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Inventor					
Name	Address	Country	Nationality		
Ms.Anna Shalini	Research Scholar, Department of English, Koneru Lakshmaiah Education Foundation, Green Fields, Vaddeswaram, Guntur, Andhra Pradesh, India, Pin Code: 522502	India	India		
Dr.S.Farhad	Associate Professor, Koneru Lakshmaiah Education Foundation, Green Fields, Vaddeswaram, Guntur, Andhra Pradesh, India, Pin Code: 522502	India	India		
Dr.Manne Rama Subbamma	Professor in EEE Department & Principal, Gouthami Institute of Technology and Management for Women, Peddasetti Palli, Proddatur, YSR District, Andhra Pradesh, India, Pin Code: 516360	India	India		
Dr.V.R.Seshagiri Rao	Assistant Professor, Department of ECE, Institute of Aeronautical Engineering, Dundigal, Hyderabad, Telangana, India, Pin Code: 500043	India	India		
Dr.Muniraju Naidu Vadlamudi	Associate Professor, Department of CSE, Koneru Lakshmaiah Education Foundation, Bowrampet, Hyderabad, Telangana, India, Pin Code: 500075	India	India		
Dr.Pundru Prasanth Kumar	Assistant Professor, Department of ECE, Rajiv Gandhi University of Knowledge Technology (RGUKT)-Srikakulam, Andhra Pradesh, Andhra Pradesh, India, Pin Code: 532402	India	India		
Dr.D.Rajendra Prasad	Professor, Department of Electronics & Communication Engineering, St,Ann's College of Engineering & Technology, Chirala, Bapatla District, Andhra Pradesh, India, Pin Code: 523187	India	India		
Mr.G.Vijay Kumar	Assistant Professor, Department of CSE, Aditya Institute of Technology and Management, Tekkali, Srikakulam, Andhra Pradesh, India, Pin Code: 532201	India	India		
Mr.Subramanyam Kunisetti	Assistant Professor, Department of CSBS, R.V.R & J.C College of Engineering, Chowdavaram, Guntur District, Andhra Pradesh, India, Pin Code: 522019	India	India		
Dr.Dasari Vijaya Kumar	Adjunct Professor, Department of Environmental Sciences, Andhra University, Visakhapatnam, Andhra Pradesh, India, Pin Code: 530003	India	India		

Applicant

Name	Address	Country	Nationality
Ms.Anna Shalini	Research Scholar, Department of English, Koneru Lakshmaiah Education Foundation, Green Fields, Vaddeswaram, Guntur, Andhra Pradesh, India, Pin Code: 522502	India	India
Dr.S.Farhad	Associate Professor, Koneru Lakshmaiah Education Foundation, Green Fields, Vaddeswaram, Guntur, Andhra Pradesh, India, Pin Code: 522502	India	India
Dr.Manne Rama Subbamma	Professor in EEE Department & Principal, Gouthami Institute of Technology and Management for Women, Peddasetti Palli, Proddatur, YSR District, Andhra Pradesh, India, Pin Code: 516360	India	India
Dr.V.R.Seshagiri Rao	Assistant Professor, Department of ECE, Institute of Aeronautical Engineering, Dundigal, Hyderabad, Telangana, India, Pin Code: 500043	India	India
Dr.Muniraju Naidu Vadlamudi	Associate Professor, Department of CSE, Koneru Lakshmaiah Education Foundation, Bowrampet, Hyderabad, Telangana, India, Pin Code: 500075	India	India
Dr.Pundru Prasanth Kumar	Assistant Professor, Department of ECE, Rajiv Gandhi University of Knowledge Technology (RGUKT)-Srikakulam, Andhra Pradesh, Andhra Pradesh, India, Pin Code: 532402	India	India
Dr.D.Rajendra Prasad	Professor, Department of Electronics & Communication Engineering, St,Ann's College of Engineering & Technology, Chirala, Bapatla District, Andhra Pradesh, India, Pin Code: 523187	India	India
Mr.G.Vijay Kumar	Assistant Professor, Department of CSE, Aditya Institute of Technology and Management, Tekkali, Srikakulam, Andhra Pradesh, India, Pin Code: 532201	India	India
Mr.Subramanyam Kunisetti	Assistant Professor, Department of CSBS, R.V.R & J.C College of Engineering, Chowdavaram, Guntur District, Andhra Pradesh, India, Pin Code: 522019	India	India
Dr.Dasari Vijaya Kumar	Adjunct Professor, Department of Environmental Sciences, Andhra University, Visakhapatnam, Andhra Pradesh, India, Pin Code: 530003	India	India

