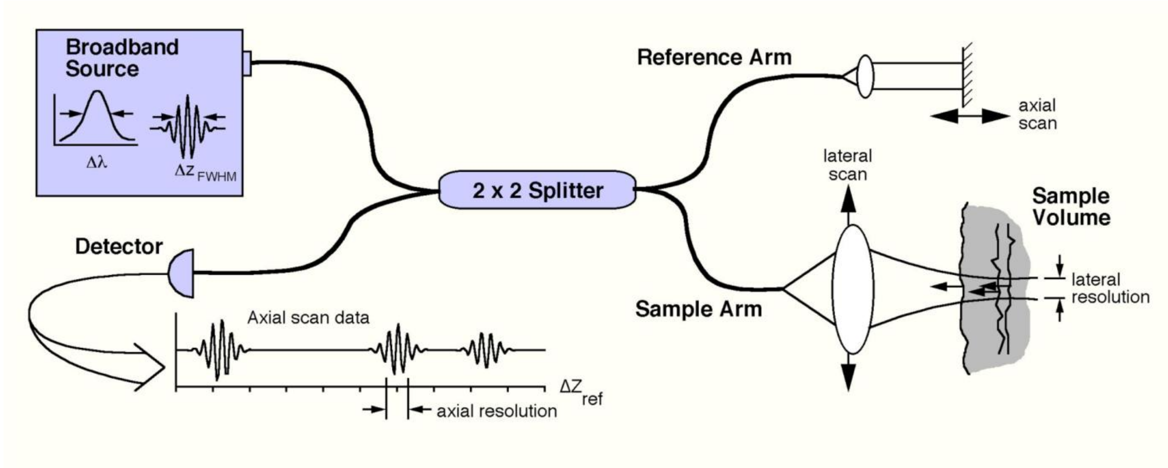

Figure. 3. OCT experimental setup

Slika 3. OCT eksperimentalna postavka

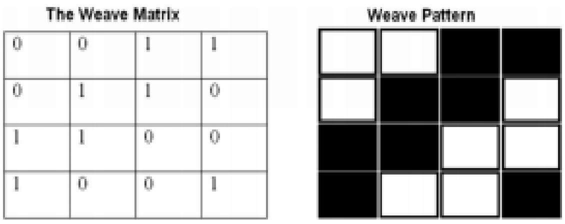

Figure 4. The weave matrix was generated from the four successive OCT scans corresponding to 2/2 twill weave pattern

Slika 4. Matrica tkanja je generisana iz četiri uzastopna OCT skeniranja koja odgovaraju uzorku tkanja od 2/2 kepera

Artificial neural network

In the era of artificial neural network began with the simplified application in the numerous fields and made a remarkable success in the pattern recognition. This study gives the clear understanding of the current and new trends in the ANN model and their application in the pattern recognition. From the result of this experiment, it shows that the current ANN models are performing excellently in their application to PR tasks. The review provides a better understanding of why ANN models are used in diverse applications to PR and at the same time, be useful to many fields in the nearest future [4]. With the comprehensive study, summary, and excellent cognitive computational approach of ANN to PR, one can propose the best performing models for future applications that can address many challenges in PR. Using more than one ANN model, the recognizer can solve simple, complex, and multicomplex problems. Figure 5 represents the process of ANN. Also, designing a new specific model for a particular problem can result in a better solution. Furthermore, problems, issues, challenges, and research directions highlighted can be useful in computer vision and natural language research.

