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Improved Brightness-preserving Bi-histogram Equalization (BBHE) Technique Based on the Pelican Optimization Algorithm (POA) for Image Enhancement

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ABSTRACT

Image enhancement is essential in image analysis, which employs intricate procedures and techniques. Enhancing photos of plant diseases is a complex task in image processing because of low image quality and numerous image characteristics. The outcomes substantially affect the clinical diagnosis and observation of diseases. Real-world optimization problems are challenging, and many applications have been developed to manage enhancement problems. Optimization algorithms, such as the pelican optimization algorithm (POA), that have high productivity need to be utilized to solve these problems. This research introduces a new technique called brightness-preserving bi-histogram equalization (BBHE) with POA (BBHE-POA). BBHE-POA is used to enhance the visual quality of plant disease images, with the aim of improving their overall appearance. BBHE, which can preserve the original brightness to a specific extent, is applied and studied mathematically. An optimization algorithm is employed to determine the ideal configuration of BBHE by amplifying the average brightness of equalized subimages surrounding the input mean. Then, qualitative and quantitative analyses of three enhancement techniques, namely, the proposed technique, standard BBHE, and discrete wavelet transform, are performed. Several measurement metrics, such as structural similarity index, absolute mean brightness error, entropy, peak signal-to-noise ratio, and elapsed time, are applied. Experiments show that proposed technique achieves excellent performance qualitatively and quantitatively and produces good values for all data images.

Introduction

The primary preprocessing phase for various computer vision purposes is image enhancement. This phase's goal is to enhance image quality and boost the information's interpretability and perception [1]. The procedure can be extended to methods of improving medical images. The augmentation process is made increasingly difficult by acquisition errors, image fuzziness, and the variability of brightness and noise levels. The goal of applying the enhancement approach is to change the properties of medical images and provide them an improved form.

The main factor in assessing the quality of a picture is contrast, which is produced by the luminance reflection of two nearby locations. The problem of low contrast is resolved by reinforcing the region of interest through the use of picture-enhancing techniques. Improvement methods have been developed to effectively visualize images [2].

These techniques are categorized as spatial- and transform-domain methods in accordance with how they affect processing. One of the traditional spatial-domain techniques is histogram equalization (HE), which improves the consistency of the image grey distribution.

A popular HE-based technique for small regions is adaptive histogram equalization (AHE), which effectively minimizes the loss of image features. Its

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