Abstract:

FIELD OF INVENTION [001] The present invention pertains to the field of digital image processing, an area focused on the manipulation and improvement of image quality through various computational methods. Specifically, this invention introduces an innovative approach to automated image enhancement that leverages artificial intelligence (AI) to perform contextual analysis of images for their optimization. Unlike traditional methods that rely on manual adjustments or apply generic, one-size-fits-all enhancements, this invention utilizes a sophisticated Al-driven framework to analyze the content and context of digital images in depth, enabling the system to apply highly tailored enhancements based on specific characteristics identified within each image. [002] Digital image processing encompasses a broad range of techniques aimed at transforming images into a more desirable form for specific applications. This includes basic operations like resizing and cropping, as well as more complex enhancements related to brightness, contrast, color balance, and sharpness adjustments. The traditional approach often requires significant human intervention, with manual adjustments being made by users or professionals who rely on their expertise and subjective judgment to enhance the image quality. This process can be time-consuming, inconsistent, and largely dependent on the individual's skill and experience. [003] In contrast, automated image enhancement methods have emerged to streamline this process, offering a faster and more accessible solution for improving image quality. However, these methods typically apply standardized adjustments without considering the unique aspects of each image, such as its compositional elements, lighting conditions, or intended use. As a result, the enhancements often fail to optimally address the specific needs of the image, leading to underwhelming or even counterproductive outcomes. [004] The invention's focus within the digital image processing field is on overcoming the limitations of both manual and traditional automated enhancement techniques by introducing an Al-driven contextual analysis system. This system intelligently interprets various elements within an image-ranging from detecting the main subjects and assessing the lighting conditions to understanding the scene's composition. By analyzing these and other relevant factors, the invention can identify the most effective enhancement strategies tailored to each image's unique context. This approach not only streamlines the image enhancement process but also significantly elevates the quality of the results, making it a groundbreaking advancement in the field of digital image processing. BACKGROUND OF THE INVENTION [005] In the realm of digital imaging, the pursuit of visual perfection is a continuous challenge. Digital images, captured through various devices such as cameras, smartphones, and scanners, often fall short of capturing the true essence and beauty of a moment due to inherent limitations. These limitations include, but are not limited to, poor lighting conditions, camera shake, sensor noise, and incorrect camera settings. As a result, images frequently suffer from problems such as underexposure or overexposure, lack of contrast, blurriness, and unsatisfactory color balance. The field of image enhancement aims to address these issues by applying a series of corrections or modifications to improve the visual quality of images, making them more pleasing to the eye and more useful for their intended application. [006] Traditionally, image enhancement has been a manual and skill-intensive process, often requiring the intervention of professional photographers or graphic designers. Tools like Adobe Photoshop, Lightroom, and GIMP offer a suite of enhancement features, including brightness/contrast adjustment, color correction, sharpening, and noise reduction. However, the effectiveness of these manual enhancements relies heavily on the user's expertise and the time they can dedicate to each image. This manual approach is not scalable, especially in the age of digital content where thousands of images may need processing within a short timeframe. [007] To address the scalability issue, automated image enhancement solutions have been developed. These solutions use predefined algorithms to adjust the various parameters of an image, such as its brightness, contrast, and saturation, without human intervention. While these automated tools offer a quicker solution than manual enhancement, they are often limited by their one-size-fits-all approach. They lack the ability to understand the context or content of the image, leading to enhancements that can sometimes degrade the quality of the image or miss the mark in terms of desired outcomes. [008] The advent of artificial intelligence (AI) and machine learning has opened up new possibilities in the field of image enhancement. Al models, particularly those based on deep learning, have the potential to understand complex image content and context in a way that was previously not possible. These models can be trained on large datasets of images, learning to recognize various elements such as landscapes, portraits, low-light conditions, and more. By understanding the context of an image, Al-driven systems can make more informed decisions about the types of enhancements needed, leading to results that are significantly superior to those produced by both manual methods and traditional automated tools. [009] Despite the progress made with AI, most current AI-enhanced image processing tools still do not fully exploit the contextual information available within images. There is a substantial gap in the capability of existing systems to analyze an image's context deeply and apply enhancements based on a comprehensive understanding of that context. Enhancements that consider the image's subject matter, intended use, compositional elements, and the interplay of colors and light can significantly elevate the visual quality of the image. Recognizing this gap, the invention of an Automated Image Enhancement Using Al-Driven Contextual Analysis seeks to revolutionize how images are enhanced, moving towards a future where every image can be automatically processed to achieve its fullest potential in terms of visual quality and impact. SUMMARY OF THE INVENTION [010] The invention represents a significant advancement in the field of digital image processing. At its core, this innovative system leverages the power of artificial intelligence (AI) to analyze and understand the context of a digital image comprehensively. Unlike traditional image enhancement techniques, which often rely on manual adjustments or apply generic, one-sizefits-all enhancements, this invention introduces a tailored approach. By understanding the unique context of each image, including elements such as scene content, lighting conditions, and intended usage, the system can apply a highly specific set of enhancements that dramatically improve the image's quality in a way that is