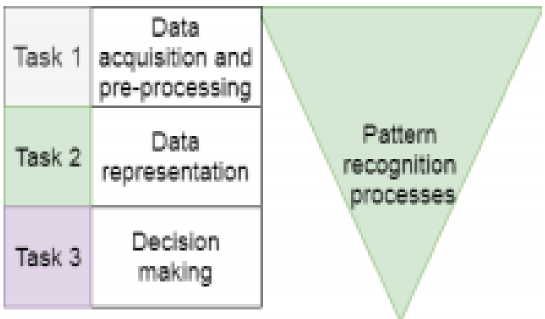

Figure 5. Process of pattern recognition

Slika 5. Proces prepoznavanja obrazaca

This comprehensive review can be useful to current researchers as a starting point in facilitating further advancement in the field, especially in addressing the issue of ANN application to PR. The components of ANN PR system is depicted as flowchart in figure 6. Similarly, this work can be helpful to a newcomer in the field, as many topics and problem areas are available to explore. Meanwhile, ANN application to PR has a bright future in diverse areas and disciplines. Experimental results showed that ANN is becoming most popular comparable to using structural, statistical, template matching, fuzzy, and hybrid techniques to addressed pattern recognition problems in many fields. Hence, one can propose that more research focus should be on feed forward neural network (FFNN) and Feed backward neural network (FBNN) models. Importantly, more research focuses on the current hotspots ANN models like Sparse auto-encoder (SAE), Generative adversarial networks (GAN), Convolutional neural network (CNN), DBN, Recurrent neural network (RNN), RBM, TDNN, Reservoir computing, Single-layer perceptron (SLP),Multilayer perceptron (MLP), Transformer model, etc [5]. Furthermore, they propose that more research is focused on the new design model of ANN to resolve many highlighted problems of PR task for a better result.

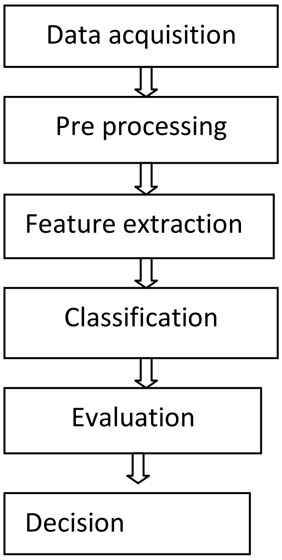

Figure 6. Components of ANN PR systems

Slika 6. Komponente ANN PR sistema

Gray-level Co-occurrence matrix method

The goal of their study is to develop an automatic fabric analysis system using inexpensive image processing technique. In the study they have proposed a novel automatic method for identification of fabric structure. That method was based on the digital analysis technique through a spatial domain integral projection approach the warp and weft yarns are segmented. Using the GLCM the texture features of the fabric have been studied. Directional values for Gray-level Co-occurrence Matrix (GLCM) technique are shown in Table 1.

In order to verify the validity of this method, the different images samples are used. Thus the result matches the actual structure of the tested samples [6].

Table 1. Directional values for Gray-level Co-occurrence Matrix (GLCM) technique

Tabela 1. Usmerene vrednosti za tehniku matrice ko-pojavljivanja na nivou sivog nivoa (GLCM)

θ	0°	45°	90°	135°
θ0	0	1	1	1
θ1	1	1	0	-1

Digital image decomposition

A method used for the recognition of weave pattern is digital image decomposition. The image of the fabric has been decomposed into the horizontal and vertical directional using the wiener filter [7]. Then the grey level image has been converted into binary image through which the weaving density can be figured out. The basic patterns like plain, Twill and Satin have been evaluated. Through this method density of fabric and the structures of the fabric can be identified exactly.

Vector quantization algorithm

A neural network and Image processing has been introduced for classifying the patterns of the woven fabric. The weave repeat of the fabric can be determined by autocorrelation function. The learning vector quantization algorithm is used for the effective recognition of woven fabric pattern. The result demonstrates the fundamental weave types, structural parameters such as yarn spacing, the ratio of warp spacing to weft spacing can be obtained

Diffraction analysis

It describes briefly the background of weave pattern .The different methods such as diffraction analysis based, frequency domain analysis, spatial domain analysis based, joints method has been employed. In this paper they have summarized the merits and demerits of frequency domain analysis and spatial domain analysis method [8]. These methods are greatly utilized for evaluating the weave patterns of the fabric.

Principal of component analysis and fuzzy clustering

Their goal is to develop an automatic fabric analysis system by using an inexpensive image processing technique. Here they proposed a novel automatic method for the identification of woven fabric structure. This method is widely used on the digital image analysis technique. It allows automatic weft yarn and warp yarn cross area segmentation through a spatial domain integral projection approach. Secondly, texture features based on grey level occurrence matrix are studied and optimized by applying principal component analysis [9]. The optimized texture features are analyzed by fuzzy c-means clustering for classifying the different cross area states [10]. The texture orientation features are calculated to determine the exact state of cross area. Finally, woven fabric structures, for example, weave patterns and yarn counts are automatically determined. To verify the validity of this method, a number of sample images are used. The samples have different weave types, different fiber appearances and yarn counts [11]. The recognition results match the actual structure of tested samples.

