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Tkinter Application: Image Correctness for a product on a marketplace

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ABSTRACT—

In the rapidly evolving landscape of e-commerce and online marketplaces, ensuring the quality, clarity, and authenticity of product images has become a crucial factor in maintaining consumer trust and platform integrity. This research presents a desktop-based image correctness analysis application developed using Python and Tkinter, integrated with advanced AI models for image verification and enhancement. The system performs comprehensive image analysis to assess parameters such as clarity, resolution, relevance, and the presence of inappropriate content or AI-generated elements. Additionally, an Enhanced Super-Resolution Generative Adversarial Network (ESRGAN) powered by RRDBNet is incorporated to improve the resolution of low-quality images without significant loss of detail. The application also features modules to detect watermarks and non-compliant imagery, streamlining the moderation process for online marketplaces. Experimental results demonstrate the system's effectiveness in providing fast, accurate, and user-friendly image verification, thereby reducing manual effort and enhancing the overall quality assurance process. This solution contributes towards fostering a more reliable and visually consistent e-commerce environment.

Keywords— Image Correctness Analysis, ESRGAN, RRDBNet, Image Quality Enhancement, AI-generated Image Detection, E-commerce Moderation, Image Verification, Python Desktop Application, Image Resolution Improvement, Watermark Detection.

Introduction

In the rapidly evolving digital marketplace, the visual representation of products plays a pivotal role in influencing consumer trust and purchase decisions. E-commerce platforms heavily rely on product images to communicate product quality, authenticity, and appeal to potential buyers. However, issues such as low image quality, blurred visuals, AI-generated fakes, watermarked images, and inappropriate content often compromise the integrity of these listings, leading to customer dissatisfaction and potential revenue loss for sellers and platforms alike.

Manual moderation of product images is both time-consuming and prone to human error, especially as the volume of product listings increases exponentially. To address these challenges, there is a growing need for automated, intelligent systems capable of assessing image correctness, enhancing visual quality, and identifying discrepancies without human intervention.

This research introduces a desktop application developed using Python and Tkinter for image correctness analysis, specifically tailored for e-commerce and marketplace platforms. The system incorporates advanced AI models to verify image clarity, quality, relevance, and authenticity. Additionally, it integrates Enhanced Super-Resolution Generative Adversarial Network (ESRGAN) with RRDBNet architecture to upscale and enhance low-quality images, improving their visual sharpness and resolution.

The application also includes AI-powered modules to detect AI-generated images, inappropriate or explicit content, and the presence of watermarks — common concerns in online
product images. By providing a user-friendly interface for uploading images and generating real-time analysis reports, this solution significantly reduces the need for manual moderation, enhances operational efficiency, and boosts buyer trust by ensuring consistent and high-quality product visuals.

This paper discusses the design, implementation, and evaluation of the proposed system, highlighting its performance, accuracy, and potential impact on e-commerce operations. The results demonstrate the application's ability to deliver reliable, real-time feedback on image correctness, ultimately contributing to safer, more transparent, and visually consistent online marketplaces.

Literature Review

The importance of image correctness analysis and quality assurance has become increasingly critical in the domain of e-commerce, where product images directly influence consumer trust, decision-making, and platform credibility. Several studies have explored different techniques for image assessment, enhancement, and classification in both academic and commercial settings.

Baraheem and Nguyen (2023) developed an AI-based system for detecting AI-generated images using Convolutional Neural Networks (CNNs) and transfer learning approaches. Their system could accurately differentiate between real and synthetic images, making it useful for moderating AI-created visuals. However, the model exhibited limitations in handling blurry, low-quality, or vintage images, often misclassifying them as fake. Additionally, AI-generated images with sharp, realistic textures occasionally bypassed detection. The method's dependency on the dataset's diversity posed a challenge, as the model's accuracy dropped on unfamiliar image sets. While valuable for AI image detection, this approach is insufficient for e-commerce needs, where image clarity, lighting, and authenticity collectively determine a product image's effectiveness.

Similarly, Zhenfeng Wei and Xiaohua Zhang (2024) proposed a method aimed at improving product image retrieval using an enhanced Fourier descriptor combined with a metric learning-based network. Their approach integrated an attention mechanism to prioritize key image regions, significantly improving image search accuracy on e-commerce platforms. Although their method successfully emphasized shape and feature details, it faced challenges when applied to flexible or variable-shaped products such as apparel. The approach also required extensive labeled data and higher computational resources, limiting its scalability for real-time e-commerce moderation. Furthermore, it focused solely on visual aspects, neglecting the potential synergy between image and product description metadata.

