Journal of Engineering and Applied Sciences 13 (Special Issue 4): 3732-3734, 2018
ISSN: 1816-949X

Ceramic Tiles Classification Using SVM Classification

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Abstract: In the ceramic tile industry, the bulk amount of ceramic tiles are manufactured, it is challenging to monitor the quality of each tile manually. An automated defect detection and classification technique has been proposed in this report that can have ensured the better quality of tiles in the manufacturing process as well as production rate. There are two steps are followed in this study feature extraction and classification. Feature extraction is based on the properties of Gray Level Co-occurrence Matrix (GLCM) technique. The evaluation of the system is carried on V×C TSG image database. Then Support Vector Machine (SVM) classifier is used for classification step. SVM classifier is used to detect the tile.

Key words: Ceramic tiles, GLCM feature extraction, SVM classifier, extraction, report, steps

INTRODUCTION

Everyday Ceramic tiles surface defect detection using image processing is described by Shire *et al.* (2011). Automated detection and classification method is presented in this report. It plays a vital role in ceramic tiles to find the defects and quality control. This classification method is used to observe the faults within a short period.

Automated visual inspection of ceramic tiles is discussed by Desoli *et al.* (1993). Advanced equipment is defined and implemented based on a developed sensor for high-resolution color-image acquisition and applies a suitable image investigation algorithm for defect detection in ceramic tiles, color measurement, texture characterization and integrating them into an automated assessment system. Surface quality control of ceramic tiles using neural networks approach is discussed by Hocenski.

Research on computer-aided defect recognition of ceramic crack is presented by Lan and Zheng (2015). Scanning the tiles is the first step then digital images are preprocessed and neural network classifier is used for classification. Feature generation is done using the auto-associative NN and selection as the probabilistic NN is used for classification. Edge defect detection in the ceramic tile based on boundary analysis using fuzzy thresholding and radon transform is explained by Mansoory *et al.* (2008). Pre-processing is the first step established based on a median filter. Afterward edge detection operator is selected for a ceramic tube. SVM classifier is also used in medical field applications to detect the difference with normal and abnormal which is described by Julius *et al.* (2015). At last iteration formulation threshold separation is used to achieve shape feature extraction. Surface defect isolation in ceramic tile based on texture feature analysis using radon transform and FCM is discussed by Mansoory *et al.* (2009).

Analysis of capillary pressure curves by wettability modification through surfactants is presented by Nagarajan *et al.* (2016). Fuzzy thresholding and morphological operand based approach for classifying surface defections. Finally, radon transforms as well as analysis of boundary is introduced.

Discrete Wavelet Transform (DWT) and Multi-Layer Perceptron Neural Networks (MLP-NN) based classification of ECG arrhythmias is presented and SVM is used as a classifier which is used in many computer vision applications.

There are four steps are maintained in this study. First radon transform based angle correction, Fuzzy C-means algorithm based background elimination, feature texture analysis and NN-based classification. Experimental study and investigation of composite coir fiber in disk brake rotor introduced by Vijay.

MATERIALS AND METHODS

In our proposed system classifying the defected tiles images normal and defected tiles using GLCM technique

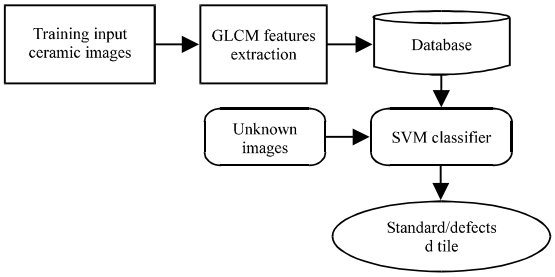

Fig. 1: Proposed block diagram of ceramic tiles classification

is used. First, the ceramic tiles image is subjected to GLCM for feature extraction from the different property. Then the elements are fed to SVM classifier using features. Finally, the tiles are classified as normal or defected tile using SVM classifier. The proposed system block diagram is shown in the Fig. 1.

Feature extraction stage: The proposed system for ceramic tiles classification system starts with feature extraction step which is a vital step for machine learning approaches. Contrast, entropy, homogeneity and correlation are determined using GLCM technique. This method is repeated for all the training images and the extracted features are stored in the database which is afterward used for classification.

Classification stage: Ceramic tile classification is done by SVM classifier. The test image will work the identical extraction process as like training image in the database. Then unknown images are used for classification stage compared with the saved database and classified by SVM classifier. Finally, classification is done with 95.19%.

RESULTS AND DISCUSSION

The first step in the proposed integrated approach for ceramic tile classification based on GLCM is to test the unknown image which is to be classified as normal or defected tile. V×C TSG database is an image database of ceramic tile that representing the wide range of surface classes in the ceramic tile industry. There are three types of ceramic patterns such as fixed, random and pseudo random. Table 1 shows the three different grades of ceramic tiles. Extracted images are given as input to classification stage. The classification stage used a novel SVM classifier

Table 1: Different grades of images in V×C TSG database

Names	Classes	Tiles/class	Size (cm)	Patterns	Aspect
Agata	13, 37, 38	16	33×33	Fixed	Marble
Antique	4, 5, 8	14	23×33	Pseudorandom	Stone
Berlin	2, 3, 11	24	20×20	Random	Granite
Campinya	8, 9, 25	30	20×20	Pseudorandom	Stone
Firenze	9, 14, 16	20	20×25	Random	Stone

Table 2: Average accuracy of the proposed system

SVM			
----------Classification accuracy (%)----------			
Grade 1	Grade 2	Grade 3	Average
94.15	95.98	95.45	95.19

to classify the images. Table 2 shows the average accuracy of the proposed classification system.

CONCLUSION

An efficient approach to ceramic tile classification based on GLCM technique and SVM classifier is presented. GLCM is used to extract the features for feature extraction. The effectiveness of the proposed system is analyzed on public database images. The obtained maximum classification rate using GLCM technique is satisfied compare to other existing methods. SVM classifier is able to correctly predict the grade of ceramic tile images with 95.19% classification accuracy.

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