Image analysis technology

The automatic methods used for the identification of woven fabrics developed in nearly 30 years starting from the mid-1980s until now. Compared with the manual method based on human eyes and experiences, the objective evaluation technology based on image processing and artificial intelligence holds the advantages of quick response, digital solution and accuracy. This paper describes briefly the background of weave pattern recognition and its development based on an overview of many researches done before. The reported methods can be classified into five categories (diffraction analysis-based, photoelectric analysis-based, frequency domain analysis based, spatial domain analysis-based, jointed methods and other ones). Both the merits and demerits of frequency domain analysis-based and spatial domain analysis-based methods have been summarized and discussed in this paper [12]. Therefore, it can provide a good reference platform for the researchers to understand and utilize these methods presented for the recognition of woven fabric weave pattern. Table 2 shows the number of images used for training and testing.

The frequency domain analysis-based methods seems to be difficult to recognize the weave pattern of derivative weaves, jacquard organizations or yarn dyed fabrics, though it's suitable for the recognition of fabrics which have a regular texture. Hence, researchers have been trying to utilize the spatial domain-based methods, convenient for the yarn locating and weave pattern recognition. In summary, both the spatial domain-based methods and frequency domain-based methods have its advantages and disadvantages, and the joint of these methods or new imaging technology should be developed with the aid of high robustness algorithms, especially for those fabrics with irregular texture or multi-colored fabrics.

Table 2. Number of images used for training and testing

Tabela 2. Broj slika koje se koriste za obuku i testiranje

S.No	LIST	NO. OF IMAGE
1	Plain fabric structure	82
2	Twill fabric structure	82
3	Matt fabric structure	82
4	No. of images for testing	60
5	Total no. of images	306

Intelligent processing

Textile fabric automation and manufacturing has been of great concern over the past decade. This is a remarkable task because of the accidental changes of fabric material properties. Due to the increasing demand of consumers for high-quality textile products, an automatic and objective evaluation of the fabric texture appearance is necessary with respect to geometric structure characteristics, surface, and mechanical properties [13]. The precise measurement of the fabric texture parameters, such as weave structure and yarn counts find wide applications in the textile industry, virtual environments, e-commerce, and robotic tele manipulation

The weave pattern and the yarn count are analyzed and determined for computer simulated sample images and also for the scanned real fabric images. 2-D integral projections are used to identify the accurate structure of the woven fabric and to determine the yarn count. They are used for segmenting the crossed areas of yarns and also to detect the defects like crossed area due to the random distribution of yarns. Fuzzy C-Means Clustering (FCM) is applied to multiscale texture features based on the Grey Level Co-Occurrence Matrix (GLCM) to classify the different crossed-area states. Linear Discriminant Analysis (LDA) is used to improve the classifier performance.

Grey based neural fuzzy clustering method

The RGB color space of original color image is transferred to HSV color space; secondly, wavelet transfer is used to acquire horizontal, vertical and diagonal images of hue and value, and calculate their wavelet energy to take them as texture features of this image. Finally, the grey-based back-propagation neural network is adopted to make fuzzy clustering analysis of this image texture feature. From experimental result, Grey-based Back-propagation Neural Network Fuzzy Clustering (Grey-based BNNFC) can accurately recognize plain, twill and satin weave textures of woven fabric, single and double textures of knitted fabric, and nonwoven texture of nonwoven fabric [14]. Among 300 test samples in total where there are 50 samples each kind of fabric texture, the recognition rate amounts to 98.3%.

Artificial neural network

Artificial neural networks commonly referred as the neural networks are the information or signal processing mathematical model that is based on the biological neuron. A neural network is a complex structure which consist a group of interconnected neurons which provides a very exciting alternatives for complex problem solving and other application which can play important role in today's computer science field so researchers from the different discipline are designing the artificial neural networks to solve the problems of pattern recognition, prediction, optimization, associative memory and control [15]. They have presented the basic study of the artificial neural network, its characteristics and its applications.

This applies to problems where the relationships may be quite dynamic or nonlinear. By studying Artificial Neural Network, we had concluded that as the technology is increasing the need of Artificial Intelligence is also increasing because of parallel processing, because by using parallel processing we can do more than one task at a time. So Parallel Processing is needed in this present time because with the help of parallel processing we can save more and more time and money in any task related to electronics, computers and robotics. If we talk about the future work, we can say that we have to develop more algorithms and programs so that we can remove the limitations of the Artificial Neural Network and can make it more and more useful for the various kinds of applications [16]. If the Artificial Neural Network concept is combined with the Computational Automata, FPGA and Fuzzy Logic we will definitely solve some of the limitations of neural network technology.

