International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 3 Issue 5, August 2019 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Texture Images Classification using Secant Lines Segments Histogram

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***How to cite this paper**: Ei Phyu Win | Mie Mie Tin | Pyae Phyo Thu "Texture Images Classification using Secant Lines Segments Histogram" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-3 | Issue-5, August 2019, pp.2607-2609, **https://doi.org/10.31142/ijtsrd27984**

IJTSRD27984

ABSTRACT

Texture classification is the process to classify different textures from the given images. The aim of texture classification is to classify the category of a texture image. To design an effective algorithm for texture classification, it is essential to find a set of texture features with good discriminating power. This paper presents a texture classification system using secant lines segments histogram and Euclidean Distance. Secant lines segments histogram is used to generate the features from texture images as a histogram. These features offer a better discriminating strategy for texture classification. These features are first used for training and later on for classifying the texture images. Euclidean Distance is used for distinguishing each of the known categories for classification.

***KEYWORDS:** texture classification; secant lines segments histogram; Euclidean distance.*

INTRODUCTION

The visual surface characteristic and appearance of something is called the texture. For image analysis texture characteristic is very important. Texture can be presented in either real or artificial data such as wood, clouds, carpet, etc. Although texture is presented every image, there did not existed a formal approach of texture analysis. The pattern of carpet, the grain of the wood, the surface of the clouds, etc. is called texture.

Kavitha & Rao (2011) presented that texture contains important information about the structural arrangement of surfaces and their relationship to the surrounding environment [1].

Textures are one of the important features in computer vision for many applications. Image texture can be considered as repeating visual patterns arranged in certain ways. The patterns themselves are usually very similar, giving rise to a uniform appearance. Texture is formed by the relationship of pixel gray levels and their spatial arrangement within a neighborhood.

Texture classification is applied in various applications such as object recognition, medical image analysis, remote sensing, pattern recognition, etc. Pattern is defined by the shape, colour and texture characteristics of image as feature arrangements. Pattern recognition is to determine the objects into each of the known categories. It is a fundamental component in artificial intelligence and computer vision. Pattern recognition is used in science, engineering, business, medicine area and etc.

Major issues in texture analysis may be summarized as follows:
There are three major issues in the texture analysis:
1. Classify the texture in a variety of texture classes.
2. Generate a description of a texture class.
3. Determine the macro boundaries between two texture regions of an image that have many distinct texture areas.

Although the pattern recognition of texture feature estimation is involved in issue 1, identification of texture is related to issue2.

Issue 3 deals with the segmentation of texture image. The goal of texture classification is to classify the category of image textures.

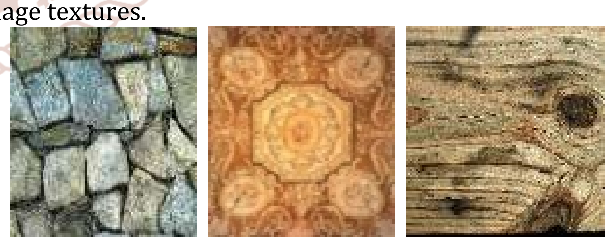

Fig1. Simple Texture Images

Fig2. Example of Some of Texture Images

The proposed system is organized as follows: texture classification is presented in section 2. the proposed texture classification system with result of feature extraction method is proposed in the section 3. Finally, section 4 concludes the discussion.

TEXTURE CLASSIFICATION

The process of determining different textures from the given images is defined as texture classification. The classification of textures often seems to be not meaningful, however, a large variety of real world problems that contains the specific textures of different images have been applied texture classification.

Texture classification identities a given texture to a variety of texture classes. There are two main classification methods: supervised and unsupervised classification. Supervised method needs examples of each texture class as a training data. By using this training data, a supervised classifier is trained to learn the characterization of each texture class. Unsupervised method is automatically found out different classes from input texture without using prior knowledge. The rest method called semi-supervised is used only partial prior knowledge being available.