For image quality assessment, Bansall et al. (2016) explored a blur detection method using the variance of the Laplacian operator through OpenCV. The technique proved fast, lightweight, and accurate in detecting blur based on edge sharpness. Despite its efficiency, the model struggled with textured or low-contrast images and failed to address complex blurring effects like motion or depth-based blur. The study emphasized the need for multi-technique integration to improve detection accuracy, especially for e-commerce scenarios where image quality significantly affects consumer perception.

In a related domain, Ismail Taha Ahmed, Baraa Tareq Hammad, and Norziana Jamil (2021) proposed a machine learning-based system for detecting watermarked images using Gabor features. Their approach efficiently identified watermarked visuals without requiring prior knowledge of the watermarking technique. By integrating different features with machine learning classifiers, the model achieved high accuracy and processing speed. However, its reliance on Gabor features limited its ability to detect watermarks in distorted or complex images. The authors recommended integrating deep learning and enhanced feature extraction methods for future improvements.

Collectively, these studies highlight critical advancements in image classification, blur detection, watermark identification, and consumer behavior analysis in e-commerce. However, most existing methods focus on isolated image issues such as AI-generated detection or blur classification, often neglecting the need for an integrated solution that assesses overall image correctness, clarity, authenticity, and visual quality. The present study addresses this gap by proposing an AI-powered image correctness analysis system combined with an ESRGAN-based enhancement module and AI detection algorithms, providing a comprehensive framework tailored for e-commerce image moderation.

Objectives

The primary objective of this research is to develop and evaluate a comprehensive image correctness analysis system tailored for e-commerce platforms, capable of detecting common image issues such as blur, watermarks, AI-generated content, and inconsistencies between product images and descriptions. The specific objectives are as follows:

i. ***Accurate Blur Detection :***

To implement an automated blur detection mechanism using a CNN-based model capable of accurately assessing the sharpness of product images. This objective aims to ensure that only clear, high-quality images are allowed for product listings, thereby enhancing user experience, increasing engagement, and reducing product returns due to poor visual representation.

ii. ***Watermark Detection for Copyright Protection:***

To develop and integrate a deep learning-based watermark detection system, utilizing CNN models

such as MobileNetV2, capable of identifying both visible and hidden watermarks in product images. This objective seeks to prevent unauthorized use of copyrighted content, protect intellectual property rights, and maintain marketplace integrity by flagging or rejecting watermarked images as per platform guidelines.

iii. ***AI-Generated Image Detection:***

To incorporate an AI-generated image detection module powered by a pre-trained Tiny-ViT model, designed to differentiate between authentic product photographs and synthetic AI-generated images. This objective ensures the authenticity of product images, safeguarding buyers from misleading content and reinforcing marketplace credibility.

iv. ***Product Description Matching:***

To implement a product description matching system using the CLIP model, which evaluates the semantic similarity between uploaded images and their accompanying product descriptions. This objective aims to detect and prevent inconsistencies or misrepresentations in product listings by alerting sellers about mismatches before publication, thereby improving buyer confidence and reducing transaction disputes.

Methodology

The design and implementation of the Image Correctness Analysis Application involve integrating deep learning models with a Tkinter-based graphical user interface (GUI) to evaluate the accuracy and quality of product images for marketplace and e-commerce platforms. The methodology adopts a modular approach, enabling independent and sequential analysis for various image correctness parameters including blur detection, watermark detection, AI-generated image identification, product description matching, and image quality enhancement.

The process begins with image selection and preprocessing. Users can select an image file through the Tkinter interface, which is then read using the OpenCV library. To maintain consistency and compatibility across the different deep learning models, the image is converted to RGB format where necessary, resized based on the model requirements, and normalized with pixel values scaled to a [0, 1] range. For model compatibility, a batch dimension is added to the processed image. Once the preprocessing is complete, the image is ready for analysis through the different modules integrated into the application.