Fuzzy C-means clustering method

A new robust recognition algorithm is proposed for fabric weave pattern recognition. The gray-level images of solid woven fabrics are captured by a colour scanner and converted into digital files and then enhanced images are obtained by a gray-level morphological operation. Based on the interstices of yarns, warp and weft crossed areas are located, and four texture features of these areas are obtained by first-order and second- order statistics [17]. Unsupervised decision rules for recognizing warp and weft floats are developed using a fuzzy c-means clustering method. The experimental materials include plain, twill, and satin woven fabrics.

Fourier image analysis technique

One of the major problems in automatic woven-fabric recognition is how to detect the areas of interlacing warp and weft yams. This problem is termed 'crossed-points detection'. With a non-periodic design, such as flowers, which may sometimes occur over a woven-fabric background, the problem of crossed-points detection becomes very difficult. In this work, we propose a new and fully automatic method based on Fourier image-analysis techniques. The application of this method to simple woven fabric, as well as to fabric with skewness or with non-periodic design, demonstrates the ability to solve such crossed-points-detection problems. Finally, the algorithm is evaluated visually by superposing the detected grid image on the initial woven-fabric image. All the detected crossed-points are displayed independently and may be saved as file-format images for further processing.

Structural analysis

Two descriptions of the image of a web structure, a convolution model and an additive model, in both the spatial and frequency domains, are combined in the design of a method to extract information about the fabric structure by image analysis. The method allows the extraction of the conventional and also the minimal weave repeats, their size in terms of number of threads, their interlacing patterns, and their patterns of repetition. It is applicable to fabrics with square and non-square conventional weave repeat.

The recognition and classification of three dominant patterns of woven fabrics such as twill, satin and plain. The proposed classifier is based on the texture analysis of woven fabric images for the recognition [18]. In the pattern recognition phase, three methods are tested and compared: Gabor wavelet, local binary pattern operators and gray-level co-occurrence matrices (GLCM). Taking advantage of the differences between the woven fabric textures, they adopted a technique which is based on the texture of the images in the pattern recognition phase. Figure 7 shows the Texture classification algorithms.

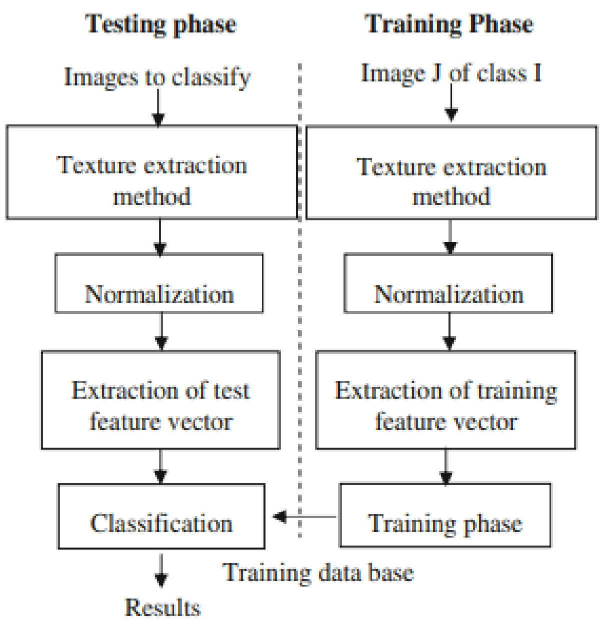

Figure 7. Texture classification algorithms

Slika 7. Algoritmi za klasifikaciju tekstura

For the classification phase vector machine is used as a support, here they have proven it is a suitable classifier for this type of problem. The experimental results show that some of the studied methods are more compatible with this classification problem than others. Although it is the oldest method, GLCM always remains accurate (97.2%). The fusion of the Gabor wavelet and GLCM gives the best result (98%), but GLCM have the better running time. They have adopted a technique which is based on the texture of the images in the pattern recognition phase. This gives us a feature extraction vector which is the input for the algorithm. In this algorithm, the support vector machine (SVM) is used to classify, which corresponds best to this type of problem. It is better than the nearest neighbor classifier (NN) and the Learning vector Quantization (LVQ). In Table 3 the Classification accuracy with different methods is portrayed.

