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Wikipedia Content	
Link :	https://en.m.wikipedia.org/w/index.php?title=User%3AWarrior2109#
Content:	<div><div>^ Overview</div><p>Contrast Stretching, also known as normalization, is an image enhancement technique used in the field of image processing. The goal of contrast stretching is to improve the visibility of details in an image by expanding the range of intensity levels it contains to span the full range of values allowed by the image. This is achieved by redistributing the gray levels or color values across the entire available dynamic range.</p><div>^ Principle</div><p>The principle behind contrast stretching is to take the narrow range of intensity values in an image and stretch them across a wider range. This is typically done by applying a linear transformation to the pixel values of the image. The transformation function is monotonically increasing and maps the intensity levels of the input image to the entire available display range. By stretching the contrast, the details in the darker and lighter regions of the image become more visible and distinguishable.</p><div>^ Detailed Mathematical Formulation</div><p>The mathematical model underpinning contrast stretching is elegantly simple yet powerful. It can be articulated as follows:</p>$T(r) = \frac{(r - r_{min})}{(r_{max} - r_{min})} \times (L - 1)$<p>In this formula:</p><ul style="list-style-type: none">• $T(r)$ denotes the transformed intensity value,• r represents the initial intensity value of a pixel,• r_{min} and r_{max} are the smallest and largest intensity values found in the original image, respectively,• L signifies the total count of potential intensity levels that the image can exhibit.<div>^ Properties</div><p>Contrast stretching has the following properties:</p><ul style="list-style-type: none">• It is a linear operation, meaning that the relationship between the input and output pixel values is described by a straight line.• It is a point operation, which means that the transformation is applied to each pixel independently, without considering its neighborhood.• It does not increase the inherent information content of the image, but it enhances the perception of the existing information.<div>^ Applications</div><p>Contrast stretching is widely used in various applications such as:</p><ul style="list-style-type: none">• Satellite imagery: To enhance the visibility of features in remote sensing images.• Medical imaging: To improve the contrast of X-ray, CT, and MRI images for better diagnosis.• Photography: To improve the contrast and detail in digital photographs, especially in low-light or high-contrast scenes.• Scientific visualization: To enhance the visibility of data in scientific images and visualizations.</div>

	<div data-bbox="483 205 664 239" data-label="Section-Header"> <h2>^ Code Example </h2> </div> <div data-bbox="483 264 1153 289" data-label="Text"> <p>Here is an example of how to perform contrast stretching using Python with the OpenCV library:</p> </div> <div data-bbox="498 312 1193 705" data-label="Text"> <pre>import cv2 import numpy as np # Read the image image = cv2.imread('path_to_image.jpg') # Convert to grayscale gray_image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY) # Apply contrast stretching min_intensity = np.min(gray_image) max_intensity = np.max(gray_image) # Transformation function contrast_stretched = cv2.normalize(gray_image, None, 0, 255, cv2.NORM_MINMAX) # Display the results cv2.imshow('Original Image', gray_image) cv2.imshow('Contrast Stretched Image', contrast_stretched) cv2.waitKey(0) cv2.destroyAllWindows()</pre> </div> <div data-bbox="483 726 1464 804" data-label="Text"> <p>In this example, the image is first converted to grayscale. The minimum and maximum pixel values in the grayscale image are then calculated. The 'cv2.normalize' function is used to perform the contrast stretching transformation, mapping the pixel values to the full range of 0 to 255. The original and contrast-stretched images are displayed using OpenCV's 'cv2.imshow' function.</p> </div> <div data-bbox="475 829 630 861" data-label="Section-Header"> <h2>^ Limitations </h2> </div> <div data-bbox="475 888 1166 913" data-label="Text"> <p>While contrast stretching can improve the visibility of details in an image, it has some limitations:</p> </div> <div data-bbox="475 919 1461 1045" data-label="List-Group"> <ul style="list-style-type: none"> • It may introduce saturation or clipping of pixel values at the extreme ends of the intensity range, leading to loss of information. • It may amplify noise present in the image, making it more visible. • It is a global operation, meaning that it applies the same transformation to the entire image, which may not be optimal for images with varying local contrast. </div> <div data-bbox="475 1054 1461 1106" data-label="Text"> <p>To address these limitations, more advanced contrast enhancement techniques, such as adaptive histogram equalization or local contrast enhancement, can be employed.</p> </div>
REFERENCE:	https://theailearner.com/2019/01/30/contrast-stretching/