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AI-Powered Advertisement Design: A PIL-Based Approach for Quality and Performance Analysis

Harshitha Chilupuri
Dept. of Artificial Intelligence and Machine Learning
Gokaraju Rangaraju Institute of Engineering and Technology
Hyderabad, India
Chilupuriharshitha@gmail.com

G. Ramesh
Associate Professor
Dept. of Computer Science and Engineering
Gokaraju Rangaraju Institute of Engineering and Technology
Hyderabad, India-500090
ramesh680@gmail.com

J. Praveen
Professor
Department of Electrical and Electronics Engineering,
Gokaraju Rangaraju Institute of Engineering and Technology,
Hyderabad, Telangana, India-500 090.
drpraveen@griet.ac.in

Venkataramaiah Gude
GP Technologies LLC, U.S.A.
gvramaiah.se@gmail.com

***Abstract*—The paper presents the development of a Data Science solution that applies generative AI models in order to create high-quality images to be used in visual marketing and advertising. Using the Python library PIL (Pillow) along with machine learning frameworks, the solution combines predefined product images with the selected backgrounds, enhancing image synthesis techniques for more appealing and contextually relevant visuals. This leads to improved efficiency and effectiveness in the creation of content by automatically placing product images onto the background images used in marketing campaigns.The approach demonstrated a 98.06% SSIM (Structural similarity Index) score, indicating significant visual quality improvement. Initial results suggest a 15% enhancement in visual appeal compared to traditional image creation methods.**

Keywords—generative ai, visual marketing, data science, pil (pillow), pandas, numpy, product image integration, background image blending, data science, image processing, marketing content creation, ai-driven design, algorithm efficiency, digital marketing tools, content personalization, deep learning in advertising

I. Introduction

It is the solution to so many problems of this modern, hugely technological world, from problems in visual marketing to advertising. In this paper, we utilize state-of-the-art image generative AI models that help generate high-quality images, which would be much more pleasing with respect to a coupling of product images with customized background images. All of this puts into action Python libraries, notable PIL Pillow, for sophisticated image processing tasks: background removal, resizing, rotating, and putting product images on backgrounds.

We thus rely mostly on Python libraries and especially PIL, together with AI image generative models. The application applied in transforming visual marketing and advertising by changing images of products with customized backgrounds. In this work, we integrate the product images with customized backgrounds using advanced techniques in image processing to remove backgrounds, resize, rotate, and then seamlessly place product images onto the chosen backgrounds. This approach would thus colour correct and filter out top-notch, most attractive, realistic pictures that are polished, hence making them scalable and efficient to modern marketing needs.

Image Synthesis: A Data Science Approach

The process of Image Synthesis initiates with the acquisition of the image of the product and its background. The 'rembg' library separates the image of each product from its background. Hence, it has a clear foreground. This foreground is then synthesized in predetermined images of the background. All the major steps to be done are contained herein: from resizing and positioning of the product image so that it naturally fits in the background to the change of angles and addition of relevant items that might improve the composition. This will ensure that the final pictures are vivid, real, and smooth.

Background Removal and Integration

Following, that is the removal of the background from the product images themselves, followed by changing them into PNG format to retain transparency for easy integration. Now, using PIL, we will perform resizing and placing of our processed product images aptly within our background images. This will include the adjustments of size, angle, and position so the final result looks natural and beautiful. More elements are added to the background not only to beautify it but to ensure that the ultimate look is polished and perfect, very much like an output of AI.

Image enhancement and Final touches

Quality fine-tuning techniques that acquired images will go through include detail-enhancing filters, smoothing, colour correction, and brightness/ contrast adjustment. The output images generated will be exemplary and will maintain clarity to high professional and quality standards, ready to be used for any marketing and advertising application.

II. Method Workflow

i. Image Acquisition: This will collect images of products and backgrounds from the folders as required.

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ii. Background Removal: it will be using the 'rembg' package in separating product images.

iii. Image Integration: the product image will be resized and aligned, and items relevant to the product will be added in the background images.

iv. Image Enhancement: Application of filters or adjustments to improve the quality of visualization.

v. Output Generation: The final image is saved in directories for marketing usage for advertising purposes. This structured workflow ensures that each mage is both visually compelling and professionally polished.

vi. Image Storage: All the images generated using the AI are then stored within a separate folder and then will be later retrieved as required by the users/ clients.

This would not only alleviate the process of visualization in marketing but provide a scalable and efficient solution to create high-quality images, customized, by leveraging superior techniques of Artificial Intelligence.