Table 3. Classification accuracy with different methods

Tabela 3. Tačnost klasifikacije različitim metodama

Method	LBP, Gabor wavelets, and GLCM	Gabor wavelets + GLCM	Gabor Wavelets+LBP	GLCM + LBP
Parameter	(1, 8) (2, 8) (2,16) (3, 4) (3, 6) (3, 8) (2, 16) (3,64) (15,10) (20, 10)	(3, 4)+(2, 8)	(3, 4)+(2, 8)	(2, 8)+(2, 8)
Satin	90,2 91,4 89,1 93,6 96,1 94,6 95 93,2 96,2 95,7	95,3	93,4	96,2
Twill	90 90,6 86,9 90 96,3 97,4 90 91,9 95,3 96,3	95,1	93,4	94,4
Plain	98,2 97,3 90,4 98,5 97,5 98,8 96,3 98,8 100 98, 8	98,2	97,4	97,5
Average	92,8 93,1 88,8 94,0 96,6 96,9 93,8 94,6 97,2 96,9	98,2	94,7	96,0
Running time	32,2 31,5 369 295 356 508,4 102,5 151,8 605,4 786,2	420	243,2	235,1
Number of feature vectors	36 36 41 16 24 36 48 32 48 240 320	56	60	68

Fast Fourier Transform (FFT)

The Fast Fourier Transform (FFT) plays a very important role in image processing and pattern recognition. Since a woven fabric consists of regular repeating units, the FFT is particularly useful for analyzing periodicity, directionality, and spacing of repeating units in the fabric. This paper describes procedures for applying FFT techniques in image processing to identify weave pattern, fabric count, yarn skewness, and other structural characteristics of woven fabrics.

A color scanner is used to digitize fabric images (two-dimensional functions in a spatial domain), and a customized software package is used to apply the FFT to the images. A power spectrum image is derived from the FFT of an image, and considered a two-dimensional function in a frequency domain. Peaks in the power spectrum image stand for frequency terms of periodic elements, from which basic weave patterns (e.g., plain, twill, satin, etc.) can be recognized [19]. A radial function and an angular function, derived from the power spectrum, are used to measure the coarseness and directionality of the periodic elements. By selecting power peaks in a certain direction to reconstruct the image, warp or weft elements can be extracted to facilitate fabric count and skewness measurements. Fourier filtering, that is, image filtering in the frequency domain, is used to suppress noise and to select features that have a certain range of frequencies. Fabrics with various weave patterns and yarn counts are tested using the FFT techniques

Convolutional neural network

Convolutional neural network (CNN), a class of artificial neural networks that has become dominant in various computer vision tasks, is attracting interest across a variety of domains, including radiology. CNN is designed to automatically and adaptively learn spatial hierarchies of features through back propagation by using multiple building blocks, such as convolution layers, pooling layers, and fully connected layers. This article provides a perspective on the basic concepts of CNN and its application to various radiological tasks, and discusses its challenges and future directions in the field of radiology.

Extraction of the texture characteristics

The extraction of the characteristics is one of the most important stages in the pattern recognition process. This stage is used in the coding and extraction of information before passing to the classification phase. In this article a major importance has been given to the algorithms of training and particularly the back-propagation neural network named multi-layer perceptron. Among the applications of this algorithm, they found the field of pattern recognition and in particular the fabric patterns identification which initially consists in collecting raw data from the digital camera or the scanner [20]. This initial image requires a set of pretreatments in order to eliminate parasitic information and to preserve those which are relevant for the recognition. After a series of treatments, two parameters were retained to automatically recognize the fabric pattern: obliqueness and orthogonality.

Multilayer extraction

Computer aided vision models are convincing so they can be correlated with the traditional classifier models. The prototype obtained serves as a vision for visually impaired by obtaining an outstanding interface platform for user in need. The proposed work focuses on fabric analysis for complex designs and provides audio and text identity guidelines by correlating the images under study. Color based feature extraction is implemented to obtain global and local features which serves as an input for elaborative analysis of a fabric texture. The obtained image is partitioned to pixilated grains to achieve the above mentioned target. The features are formed as a cluster with the help of SVM classifier and HMAX (Hierarchical model and X) model. In order to improve the efficiency in complex texture fabric identification HMAX solution is combined with the traditional methods. HMAX provides good result on object recognition for methods involved in computer vision. The detail of each pixel is divided to undergo block operations to obtain solid and uniform color estimation. The estimation identifies the color and further analysis is carried out for complex textures.