meaningful and appropriate for its context. [011] The detailed operation of this invention unfolds through several interconnected modules, each playing a crucial role in transforming the original image into its enhanced counterpart. Initially, an image input module receives the digital image to be enhanced. Following this, the Al-driven contextual analysis module takes center stage, employing a sophisticated deep learning model that has been trained on a vast array of images encompassing a wide variety of contexts and quality metrics. This model analyzes the provided image to identify its scene type, the lighting conditions present, the main subjects or objects within the scene, and any quality deficiencies that may exist. [012] Upon completing the contextual analysis, the system then proceeds to the heart of its innovation: the decision-making process regarding which enhancements are most suitable given the identified context. This process is not arbitrary but is informed by the deep learning model's understanding of similar contexts and the enhancements that have historically led to the most significant improvements in image quality for those contexts. [013] The subsequent step involves the actual application of the determined enhancements. The image enhancement module is capable of adjusting a wide range of image attributes, including but not limited to brightness, contrast, saturation, sharpness, and color balance. The specific adjustments made are those that the system has determined to be most effective for the image's particular context, ensuring that the enhancements are both appropriate and optimally beneficial. [014] Finally, the output module presents the enhanced image to the user, completing the process. The result is an image of significantly improved quality, with enhancements thoughtfully applied in a manner that respects and enhances the original context of the image. [015] In summary, this invention offers a groundbreaking approach to image enhancement, characterized by its intelligent, context-aware methodology. By understanding the specific context of each image, the system is able to apply enhancements that are uniquely suited to improving the image's quality in meaningful ways. This process is fully automated, requiring no manual intervention from the user, and represents a significant leap forward in making advanced image enhancement techniques accessible and effective for a wide range of applications. BRIEF DESCRIPTION OF THE DRAWINGS [016] The accompanying figures included herein, and which form parts of the present invention, illustrate embodiments of the present invention, and work together with the present invention to illustrate the principles of the invention Figures; [017] Figure 1, illustrates a general functional working diagram, in accordance with an embodiment of the present invention. [018] Figure 2, illustrates a concept of the functional flow diagram, in accordance with an embodiment of the present invention. in accordance with an embodiment of the present invention. DETAILED DESCRIPTION [019] The invention presents an advanced system for enhancing digital images through an Al-driven process that intelligently analyzes the context of each image. Unlike traditional enhancement methods that apply generic adjustments, this system employs a deep learning model to understand the image's specific context, including its subject, environmental conditions, and intended use. By leveraging this contextual understanding, the system can apply a set of targeted enhancements to improve the image's overall quality and aesthetics significantly. [020] The system's architecture is designed to seamlessly integrate with existing digital imaging environments, whether it be standalone software, a web-based application, or embedded within camera systems. The primary components include: • Image Input Module: This module serves as the entry point for images into the system. It supports various image formats and sources, including direct uploads, integration with cloud storage, or live feeds from camera devices. • Al-Driven Contextual Analysis Module: At the heart of the system, this module utilizes a sophisticated deep learning algorithm trained on a diverse dataset of images. The dataset encompasses a wide range of contexts, scenes, and image quality metrics. This module analyzes each image to identify its unique context, including scene composition, lighting conditions, main subjects, and potential quality issues. • Image Enhancement Module: Based on the analysis provided by the AI module, this component tailors enhancement strategies specifically for the image in question. It adjusts parameters such as brightness, contrast, color saturation, sharpness, and noise reduction. The adjustments are not uniform but are instead dynamically applied to different regions of the image as required, based on the context. • Output Module: After enhancement, the image is processed for output. This module ensures that the enhanced image is compatible with various devices and platforms. It supports multiple image formats and resolutions, enabling users to select their preferred output specifications. [021] The operation of the system unfolds through a series of steps, each designed to ensure that every image is enhanced optimally based on its unique characteristics and context: [022] Image Submission: Users submit images to the system through the Image Input Module. The system is designed to handle single or batch processing, accommodating various user needs. [023] Contextual Analysis: The Al-Driven Contextual Analysis Module receives the image and performs a comprehensive analysis. Using convolutional neural networks (CNNs), the module evaluates the image's composition, identifies the main subjects (e.g., people, landscapes, objects), assesses the lighting conditions, and detects any quality issues (e.g., blurriness, underexposure). [024] Enhancement Strategy Determination: Leveraging the insights from the contextual analysis, the system formulates a custom enhancement strategy. This strategy is highly specific, considering factors such as the need to brighten shadows without overexposing highlights, enhancing colors in a sunset without affecting skin tones negatively, or sharpening details in specific areas while avoiding amplification of noise. [025] Tailored Enhancement Application: The Image Enhancement Module applies the determined enhancements. Advanced algorithms ensure that adjustments are made selectively, focusing on improving areas of interest while preserving the overall natural appearance of the image. Techniques such as layer masking, adaptive filtering, and local contrast enhancement are employed to achieve highquality results. [026] Final Output and Delivery: The enhanced image is then prepared for delivery by the Output Module. Users can choose the format and resolution of the output image, depending on their intended use, whether it be for digital viewing, printing, or online sharing. The system can also store the enhanced images in cloud storage or