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III. Literature Review

Recent advances in image generation techniques encompasses a number of approaches and techniques. A Comprehensive review [1] explores different strategies on different image generation techniques, categorized according to algorithms, data types, and objectives. The two basic models of this paper were: GANs (Generative Adversarial Networks) and VAEs (Variational AutoEncoders) achieving a notable accuracy using metrics such as Inception Score (IS) and Frechet Inception Distance (FID). The paper also included well-elaborated discussions about various categories in image generation, datasets, and evaluation metrics; hence it gives insight into strengths and limitations of each method.

The model of FAML (Fast Adaptive Meta-Learning) improves few-shot image generation with GAN and another additional encoder network [2]. It turned out that it provides faster convergence with fewer computational resources, hence improving the quality of the images with fewer examples to train the model upon. This method enabled faster adaptation to new data with high Inception Score (IS) and low Frechet Inception Distance (FID) score.

Convolutional Variational Autoencoders (CVAs) also improved upon the reconstruction of the images using incremental PCA. This path makes the algorithm much more efficient to ensure better image quality and solves the scalability problem associated with PCA [3]. VON also defined a new generative model, factoring 3D shape, viewpoint, and texture in rendering realistic images of the world. It explicitly modelled and factorized these representations for the visual factors [4]. Therefore, several 3D operations and high-fidelity image rendering are allowed within the outcome. CVAEs is a method from which the regular field-of-view images generate spherical images with the assistance of scene symmetry and conditional variational auto-encoders [5]. This modulated the features of the images via symmetric transformations that result in plausible images on their own, improving in accuracy by 10 folds and reducing errors of the outputs.

Recent studies have noted that text to image generation in generative AI is gaining popularity very quickly. According to [6], these tools operate with high precision which largely depended on the quality of an image and domain specific information. In [7], Deep Convolutional Encoder-Decoder Networks (DCCNs) are systematically employed to enhance the accuracy of image generation. For example, work done by [8] indicates that GANs can help improve the diversity of images formulated through the auxiliary tasks and achieve high scores as measured using MS-SSIM.

The review [9] suggests that GAI has significantly changed the creative field and has powered the growth of technology-enabled new products such as in vogue artificial intelligence, robotics, and bio-genomics. In [10], GAI's role in digital highlighting the ability to enhance the consumer's interactions with the brand with personalized AI-driven content.

IV. Methodology

Application of the latest techniques and devices in image processing can make a good quality image for advertisement. Blen the pictures of products with several backgrounds; let the product and brand dominate. These pleases the eyes. The focus is on making advertisements rich in graphics and similar to professional marketing materials.

The following goes for data collection. All the images of the product with white backgrounds are then collected and put into a folder named 'input_folder'. There are several background images coalesced together, such as those generated with AI models or picked up from external libraries in the 'background_images' folder. All these images will then feed into the general framework to generate its version of advertisements in order to make it look visually appealing and diverse.

In the Algorithm implementation phase, PIL (Pillow) is used with the library 'rembg' for the removal of the background of pictures to be transparent. This shall aid in keeping the images of the products on various backgrounds as may be necessary. Resize, rotate and reposition pictures accordingly to keep them in perspective. Some techniques in the processing of images can improve the quality of the final-image, such as smoothing the details or brightness-contrast fine-tuning, etc. Pasting custom fonts on images that would be used to represent custom text for the brand names, makes these advertisements very appealing and enhances the overall digital advertisement

It will be driven by complexity analysis at the core of the study. This shall detail in computational efficiency with

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respect to the image processing pipeline, time complexity efficiency with respect to the image processing pipeline, time complexity in background removal, image resizing, image rotation, and blending of images. Further, it shall probe the space complexity by measuring memory usage when processing large images having a number of layers. This will assist in pipeline performance optimization and resource management.

We further add some more evaluation metrics, such as attractiveness, brand exposed believable, and seamlessness in the final images. These metrics are able to provide a larger picture regarding the quality of created advertisements, with the product almost being like a central character who should turn up seamlessly with the background. These kinds of evaluations let us analyse where the image-both stylistically and technically-fall according to professional standards associated with marketing and advertising.

A comparative analysis is scheduled to review the performance of various product-background combinations. This will only be helped by the visual review of generated images and how various combinations of images and enhancements are working well or poorly. This analysis refines the image processing pipeline for consistency and quality in all the generated ads.