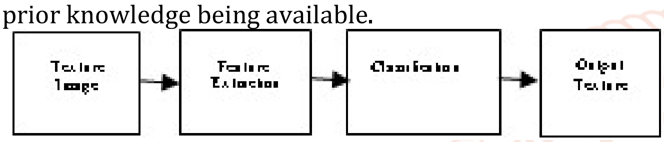

Fig3. Block Diagram of Texture

Classification

There are two major stages in texture classification: feature extraction and classification. In feature extraction stage the most distinguishable texture features are extracted from each texture. Then, the classifier takes these selected features as inputs and produces texture class as outputs.

Lepisto, et al. (2003) have presented some applications in which textured objects of surfaces are contained such as wood species recognition, rock classification [2], fabric classification, face detection, and etc. The target subjects are viewed as a specific texture in all of the applications and hence these systems can be performed successfully using texture classification techniques.

A different variety of techniques have been proposed for describing image texture. S. K. Roy, et al. (2018) has proposed a texture classification system using a robust descriptor, called fractal weighted local binary pattern (FWLBP). In this system, a Gaussian Scale Space representation of texture image is firstly generated and then, in order to get fractal dimension, differential box counting algorithm is applied. Finally, to form a normalized feature vector, the histogram of FWLBP are concatenated for all LBP elements [5].

L.Liu, et al. (2012) had proposed a very powerful texture classification approach for large texture database applications. In this approach a small set of random features is extracted from local image patches. In order to do texture classification, these random features are embedded into a bag--of-words model. This proposed feature extraction method is simple because the sparse nature of texture images is leveraged [6].

Y.Q. Chen (1995) had stated the various texture classification techniques. These are categorized into five groups. They are statistical, model-based stochastic, morphology-based, structural and signal processing methods [3]. Among these five techniques, statistical and signal processing methods are widely used because they can be directly used onto any texture. The rest other methods are not widely used.

The model based stochastic methods are not easily performed because of the complexity to estimate the parameters. The morphology-based methods are not applied because it is very newly and its process is very simple. The structural methods require structured textures that are naturally rare. So, these methods cannot provide a good quality of feature textures.

PROPOSED TEXTURE CLASSIFICATION SYSTEM

The proposed texture classification system is implemented using a new feature extraction method called secant lines segments histogram. This system classifies texture images such as floor coverings, wood & fiber and marble & stone.

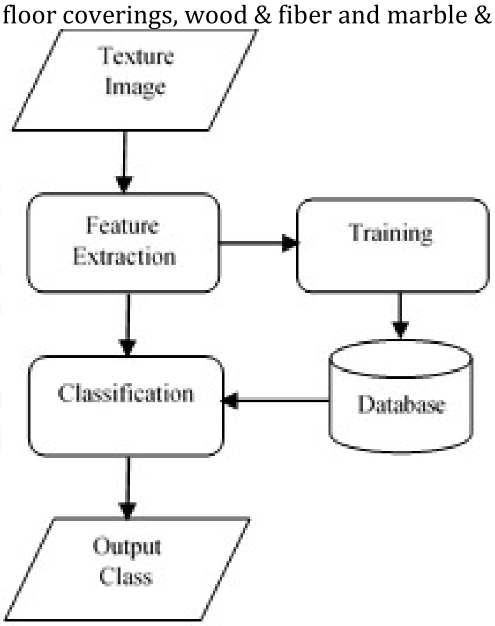

Fig4. Process of Proposed Texture Classification System

The proposed system mainly involves three main processes:
1. Feature extraction process, where texture features are extracted from the texture image.
2. Training process, where the texture images are trained to extract histogram of features for classification.
3. Classification process, where the probability of texture class is determined using the extracted texture features as inputs.

FEATURE EXTRACTION

A feature extraction process plays an important role in content based image classification. Feature Extraction is a crucial step to the success of classification of texture images [7]. Therefore, it is very important to extract the most discriminating information present in the texture image. characterization of each texture class is yielded by feature extraction as feature measures.

Identifying and selecting the distinguishable features that are invariant to translation, rotation and scaling is important. Therefore, for similar textures, the extracted feature's quantities measurements should be very close.