For blur detection, the application employs a pre-trained Convolutional Neural Network (CNN) model built with TensorFlow and Keras. The image is resized to 128×128 pixels and passed into the CNN model, which predicts whether the image is blurry or sharp. A probability threshold of 0.5 is set to classify the image; predictions above this threshold indicate a blurry image, while values below it signify a sharp image. The result is displayed within the Tkinter interface, offering users immediate feedback on image clarity.

Watermark detection is handled using a MobileNetV2-based CNN model. Depending on availability, the model can either be loaded from pre-trained weights or trained from scratch using a curated watermark dataset. The input image is resized to 224×224 pixels and normalized before being fed into the model. This module performs binary classification to detect the presence or absence of a watermark in the image. The result is then displayed in the GUI, notifying the user whether the image contains a watermark or is watermark-free.

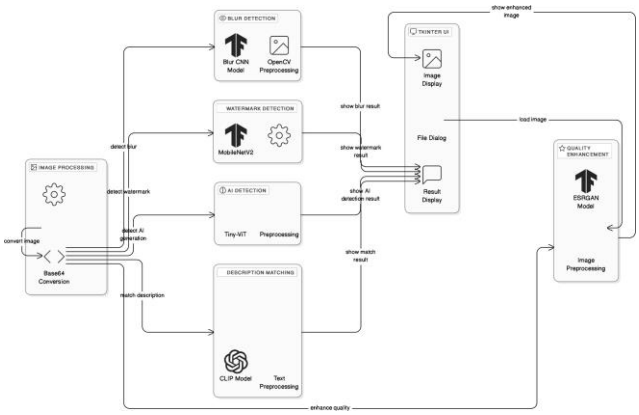

Figure 1. System Architecture

The application also incorporates AI-generated image detection by integrating a pre-trained Tiny Vision Transformer (Tiny-ViT) model sourced from Hugging Face. Preprocessing is carried out using Hugging Face's AutoFeatureExtractor to ensure the image is in RGB format and converted into a tensor suitable for inference. The processed image is passed through the Tiny-ViT model, which classifies it into labels such as "AI-generated," "Real."

To verify whether the image content aligns with a provided textual product description, the system utilizes the CLIP (Contrastive Language-Image Pretraining) model, specifically the ViT-B/32 variant. The image is resized to 224×224 pixels and normalized according to CLIP's standards, while the accompanying text description is tokenized. The application then extracts image and text embeddings using the CLIP model and calculates the cosine similarity between them. A high similarity score suggests that the image content matches the product description, while a low score indicates a mismatch. This similarity score and the assessment result are displayed in the Tkinter interface to inform the user about the accuracy of the listing.

To address low-resolution images and improve product image usability, an image quality enhancement module is incorporated into the application using Enhanced

Super-Resolution Generative Adversarial Networks (ESRGAN). Users can upload low-quality images, which are then converted into a tensor format suitable for deep learning inference. The RRDBNet model from ESRGAN processes the low-resolution image and generates a high-resolution version, significantly improving visual clarity. The enhanced image can be previewed and saved through the GUI, ensuring better presentation quality for product listings.

The entire workflow is integrated into a Tkinter-based graphical user interface, designed for simplicity and user convenience. Additional interface functionalities, such as image upload options, enable dynamic interaction and smooth navigation through the application's features. This modular, GUI-driven system ensures an accessible and efficient solution for verifying the correctness and quality of images used in online marketplaces.

Expected Outcomes

Desktop Application for Image Correctness Analysis

The system successfully developed a desktop-based application using Python and Tkinter for analyzing the correctness of product images on e-commerce platforms. The application assesses product images based on clarity, quality, relevance, and correctness, providing immediate feedback through an intuitive graphical interface. This ensures that product listings maintain a high standard of visual content, helping sellers and platform moderators quickly verify images before publishing.

AI-Driven Image Verification

Advanced AI models were implemented within the system to analyze critical image attributes such as clarity, resolution, watermark presence, content relevance, and AI-generated content detection. These models automate the image assessment process, significantly reducing the need for manual verification by platform moderators while improving the accuracy and consistency of content quality control on e-commerce platforms.

Image Enhancement using ESRGAN (RRDBNet)

The application integrated the Enhanced Super-Resolution Generative Adversarial Network (ESRGAN) with RRDBNet architecture to enhance and upscale low-resolution product images. This module improves image resolution and visual clarity, allowing sellers to upgrade poor-quality images without using external tools. As a result, e-commerce listings can maintain high-resolution visuals, enhancing customer trust and engagement.