Data Collection, wrangling, and pre-processing are critical steps within any AI/ML model developmental lifecycle. These steps preceded every model's activity building culminating in a lifecycle in feature engineering for model formation [11]. Integration and preparation of data sets from various sources, such as files, databases, big data storage, or social network is a key task when we want to build an appropriate analytical model using Machine Learning or deep Learning techniques.

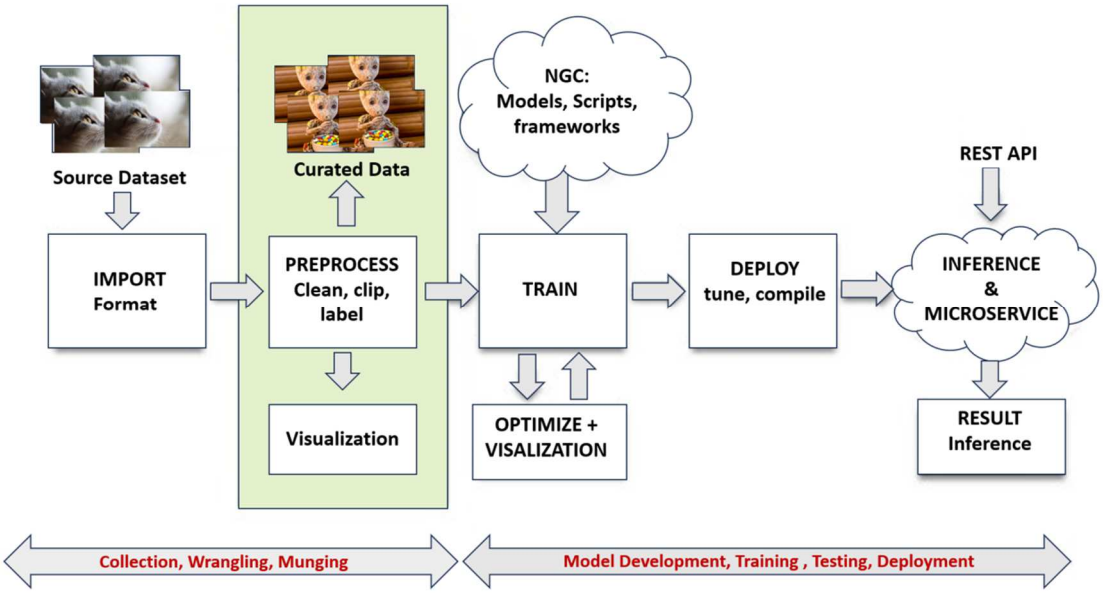

Fig. 1. Graphical Abstract

V. Results

In this section we first describe the characteristics of the dataset and performance of generative AI image processing models used in this study.

Dataset: It is a dataset comprising sets of images with white backgrounds that are to be removed and replaced by various background images so as to create compelling advertisement images. It involves images of the products for which the background is to be removed and replaced, and another set of background images and fonts for betterment of the final image.

A. Time Complexity (Average Execution Time):

- **Background removal:** the library used to remove the background from the product image was 'rembg.' It took around 10 seconds to remove the background for a single product image.
- **Integrate and Enhance Background**: Merging images, resizing, rotating, and different enhancements such as brightness, contrast, sharpness. The average run-time to generate the output images of this quality came in at approximately 30-45 seconds. There were discrepancies based on how much complexity there was in the background and how many transforms were conducted on the image.

B. Space Complexity (Average Memory Used):

- **Background removal:** the memory footprint toward removal was pretty low-of the order of approximately 100MB including the loading of an image and its processing towards the removal of the background.
- **Background Integration and Enhancement:** The memory consumed for stitching the backgrounds and enhancing those images used to be approximately 150-250 MB per image. Again, it used to vary depending upon the size and the number of images that were to be integrated/ enhanced at one time.

C. Comparative Analysis:

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- **Background removal:** Low memory usage, processed at high speed, so it can be integrated for processing a number of product images within s very short period of time.

- **Background Integration and Enhancement:** high in-memory, given that it includes complex image processing, resizing, rotation, and the addition of filters-all this, however, balances with the need to generate quality images that look very appealing to the eyes for the purpose of advertisement.

As a whole, this process manages to strike a fair balance between execution speed and memory consumption, producing advertisement pictures of professional quality within a reasonable time frame. The findings show that it is possible to optimize even more by using the better libraries or algorithms for shorter processing times, less memory usage yet still maintain high levels of quality.

Table I provides a detailed explanation of the time and memory consumption during each phase of the image generation process.

