

## IMAGE TEXTURE CLASSIFICATION: SURF WITH SVM

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### ABSTRACT

Nowadays, various approaches of texture classification have been developed which works on acquired image features and separate them into different classes by using a specific classifier. This paper gives a state-of-the-art texture classification technique called Speeded up Robust Features (SURF) with SVM (Support Vector Machine) classifier. In this concept, image data representation is accomplished by capturing features in the form of key-points. SURF uses determinant of Hessian matrix to achieve point of interests on which description and classification is carried out. This method gives superior performance over already established methods in terms of processing time, accuracy and robustness. In this paper, we have taken UMD dataset for processing and calculated different performance parameters which gives excellent results.

**KEYWORDS:** Classification, Description, Extraction, Key-points, Matching, SURF

### INTRODUCTION

Texture classification is a way of grouping similar things together according to common characteristics which enables us to acquire information about the image. This information can be obtained by extracting image features. With the help of features we can describe huge amount of data accurately. For acquisition of image features, texture plays a crucial role as it describes the appearance of an object. We cannot classify overlapped images separately, but they can be characterized by using their textures because each image has a specific texture that defines characteristics of an image. Texture classification has wide variety of applications in rock classification, wood species recognition, face recognition, geographical landscape segmentation, object detection and many other image processing applications [1], [2], [3], [4].

Advances in digital technology have created huge collection of digital images which requires an efficient and intelligent technique of texture classification. Texture classification is the process to divide texture features into texture classes. First stage of classification is feature extraction process in which features are extracted from image by using its texture. In second stage, features are converted into texture classes by using a classifier. Many texture classification methods have been introduced like Local Binary Pattern (LBP) [5], gray level co-occurrence matrices (GLCM) [6], Gabor filters [7], wavelet transform methods, and Independent component analysis. All these methods are based on simple computations and take more time for execution. Surf method is superior to all these earlier methods due to having advantages like robustness, computation speed and accuracy. Processing of SURF method is much faster than SIFT (Scale Invariant Feature Transform) method. SURF is an upgraded version of SIFT [8], [9], [10].

SURF is a texture detector and descriptor method which has application like object recognition, image registration, classification, reconstruction of 3D scenes and tracking objects. SURF technique handles blurred and rotational images efficiently. First process in SURF classification is integral image computation which is used to increase the performance speed. Further to extract features from an image, points of interests are achieved by using Hessian blob detector and description is obtained for each point of interest. The descriptor is based on sum of Haar wavelet responses around the point of interest. Last stage is matching of descriptors obtained from different images [11].

SURF overcomes these problems and speed up the computation with the help of integral images. Hessian matrix determinant is used in SURF to detect the location of interest points and gives stable performance as compared to other detectors like Harris detector. SURF features are extracted in terms of key-points which are found by describing the intensity distribution of pixels [12].

## PROPOSED METHODOLOGY

In this section we present our approach. First input image is acquired from UMD dataset and then SURF features are extracted from it by using determinant of Hessian Matrix. Finally, obtained features are given to SVM classifier which converts these features into different texture classes. Simplified block diagram of this method is given below:

### BLOCK DIAGRAM



**Fig.1: Block Diagram of proposed system**

### PROCEDURE

SURF feature classification algorithm is explained into following parts:

#### A. IMAGE ACQUISITION:

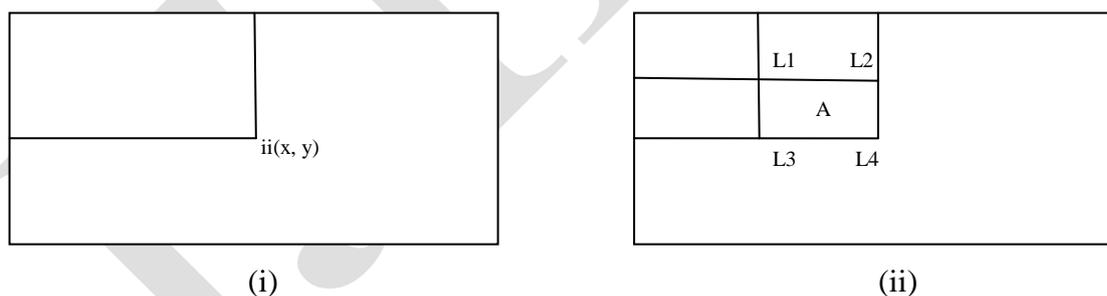
Input image is taken from UMD dataset for processing. This dataset consists of 25 different texture classes with 40 images in each class. The size of each image is 1280x960. All images from the dataset are taken with different viewpoint changes and scale differences. The dataset contains images of fruits, various plants, shelves of bottles and buckets and floor textures.