AI Models for Detection

A dedicated module was developed to detect AI-generated images, blur presence, watermarks, and the relevance of images to their associated product descriptions. By automating these verification checks, the application ensures compliance with e-commerce platform policies, effectively filtering out unauthorized, misleading, or inappropriate images before they reach the public listing.

User-Friendly Interface for Image Analysis

The system features a clean, intuitive, and easy-to-use interface developed with Tkinter. This graphical dashboard allows users to upload product images, run multiple correctness analyses, and instantly view detailed results and suggestions for improvement. The streamlined interface enhances the user experience by reducing technical barriers, making the tool accessible for sellers, platform moderators, and administrators with varying levels of technical expertise.

Reduction of Manual Image Analysis

Through AI-powered automation, the system substantially reduced the need for manual image verification and feedback generation. The automated analysis workflow minimizes human intervention in the image approval process, improving operational efficiency, saving time, and lowering resource costs while increasing the accuracy and consistency of moderation outcomes.

Enhanced Buyer Trust on E-Commerce Listings

By ensuring product images are clear, relevant, and policy-compliant, the system contributes to building buyer trust and credibility on e-commerce platforms. Correct and high-quality images reduce the likelihood of buyer dissatisfaction, return requests, and product disputes, leading to improved customer satisfaction and stronger engagement on online marketplaces.

Real-Time, AI-Powered Image Assessment Feedback

The system provides instant, AI-generated feedback on image quality and correctness, offering real-time suggestions for enhancement or replacement. This rapid assessment feature accelerates listing approvals, allowing sellers to quickly address image issues and improving the readiness of product images for online publication, thereby increasing the overall operational speed and content quality on e-commerce platforms..

Obstacles And Constraints

During the development and implementation of the image correctness analysis application, several obstacles and constraints were encountered that influenced both the design and performance of the system. These challenges are outlined as follows:

One of the primary challenges faced during the AI model training process was the limited availability of publicly accessible, high-quality, labeled datasets specifically tailored to e-commerce product images. Most available
datasets lacked annotations for parameters such as image clarity, watermark presence, AI-generated content, and relevance to product descriptions. This limitation affected the diversity and robustness of the trained models, necessitating additional efforts in data collection, preprocessing, and augmentation.

Achieving real-time feedback for image correctness analysis while maintaining high accuracy posed significant computational challenges. Image assessment models, particularly super-resolution and AI-detection algorithms, are resource-intensive and require substantial processing power, especially when running on standard desktop systems without GPU acceleration. To address this, model optimization techniques and lightweight inference architectures had to be implemented, sometimes at the cost of slight reductions in accuracy.

The application integrates various AI models for tasks such as clarity analysis, watermark detection, blur detection, AI-generated image identification, and description-image relevance checking. Coordinating the seamless integration and concurrent execution of these models within a single desktop environment was technically complex. Balancing the system's response time while avoiding conflicts between modules required careful threading and memory management strategies.

The ESRGAN (Enhanced Super-Resolution Generative Adversarial Network) model, particularly with the RRDBNet architecture, demands significant computational resources for processing high-resolution images. On systems lacking advanced hardware configurations such as dedicated GPUs, the processing time for image enhancement increased considerably, affecting the overall performance and user experience of the application.

While Tkinter was selected for its simplicity and ease of use in developing desktop applications, it presented limitations in terms of advanced UI customization, modern design aesthetics, and performance during the display of multiple large images and real-time updates. These constraints required workarounds to maintain an intuitive and user-friendly interface without overcomplicating the framework.

Differentiating between authentic product images and AI-generated images or subtle watermarks proved challenging due to the evolving sophistication of generative AI tools. Developing reliable detection algorithms for diverse and visually complex product categories demanded continuous fine-tuning of models and the use of multiple feature extraction techniques to maintain acceptable detection accuracy.

As a desktop-based application, the system's scalability is inherently limited compared to web-based or cloud-hosted solutions. Deploying the application for large-scale, multi-user environments would require significant modifications, including transitioning to server-based architectures and ensuring adequate computational resources for concurrent processing.

