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Case Studies

# Novel technique of oversampling the broken images using wavelet transform

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ABSTRACT

The paper presents an oversampling technique to overcome the loss incurred at the time of binarizing the images. As such there are very few techniques available in the literature to approximate the loss in the images. This technique is based on the Estimate wavelet transform (EWT) which fulfills the loss and makes the image smooth. Coiflet and Daubechies D8 wavelets are employed in EWT and performances are compared with the traditional Gaussian lowpass filter. All the three approaches are tested on seven distorted images, and observed that the Daubechies D8 and Coiflet wavelets using EWT are better able to approximate the image than Gaussian lowpass filter. Out of seven images two are presented in this paper.



## 1. Introduction

Wavelets are being used in variety of applications like Image compression, edge detection, interpolation of finite signals [4–8]. So far the technique of Estimate Wavelet Transform is used in approximating the single dimensional signals [1–3,12]. This is the first time when it is applied to approximate the broken two dimensional images. The objective of this paper is to approximate the loss occurred in the image. Three techniques are applied, viz. (1) Coiflet wavelet using EWT, (2) Daubechies wavelet using EWT, (3) Gaussian Lowpass filter. The third one is a traditional method of oversampling the image by taking appropriate size of Gaussian window and the first two are the novel techniques to tackle the problem. Up on employing first two techniques, the size of the original image gets doubled and the resultant image becomes smooth. Some time these double size images would generate noise, so that they can be filtered using image compression technique of discrete wavelet transform. The size of the compressed image will be the same as the original image and that too without discontinuity in the image. The technique is explored in filling the loss incurred from the environment in general and separating connected components from the dull or blurred images in particular. Due to the dyadic property of discrete wavelet transform, the size of image is considered to be even while applying EWT. It is merely useful when there is no optimal threshold found to binarize an image.

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**Fig. 1a.** Image is of Gujarati word.

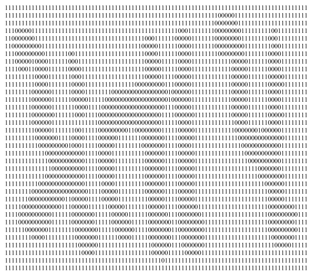

**Fig. 1b.** Matrix of Gujarati word.

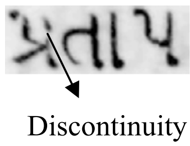


**Fig. 2a.** Image is of Gujarati word.

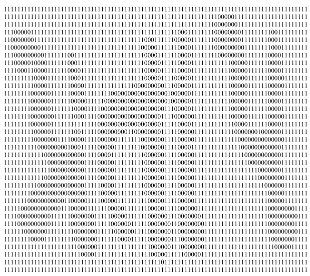

**Fig. 2b.** Matrix of broken word.

**Problem Definition.** At the time of binarizing an image, an appropriate threshold value needs to be fixed which separates the high and low frequency pixel values. Fig. 1a and 1b show a sample text of Gujarati word with poor resolution and the corresponding matrix representation, respectively. The image depicted in Fig. 1a is stored in “png” format and the dimension of the image is $91 \times 35$. The range of the pixel values lie between 0 and 237. One encounters the text like this, for example, in fax transmissions, duplicated material, and historical records.

The threshold being used for binarization in Fig. 1b is 202. One can easily observe that the image shown in Fig. 2a is broken, hence the corresponding matrix is also discontinuous as depicted in Fig. 2b.

While dealing with the tasks related to pattern recognition, segregation of connected component plays a major role. As shown in Fig. 2a, the first glyph is divided into two unusual parts due to the occurrence of discontinuity. This is how one may lose an important feature of the glyph. Such phenomenon occurs several times when scanning the old literature. In order to overcome such problems, one way is to increase the threshold value. By incrementing the value of threshold by 1 (i.e. 203), the image gets connected in an undesirable manner as shown in Fig. 3a and 3b. The middle glyph gets connected with the vertical line ‘Kana’ as depicted in Fig. 3.