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Image Augmentation based on GAN deep learning approach with Textual Content Descriptors

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Abstract

Computer vision, also known as computational visual perception, is a branch of artificial intelligence that allows computers to interpret digital pictures and videos in a manner comparable to biological vision. It entails the development of techniques for simulating biological vision. The aim of computer vision is to extract more meaningful information from visual input than that of a biological vision. Computer vision is exploding due to the avalanche of data being produced today. Powerful generative models, such as Generative Adversarial Networks (GANs), are responsible for significant advances in the field of picture creation. The focus of this research is to concentrate on textual content descriptors in the images used by GANs to generate synthetic data from the MNIST dataset to either supplement or replace the original data while training classifiers. This can provide better performance than other traditional image enlarging procedures due to the good handling of synthetic data. It shows that training classifiers on synthetic data are as effective as training them on pure data alone, and it also reveals that, for small training data sets, supplementing the dataset by first training GANs on the data may lead to a significant increase in classifier performance.

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Keywords: Deep learning, image augmentation, GAN, content descriptors, classification, computer vision

1. Introduction

Computer Vision (CV) is a multidisciplinary discipline that enables computers to gain a visual comprehension of digital pictures. CV is the heart of machine intelligence. Computer vision is required for a machine to see like an animal or a person. Face identification, object detection, biometrics, the medical diagnosis of faces, self-checkout kiosks, autonomous cars, image recognition, image enhancement, image deblurring, motion tracking, video surveillance, robot control, mammography analysis, and X-rays are a few examples of how CV is being used in our daily lives [1-5].

Every day, the technology world continues to change and evolve. To satisfy consumer demands and tackle certain difficult societal issues that cannot be solved with traditional technology, the study of deep learning technology, a new field in machine learning is rising. Deep learning technology is an artificial intelligence branch due to which autonomous systems are becoming more intelligent and they are now able to make better judgments and choices when presented with natural data [6, 7]. As a consequence, the majority of industrial goods will see an increase in both quality and quantity. Administrative and management issues may also be solved using this technique if the problems are recorded in data forms and an algorithm can be created to deal with them [8-11]. Figure 1 shows image augmentation through feature engineering.

In artificial intelligence (AI), computers may mimic human behaviour and nature by reproducing it. Intelligent autonomous robots, better mobile phones, and the internet have all been made possible by artificial intelligence. International commerce will be transformed by artificial intelligence. Trade barriers are already being reduced by specialized applications like data

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analytics and translation services. International trade regulations, on the other hand, may be able to solve AI development problems like increasing worldwide access to data for training AI systems. The overview of some of the most important AI trade possibilities as well as the areas where trade laws assist, promotes AI development [12-14].

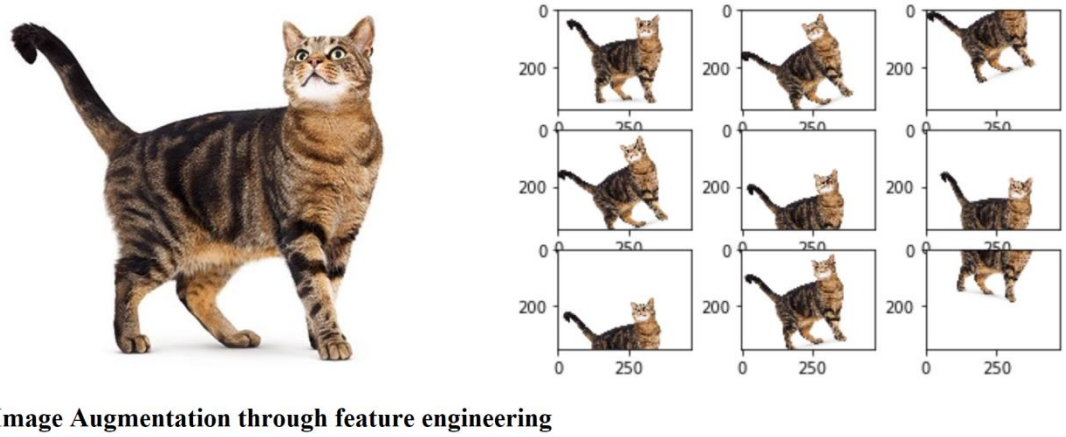

Figure 1. Sample image for image augmentation procedure

Motivation

Most of developing countries have development difficulties centred on management and administrative procedures and practices. AI (deep learning) technology and data democratization, which may lead to a more transparent government, can address most of the difficulties and economic issues that most developing nations face. People will be empowered to take action and comprehend what's going on behind the scenes as a result of this information being made available. Furthermore, AI has the potential to enhance a variety of industries and provide the country the competitive edge it needs, such as improving agricultural production efficiency, uncovering new market niches, and transforming the country into a globally competitive economy.