Table 4. Prediction efficiency of fabric pattern

Tabela 4. Predviđanje efikasnosti uzorka tkanine

S.No	Fabric pattern	Prediction efficiency %
1	Plain	72
2	Twill	78.2
3	Matt	77.5

The block obtained by that outcome is incorporated with the images under study and their respective description is provided for the user. Image enhancement can be achieved through histogram equalization. The methodology adopted proves reliable and effective solution. The pattern can be defined using parameters like variance, histogram and gray level features. The existing methodology is incompetent due to lack of analysis in complex fabric patterns. The difficulty arises due to scale transforms, occlusions and light intensity. The challenge lies between preference and invariance. Therefore it's important to develop a texture recognition system for complex patterns to analyse a fabric for visually challenged. Table 4 shows the prediction efficiency of fabric pattern.

Current research

The recognition of woven fabric pattern is a crucial task for mass manufacturing and quality control in the textile industry. Traditional methods based on image processing have some limitations on accuracy and stability. Currently, an automatic method is proposed to jointly realize yarn location and weave pattern recognition. First, a new big fabric dataset is established by a portable wireless device. The dataset contains wide kinds of fabrics and detailed fabric structure parameters. Then, a novel multi-task and multi-scale convolutional neural network (MTMSnet) is proposed to predict the location maps of yarns and floats [21]. By adopting the multi-task structure, the MTMSnet can better learn the related features between yarns and floats. Finally, the weave pattern and basic weave repeat are recognized by combining the yarn and float location maps. Extensive experimental results on various kinds of fabrics indicate that the proposed method achieves high accuracy and quality in weave pattern recognition.

3. CONCLUSION

Automation in the textile industry through artificial neural network (ANN) has led to the development. The ANN model can be useful to minimize the labour wages and time in various unit operations in garment industry and for getting accuracy in fabric pattern detection. This automatic recognition of fabric pattern will avoid the confusion while predicting the patterns of various weave derivatives. In this paper, the various artificial neural networks for the prediction was studied and analysed. The real samples of the fabric weave pattern was given as the input. The different neural network were trained and tested with samples of the fabric weave pattern. The efficiency rate of each neural network was varied. The obtained result from the proposed neural network concluded that the automatic prediction of fabric pattern is a time consuming process and it can produce high efficiency, less error rate and reliable than the manual prediction of fabric weave pattern.

4. REFERENCES

[1] G.Abdel Azim (2015) Identification of Textile Defects Based on GLCM and Neural Networks, Journal of Computer and Communications, 03(12), 1-8.

[2] R.Shankar Dwivedi (2017) Digital Image processing, Springer Link: 117-65

[3] R.Haralick, M.K.Shanmugam, D.Its'Hak (1973) Textural features for image classification,IEEE Trans. Syst. Man and Cyber, 3(6),10– 21.

[4] J.Boong Soo, J.Hyun Bae, M.Suh (2003) Automatic recognition of woven fabric patterns by an artificial