Handling product images, especially when sourced from live e-commerce platforms, raised concerns regarding data privacy and copyright compliance. Ensuring that the system processed images securely, without unauthorized storage or redistribution, was an essential constraint to address during application design and testing.

Future Scope

Future upgrades would include expanding the image correctness analysis system to support a broader range of e-commerce product categories and specialized image types, such as 360-degree product views, promotional banners, and lifestyle images. Incorporating category-specific assessment criteria would enhance the system's applicability across diverse online marketplaces and enable more precise image evaluations tailored to specific product domains like fashion, electronics, furniture, and food products.

Future avenues of research would focus on improving the system's capability to detect complex image manipulations and subtle AI-generated visuals that continue to evolve with advanced generative models. Current detection algorithms may face limitations in identifying highly realistic synthetic images or watermarks with adaptive blending techniques. Integrating cutting-edge deep learning-based forensic analysis models and adversarial detection networks would strengthen the system's resilience against such challenges and maintain compliance with marketplace authenticity standards.

Another significant area for enhancement is the development of real-time image analysis features for live listings and seller uploads on e-commerce platforms. While the current desktop application offers reliable image assessment for batch processing, future iterations could enable integration with e-commerce APIs to perform instant correctness checks during image uploads. This would streamline the listing approval workflow and improve moderation efficiency in large-scale, dynamic marketplaces.

The improvement would also involve extending the application's image enhancement module to support multiple upscaling options and AI-driven background removal tools. Enabling sellers to automatically clean, enhance, and optimize product images within the same platform would improve image presentation consistency, visual appeal, and compliance with platform guidelines, without requiring external tools or manual editing skills.

Integration of the system with cloud-based services and scalable web platforms could significantly broaden its operational scope and accessibility. Developing a web-based version or RESTful API service for e-commerce companies would allow large-scale, multi-user access and concurrent image assessments, making the solution adaptable for enterprise environments. Additionally, integrating this system into popular e-commerce content management
systems (CMS) like Shopify, WooCommerce, or Magento could provide on-the-fly image correctness analysis as part of the seller workflow.

Another potential area for advancement is the improvement of AI-driven description-to-image relevance models. Current models provide basic semantic matching between image content and product descriptions. Future research could incorporate advanced vision-language transformer models to capture deeper contextual relationships, detect misleading visuals, and ensure precise alignment between product listings and their corresponding images. This would further improve buyer trust and minimize customer grievances due to misrepresented products.

In summary, as advancements in computer vision, AI-driven content moderation, and generative media forensics progress, future versions of the image correctness analysis system will incorporate more sophisticated detection models, real-time processing capabilities, and seamless integrations with modern e-commerce ecosystems. This continuous evolution will enable marketplaces to uphold high-quality visual standards, prevent content misuse, and enhance the overall online shopping experience for buyers worldwide.

Conclusion

The proposed desktop-based image correctness analysis application successfully addresses a critical requirement in modern e-commerce platforms — ensuring the accuracy, clarity, and relevance of product images uploaded by sellers. By leveraging AI-powered image verification models, super-resolution enhancement techniques, and intelligent detection modules for blurred, watermarked, and AI-generated visuals, the system offers a comprehensive solution for maintaining high visual standards in online marketplaces.

The integration of ESRGAN (RRDBNet) for image enhancement not only improves the resolution of low-quality images but also empowers sellers to refine their visuals without the need for external tools. The user-friendly interface developed using Tkinter ensures accessibility for both technical and non-technical users, enhancing the operational workflow for sellers, content moderators, and platform administrators alike.

Moreover, the AI-driven automation of image assessment and feedback generation significantly reduces manual verification efforts, streamlining the content approval process and improving moderation efficiency. This contributes to enhanced buyer trust, reduced return rates, and improved customer satisfaction by ensuring product images accurately represent the listed items.

While the current implementation provides reliable and effective solutions, there remains substantial scope for future enhancements. Expanding support for real-time, cloud-based integrations, developing advanced manipulation detection techniques, and incorporating category-specific assessment criteria will further refine the system's utility and adaptability across diverse e-commerce ecosystems.

In conclusion, this research presents a valuable contribution to the field of AI-based image quality assessment and e-commerce content moderation. It lays a strong foundation for future innovations aimed at ensuring marketplace integrity, improving buyer experiences, and supporting sellers in maintaining professional, trustworthy, and visually appealing product listings.

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