send them directly to social media platforms or other destinations as specified by the user. [027] The described invention offers significant advantages over existing image enhancement solutions. By integrating Al-driven contextual analysis, the system provides tailored enhancements that significantly improve image quality in a manner that aligns with the image's unique context and the user's needs. This approach not only elevates the visual appeal of images but also saves time and resources by automating a process that typically requires manual intervention and expertise. [028] In conclusion, the invention of "Automated Image Enhancement Using Al-Driven Contextual Analysis" represents a significant advancement in the field of digital image processing. By intelligently analyzing the context and content of images, this system can apply highly tailored enhancements that significantly improve image quality. This approach overcomes the limitations of manual image editing and generic automated enhancements, offering a bespoke solution that adjusts to the unique requirements of each image. The invention not only streamlines the process of image enhancement for users of all skill levels but also ensures that the enhanced images are of superior quality and suited to their intended use.

Complete Specification

Description:[029] The present invention relates to the domain of digital image processing, introducing an advanced system and methodology for automated image enhancement powered by artificial intelligence (AI) that performs contextual analysis of images. The innovation leverages a sophisticated AI model to thoroughly examine various aspects of an image, including but not limited to its subject matter, ambient lighting conditions, and the image's intended application. Upon conducting this contextual analysis, the system autonomously identifies and applies a series of enhancement adjustments tailored specifically to each image. These enhancements are designed to optimize image quality factors such as brightness, contrast, saturation, and sharpness, thereby significantly improving the visual appeal and utility of the images. This automated, context-aware approach to image enhancement marks a significant advancement over traditional, manual image editing techniques and existing automated methods that lack contextual sensitivity, offering a more efficient, accurate, and user-friendly solution for enhancing digital images across a wide range of applications.

Accompanied Drawing [FIGS. 1-2]

- , Claims:1. A method for enhancing digital images, comprising:
- Receiving an input digital image;
- Analyzing the context of the said image using an Al-driven contextual analysis module, wherein the analysis includes determining at least the scene type, lighting conditions, main subjects, and intended use of the image;
- Identifying, by the Al-driven contextual analysis module, specific enhancement strategies based on the determined context;
- Automatically applying the identified enhancement strategies to the image to improve its visual quality

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