SECANT LINES SEGMENTS HISTOGRAM

The procedures of proposed feature extraction method are as follow:

1. Load texture image.
2. Convert texture image to binary image.
3. Set the secant lines on the texture image as the user like such as 5 lines, 20 lines, 100 lines, etc.
4. Generate histogram of same distance of texture
5. Image between black and white along the secant lines as features of texture image.

In our feature extraction method, the texture image is loaded firstly. Then, this image is converted into binary texture image to count features in the texture image. Binarization is an important step for all image processing systems. A binary image is one in which the pixels can only have two values, 0 and 255 that represent white and black. It can provide information present in texture clearly for extracting the features of texture.

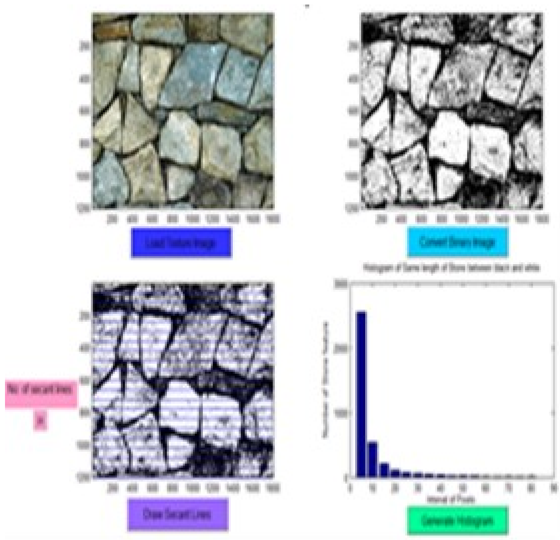

Fig5. Experiment result Proposed Feature Extraction Method

Then, the secant lines are set horizontally on the binary texture image such as 10 lines, 20 lines, 30 lines, 40 lines and 50 lines. Generally, the more the secant lines, the better the classification. The proposed texture classification system is tested using different numbers of secant lines to evaluate the best accurate classification.

Finally, same intervals of length of textures are generated along the secant lines as a histogram. According to our experiments, different texture images provide the different histograms. The proposed secant lines segments histogram, is based on this characteristic in order to get accurate classification.

TRAINING

In the texture training step, the texture features are extracted from the texture images for each of texture classes, using the proposed feature extraction method. The output of feature extraction, the feature's histograms of each texture image, are stored in the feature database, which is used for texture classification.

CLASSIFICATION

Mahersia & Hamrouni (2008) have presented that a texture classification system in which the test samples of texture are grouped into classes, where each class involves the related samples of some similarity criterion [4]. The aim of classification is to determine the most appropriate category of texture given a set of known categories. The classification may be performed by distinguishing the probability for each of the known categories because perfect classification approach is not possible.

EUCLIDEAN DISTANCE

Euclidean distance is mostly used for calculating the similarity metrics for textures. In our system, the histogram generated in the feature extraction stage needs a matching metric to measure the similarity between two feature histograms. The classification module determines how closely the histogram matches the histogram stored in the database. The Euclidean distance classifier is found to perform the best to this system. Euclidean distance is chosen as a classifier, which calculates the similarity between the two feature histograms. Euclidean distance between two points in p-dimensional space is a geometrically shortest distance on the straight line passing through both the points. For a distance between two p-dimensional features x = (x1, x2, xp) and y1=(y1,y2,…,yp).The Euclidean metric is defined as:

$$d(x,y) = \left[\sum_{i=1}^{p}(x_i - y_i)^2 \right]^{1/2} \qquad (1)$$

CONCLUSIONS

In this paper, a texture classification system is proposed using a new feature extraction method called secant lines segments histogram. Feature extraction identifies the most prominent features for classification. This feature extraction method provides the most discriminating information present in the texture images as a histogram. The histogram of each texture image is stored in the feature database, which is used for texture classification. Euclidean Distance is used to determine the probability for each of the known categories for classification.

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