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2. Organization of the Research

The rest of the study paper is structured as follows; section 3 discusses previous research work on picture enhancement. Section 4 describes a new suggested technique for picture enhancement. Section 5 goes through the experimental findings of the suggested technique. This study ends with an expanded potential inquiry in the last part.

3. Preliminaries

Elman and colleagues suggested that pictures be created using subtitles/captions that are carefully considered. A model that generates images from conventional verbal representations was developed by the authors, who were inspired by the progress being made in generative models. In the proposed approach, fixes are drawn on a canvas iteratively, and relevant words inside the representation are also taken care of. After preparation for Microsoft COCO, the model was compared to a few common generative models on image ageing and recovery tasks. An inscription-based generating method for images is described in the model. Pictures were said to be series of patches painted on a canvas using a bidirectional RNN, and subtitles were mentioned as a cluster of back-to-back phrases [15].

AttnGAN, the attention-generating network, is used to synthesize fine-grained features in various areas of the picture, according to Tao et al. in their article "AttnGAN: Fine-grained Text to Image Generation with Basic Cognitive Process Generative Adversarial Networks." It was accomplished by making a mental note of the key terms in the description provided. The focus on GAN beats prior models significantly, outperforming the most effective published inception score by a factor of fourteen when tested on the CUB dataset [16].

Han and colleagues suggested that Stackgan be used for picture enhancement. It was suggested that for practical picture unification, Stacked Generative Adversarial Networks

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(SGENs) to be used. It was tough to make top-notch images even using generative adversarial systems, despite their notable victories in many tasks. Stackgan was put forward as a way to take photos with a certain purpose in mind while still generating real-world results [17].

Generative Adversarial Networks (GANs) have seen a significant increase in research in recent years, according to He et al. The basic concepts of GANs were reviewed in their paper, and three main approaches to image generation were identified: direct methodology, hierarchic methodology, and the iterative method. Additionally, another generation strategy known as iterative sampling was also mentioned [18].

The article "Chatpainter: enhancing text to picture creation via conversation" by Shikhar et al. details the process of generating realistic images from text descriptions. Since each picture in the collection contains many items, it was a difficult job to complete. They discovered that text captions have already been utilized to create pictures in the field. Besides that captions were not informative enough to capture the whole picture, they also proved inadequacy to enable the model to recognize which items in the photos corresponded to which phrase in the caption [19].

As a result of advancements in generative adversarial systems over the years, it is now possible to generate meaningful images with high objective that are reliant on regular language representation, such as picture inscription. This work has done by Tobias et al. However, it is still difficult to get fine-grained control of the image design, for example, where specified elements should be located in the picture [20].

Text-to-picture Generation via Redescription was proposed by Tingting et al. Visual authenticity and semantic coherence are the two goals when creating an image based on a book representation. The ability to create high-quality and externally acceptable images using generative ill-disposed systems has made significant progress but maintaining semantic coherence between the content representation and visual substance continues to be a challenge [21].

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Image segmentation is an essential image analysis method, according to Girshick et al. An artificial neural network is used to extract picture characteristics in an existing image by image segmentation techniques. The approach used deep learning features and community detection to segment images. The deep learning characteristics of an image was extracted using a pre-trained convolutional neural network (CNN) [22].

Research Gap

On the validation set, the existing model does not perform as expected. By strengthening the model and getting additional training data, overfitting may be reduced or eliminated. The model's performance may be improved by eliminating feature detectors from the model's design at random.

4. Methodologies

Generic Adversarial Networks (GAN) are a strong neural network type that focuses on solving new kinds of problems by learning from examples. It's built from two rival models that are also rivals in the market. GAN is proposed as unsupervised learning, but adding a certain number of labels in practical applications can improve its generating ability. Figure 2 contains the proposed work with Texture Content Descriptors (TCD).

4.1 Pre-processing with integration

There is a subsection of machine learning, known as deep learning or hierarchical learning, which has been originated as a subfield of artificial intelligence. In artificial intelligence, the goal is to have robots think and act intellectually on their own, without the need for human intervention [23-25]. In AI, people create rules for the data, and the computer responds to those rules. Many people questioned whether a computer could learn data processing principles just by seeing it. As

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a response to this dilemma, machine learning, a new paradigm in programming, was created. Data and solutions are provided to the computers to create the rules using machine learning. Instead of being explicitly coded, a machine learning model is trained.