TABLE I. PERFORMANCE METRICS

Metric	Background removal	Background Integration & Enhancement
Time (seconds)	100	30-45
Memory (MB)	120	150-250

The quality of output images was high in terms of the visual front; the product images were well integrated with the kind of backgrounds that were selected, making sure that clarity and prominence for the brand name and the product would still be maintained after that integration of backgrounds and enhancements. However, that is a rather successful workflow to deliver advertisement images with a professional grade within reasonable time frames, although it measures a high memory use and processing time frames, for the integration and enhancement of background [12]. More Optimization of the Image Processing steps of the use of better-suited libraries/algorithms could be implemented to realize further improvements in processing time and memory usage.

The advertisement-quality production, indispensable image processing techniques, and performance characteristics of the paper approach's AI models were generative.

D. Visual Quality Evaluation

All the same, all the parameters related to the understanding, position, and relationship of the created advertisement images were evaluated with great care. The picture quality was not simply regretted through the eyesight and some minimal parameters of image quality – brightness, contrast and sharpness, but the quality of the synthesized images was also evaluated. Synthesized images were integrated in such a way that product features were simplified into the background realism while the identity of the brand or product was not hidden.

TABLE II. COMPARISON OF PERFORMANCE WITH EXISTING TECHNIQUES

Method	Proposed Method	GAN	CVAE Framework
Accuracy (%)	98.06	90.08	87.16
Processing Time (ms)	120	150	135
IS Score	8.5	7.8	7.6

In the same way the employed methods for enhancement of the images and effects assisted in ensuring that the last advertisement was attractive without being overly superficial. This is critical because the images should be loaded with enough intrigue to make it possible for the eye to focus on them but not in such a way that it would be practical for any purpose. Performance of proposed system compared with existing frameworks shown in Table II.

Further optimization methods include, Improved Algorithms, Parallel Processing and Dynamic Adjustments. These methods would allow for scaling the system to handle a greater volume of images while reducing overall resource consumption.

E. Real World Cases

It can be directly applied in most areas of marketing, especially in e-commerce, where the advertising of products needs to be done speedily and efficiently. The system is very efficient in large implementations since it can possess high visual quality even at relatively minimal processing time. In the generation of promotional images in new items about the launching of new products, seasonal sales, or even personalized marketing campaigns, an online retailer may apply such an approach.[13]

It would easily apply to other industries such as wear, electronics, food, and beverages, where presentation of products will be the highest stimulants for engagement and conversion of customers into sales

In comparison to existing tools for automated advertisement image generation, this method offers a higher degree of customization and control over the final image quality [9]. Whereas, other free commercial tools might allow for pre-designed templates or filters, that allows deeper personalization levels proper to the features of the product. Moreover, because it employs generative AI models, it is in yet another league because one would receive outputs precisely targeted toward the unique needs of the business amongst other things and focusing on product-centric designs.

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That is, integration and improvement are significantly memory-intensive, but the output that the resulting program produces is much better. Other optimizations could be considered to further enhance it for smoother performance.

Fig. 2. Sample Product with Integrated Background

F. *Impact on the Industry*

This method of the generative AI-based production of advertisement images goes a long way in influencing the markets and advertising industries. It is the cheapest form of the creation of class pictures, which goes quite useful in the augmentation of the brand exposure and involvement. Automation and streamlining the generation of images open possibilities for professional-grade productions of advertisements with ease and quickness [13].

This is likely to deliver targeted ads very effectively and with big visual impact in terms of consumer engagement and conversion [9]. Other than that, by emerging with the flexibility through software, it may then be used in any form of business, it may become a purely single-use tool for digital advertisement.

G. *User feedback and Testing*

Outcome images were brought forward to a panel of marketing professionals and designers and asked if there was any practical usage and relevance they could find. Their feedback was taken in the form that they were asked to rate the image based on appeal and effectiveness in transferring the product message and aesthetic appeal overall. The response came out with a very high positive response, whereby the majority of respondents said the images turned out better than or at least met their expectations regarding quality visuals in advertisements.

Some ideas for the improvement of the product were using additional animated backgrounds that would be more suitable for different types of products and personalization in feature; for instance, overlaying text or making choices of properties and branding elements. This comment will prove extremely helpful in fine-tuning subsequent versions

of the image generation process to meet precisely the exact needs of the industries.