neural network, Textile Research Journal, 73, 645-650.
[5] T.Kang, C.H.Kim, K.W.Oh (1999) Automatic recognition of fabric weave patterns by digital image analysis, Textile Res. J., 69 (2), 77–83.
[6] Pr.Kumar, P.Sharma (2014) Artificial Neural Network- Study, International Journal of Emerging Engineering Research and Technology ,2(2), 143-148.
[7] J. Kuo, Ch.-Yang Shih, Ji.-Yih Lee (2004) Automatic recognition of fabric weave patterns by a fuzzy C-means clustering method, Textile Research Journal, 74,107-111.
[8] A.Lachkar, R. Benslimane, L.D'Orazio, E.Martuscelli (2005) Textile Woven Fabric Recognition using Fourier Image Analysis Techniques: Part II - texture analysis for crossed-states detection. J. Text. Inst., 96,179- 183.
[9] M.Rallo, J.Escofet, S.Millan (2003) Weave-repeat identification by structural analysis of fabric images, *Appl. Opt*., 42 (17), 3361–3372.
[10] A.Lachkar, T.Gadi, R.Benslimane, L.D'Orazio (2003) Textile woven fabric recognition using Fourier image analysis techniques: Part I: A fully automatic approach for crossed-points detection., J. Textile Inst, 94 (3/4), 194–201.
[11] S.Yassine Ben, S.Nasri (2010) Automatic recognition of woven fabrics based on texture and using SVM ,Springer-Verlag London, 4(4), 429–34.
[12] A.Satish, K.Sh. Sobana Rani, B.Saranya (2007) Fabric Texture Analysis and Weave Pattern Recognition by Intelligent Processing, Journal of Telecommunication, Electronics and Computer Engineering, 10, 1-13.
[13] X.Wang, Ni.D.Georganas, E.M.Petriu (2011) Fabric Texture Analysis Using Computer Vision Techniques, IEEE Transactions on Instrumentation and Measurement, 60 (1), 44-56.
[14] Xu.Bugao (1996) Identifying fabric structures with Fast Fourier Transform techniques, Textile Res. J, 66 (8), 496–506.
[15] R.Yamashita, M.Nishio, R.K.Gian Do, K.Togashi (2018) Convolution neural networks: an overview and application in radiology, Insights into imaging, 9, 611-29.
[16] J.Mohamed, B.Zitouni, S.Faouzi (2006) Automatic recognition of woven fabric patterns by extraction of the texture characteristics, 2nd International Conference of Applied Research in Textile (CIRAT-2).
[17] K.Sharath, M.Rama Bai (2019) Deploying Multi Layer Extraction and Complex Pattern in Fabric Pattern Identification,Multimedia Tools and Applications, 79 (15-16), 10427–10443.
[18] M.Sabuncu, H.Ozdemir, M.U.Akdogan (2017) Automatic Identification of Weave Patterns of Checked and Colored Fabrics Using Optical Coherence Tomography, IEEE Photonics Journal, 9(5), 358-366.
[19] I.S.Abiodun, A. Jantan, Ab.E. Omolara, K.V. Dada, A.M. Umar, O.U. Linus , H. Arshad, Ab.A. Kazaure, U. Gana, M.U. Kiru (2019) Comprehensive Review of Artificial Neural Network Applications to Pattern Recognition, IEEE ACCESS 7.
[20] Te-Li Su, Le-shin Chang, Fu-chen Kung (2009) Intelligent computerized fabric texture recognition system by using Grey-based neural fuzzy clustering, International Conference on Wavelet Analysis and Pattern Recognition (ICWAPR).
[21] Sh.Meng, R.Pan, W.Gao, Ji.Zhou, Ji.Wang, W.He (2021) Journal of Intelligent Manufacturing 32, 1147–1161.

IZVOD

PRIMENA VEŠTAČKE NEURALNE MREŽE U ODREĐIVANJU OBRAZA TKANJA

Uzorak tkanja (tekstura) tkanog materijala smatra se važnim faktorom dizajna i proizvodnje visokokvalitetnih tkanina. Tradicionalno, prepoznavanje tkanog materijala ima mnogo izazova zbog ručnog vizuelnog pregleda. Pristupi zasnovani na ranim algoritmima mašinskog učenja direktno zavise od ručno izrađenih funkcija, koje oduzimaju mnogo vremena i javljaju se više grešaka. Dakle, potreban je automatizovani sistem za klasifikaciju tkanog materijala da bi se poboljšala produktivnost. Zajedno sa brzim razvojem kompjuterskog vida, očajnički su potrebne automatske i efikasne metode za klasifikaciju tkanih tkanina. Predviđanje tkanja uzorka tkanine se vrši dobijanjem visokokvalitetnih slika tkanine. Zatim se dobijene slike podvrgavaju algoritmu za klasifikaciju tkanja. Izlaz obrađene slike se koristi kao ulaz u Veštačku neuronsku mrežu (ANN) koja koristi algoritam povratne propagacije da izračuna ponderisane faktore i generiše željenu klasifikaciju uzoraka tkanja kao izlaz. U ovom preglednom radu govori se o studiji o različitim neuronskim mrežama koje se koriste za predviđanje uzorka tkanine.

Ključne reči: *Veštačka neuronska mreža (ANN), Dezen tkanine, predviđanje uzoraka tkanine, Klasifikacija uzoraka tkanine, Algoritam povratnog širenja.*

Pregledni rad

Rad primljen: 03. 03. 2022.

Rad prihvaćen: 26. 03. 2022.

Rad je dostupan na sajtu: www.idk.org.rs/casopis