#### B. SURF FEATURE EXTRACTION:

SURF feature algorithm consists of following parts-

##### 1) Integral image computation-

Texture features can be promptly computed by using intermediate representation called integral image. It is very important to boost the performance speed of SURF method. Each input image is first converted into integral image and then passed for further processing. If input image and a point with coordinates  $x$  and  $y$  are given then integral image is calculated by the sum of the values between the point and the origin. Calculation of integral image is shown in following figures:



**Fig. 2: Integral Image Calculation**

[(i) Integral image. (ii) Calculation of region  $A = L4 + L1 - (L2 + L3)$ ]

If  $i(x, y)$  is an input image then integral image is given by  $ii(x, y)$  by using following formula:

$$ii(x, y) = \sum_{x' \leq x, y' \leq y} i(x', y') \dots \dots (1)$$

##### 2) Interest point detection-

Hessian blob detector is used by SURF to detect interest points. We have used determinant of Hessian Matrix to measure the local change around the point of interest and points are chosen with maximum value of the determinant. If we have given a point  $P(x, y)$  in an image  $I$  then Hessian matrix  $H(\rho, \sigma)$  is given by,

$$H(\rho, \sigma) = \begin{pmatrix} L_{xx}(\rho, \sigma) & L_{xy}(\rho, \sigma) \\ L_{yx}(\rho, \sigma) & L_{yy}(\rho, \sigma) \end{pmatrix} \dots \dots (2)$$

Where  $L_{xx}(\rho, \sigma)$ ,  $L_{xy}(\rho, \sigma)$ ,  $L_{yx}(\rho, \sigma)$  and  $L_{yy}(\rho, \sigma)$  are second order derivatives of gray scale image.

### 3) Description-

Descriptor is used to provide a unique and robust description of an image features by describing the intensity distribution of pixels within the point of interests. This feature descriptor is depend upon Haar wavelet responses which are computed in X and Y direction around the point of interest. Description is obtained for each and every point of interest identified previously. SURF descriptors have been used widely to detect and recognize objects, faces and to extract point of interests.

### 4) Matching-

In the matching stage, matching pairs are found by comparing the descriptors obtained from different images. We compare features if they are of same contrast.

### C. CLASSIFICATION:

Final stage of SURF algorithm is classification. Here, we have used multi-level SVM classifier which converts image features into texture classes. It compares testing set with the training set and gives proper classification of objects. SVM divides two classes by using a hyperplane. Accuracy of SVM is better than that of ANN and Nearest Neighbour Classifier.

## RESULT AND DISCUSSION

To analyze the performance of the proposed method, we have conducted experimets on UMD dataset.

Step1: We have implemented SURF method by using GUI. After running the code we get following GUI window. Here button 'Init DB' is used to start processing of whole dataset.

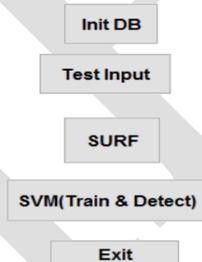


Fig. 3: GUI window

Step 2: Take input image from dataset by pressing button 'Test Input'



Fig.4: Test input image

Step 3: SURF features are extracted in the form of key-points by using button 'SURF'.



**Fig.5: Feature Extraction**

Step 4: Final stage is classification of input image by using SVM classifier.



**Fig.6: Classification**

**CONFUSION MATRIX:**

It is a table which is used to describe the performance of a classifier by using test data. We have computed confusion matrix for five images from each class.



**Fig. 7: Confusion Matrix**

**ACCURACY OF SVM CLASSIFIER:**

Accuracy gives the percentage of correct classification of classifier which is the ratio of sum of true positive and true negative values to the total number of images.

$$\text{Accuracy} = \frac{(TP+TN)}{TOTAL} * 100 = \frac{43+0}{50} * 100 = 86\%$$

Where,

TP = True Positive= the number of samples correctly marked as positive.

TN= True Negative= the number of samples correctly marked as negative

## CONCLUSION

We have proposed SURF image classification techniques in which SURF feature are extracted by obtaining key-points and description is given for each detected point of interest. We have also performed classification using SVM classifier that gives accuracy of 86%. From results; we can say that SURF classification method gives best results in terms of processing speed and robustness.

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