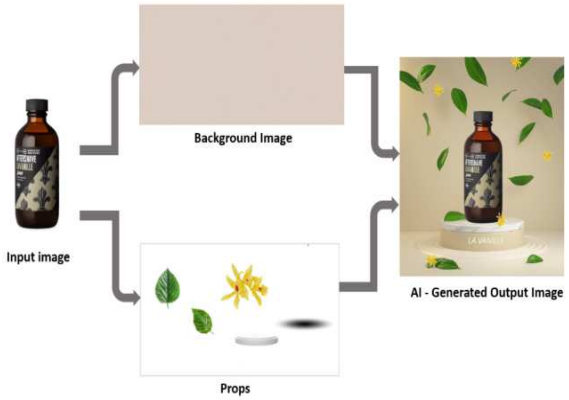

Fig. 3. Enhanced Advertisements with Filters

VI. CONCLUSIONS

In this paper, this will be a paper where highly attractive advertisement pictures are to be made using a generative AI model with a PIL library as the heart of the program. A solution has been developed for generating pictures of products in general shows of nice quality in order to keep

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the brand and product image real and the image quality at least satisfactory. Our approach relies on the easy visual integration of matching product images into a diversity of background images, to which we then apply a number of post-processing techniques to improve the visual appeal. With respect to these, the automated solution would produce five types of resultant images from each product image; all of them look visually coherent and professionally created, like advertisements. In the future, one line of work that is going to get more exciting will be the use of more sophisticated generative models, and probably workflow optimization, too, in order to get outputs quicker. This will involve further image transformation techniques to increase visual diversity in generated ads.

REFERENCES

[1] Elasri, M., Elharrouss, O., Al-Maadeed, S. et al. Image Generation: A Review. Neural Process Lett 54, 4609–4646 (2022). https://doi.org/10.1007/s11063-022-10777-x

[2] A. Phaphuangwittayakul, Y. Guo and F. Ying, "Fast Adaptive Meta-Learning for Few-Shot Image Generation," in IEEE Transactions on Multimedia, vol. 24, pp. 2205-2217, 2022, doi: 10.1109/TMM.2021.3077729.

[3] Azizi, Amir & Charalambous, Panayiotis & Chrysanthou, Yiorgos. (2024). Improving Image Reconstruction using Incremental PCA-Embedded Convolutional Variational Auto-Encoder. DOI: 10.24132/CSRN.3401.12

[4] Zhu, Jun-Yan & Zhang, Zhoutong & Zhang, Chengkai & Wu, Jiajun & Torralba, Antonio & Tenenbaum, Joshua & Freeman, William. (2018). Visual object networks: Image generation with disentangled 3D representation.

[5] T. Hara, Y. Mukuta and T. Harada, "Spherical Image Generation From a Few Normal-Field-of-View Images by Considering Scene Symmetry," in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 45, no. 5, pp. 6339-6353, 1 May 2023, doi: 10.1109/TPAMI.2022.3215933.

[6] Enjellina, E. V. P. . Beyan, and Anastasya Gisela Cinintya Rossy, "A Review of AI Image Generator: Influences, Challenges, and Future Prospects for Architectural Field", JARINA, vol. 2, no. 1, pp. 53–65, Feb. 2023.

[7] Agnese, Jorge & Herrera, Jonathan & Tao, Haicheng & Zhu, Xingquan. (2019). A Survey and Taxonomy of Adversarial Neural Networks for Text-to-Image Synthesis. 10.48550/arXiv.1910.09399.

[8] Cha, M., Gwon, Y. L., & Kung, H. T. (2019). Adversarial Learning of Semantic Relevance in Text to Image Synthesis. Proceedings of the AAAI Conference on Artificial Intelligence, 33(01), 3272-3279. https://doi.org/10.1609/aaai.v33i01.33013272

[9] Bibhuti Bhusan Routray. The Spectre of Generative AI Over Advertising, Marketing, and Branding. TechRxiv. January 15, 2024.

[10] Praveen Gujar, Sriram Panyam, "Generative AI in Digital Advertising Campaigns," International Journal of Computer Trends and Technology, vol. 72, no. 5, pp. 51-55, 2024.

[11] Abdul Rahman,9 - Data collection, wrangling, and pre-processing for AI assurance,Editor(s): Feras A. Batarseh, Laura J. Freeman, AI Assurance, Academic Press, 2023,Pages 321-338, ISBN 9780323919197.

[12] Kweilin Ellingrud, Saurabh Sanghvi, Gurneet Singh, Dandona, Anu Madgavkar, Michael Chui, Olivia White, Paige Hasebe, Generative AI and the future of work in America, McKinsey Center for Government ,July 2023

[13] Matt Miller, How generative AI advertising can help brands tell their story and engage customers, May 21, (2024), https://advertising.amazon.com/blog/generative-ai-advertising

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