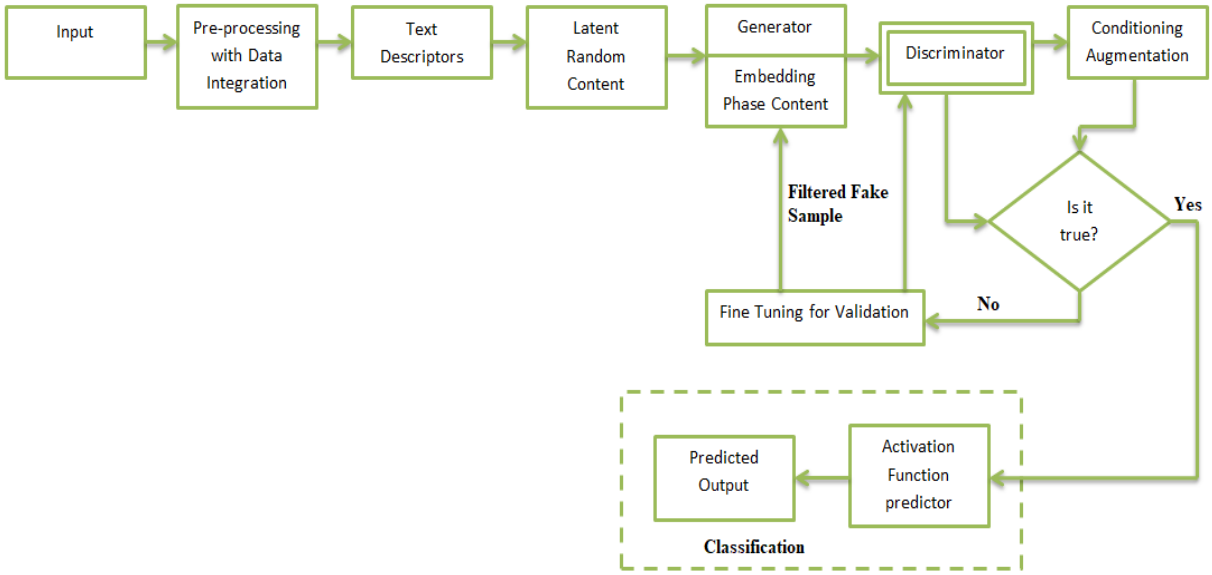

Figure 2. Proposed framework with content descriptors

As a result of the increasing complexity of tasks like language translation, audio recognition, and picture classification, Artificial Intelligence (AI) techniques such as machine learning and deep learning have emerged. In data mining, pre-processing refers to the process of changing raw data into a usable form. There are numerous inaccuracies in real-world data since it's often fragmentary, inconsistent, and lacks specific behaviours or patterns. Detecting the training type is done using the collected data. The Apple graphics and associated labels have been loaded. It is possible to enhance an image after it has been captured [26-28]. Visualizing and identifying the GAN architecture is learned and trained.

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4.2 Data procedure

Missing and erroneous data are dealt with in order to ensure data consistency. This study's dataset is free of missing data, outliers, and other anomalies. The process of altering the format, structure, or content of data is known as data transformation. The data is foreseen and resized. In order to train and test the benchmark dataset, the images are divided into two (80 percent & 20 percent).

4.3 Training Model

At this point, the algorithm is being trained using real-world data to prepare the model for use. Real-world photos are used to train the GAN architecture. Because of the YOLOv3 model loaded in neural network structure, it is possible to identify if the fruit is fresh in the picture. It is necessary to randomize the model's weight in the beginning. To do this, the algorithm must be fed with data over time. When running input data through the algorithm, the training model compares the processed results with the sample results. The correlation result is used to make changes to the model and saves them [29-33].

4.4 Active function prediction

The gradient will be 0 since the network will not react to input or error changes because ReLU provides zero output for negative input values. Because of the dead neurons in this situation, a portion of the network may become inactive. Dying leaky RELU, which can be addressed by ReLU, is an issue. When using a leaky ReLU, the negative input is not turned into zero. Instead, when the input is in a negative state, it returns a minuscule nonzero number like 0.01.

During the iteration process, the generator and discriminator continuously enhance the quality of the data samples. To put it in another way: A discriminator is a classifier that can

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determine if the input is true or bogus. Back-propagation is used to fine-tune the network's training. The sample label is used to estimate error, and an error back-propagation technique is used to update the discriminator output and the parameters of G.

5. Result and Discussion

The GANs were trained using the Adam optimizer with varying learning rates for the discriminator and generator for all experiments in this research. The GANs training consists of two generator training phases and one discriminator training step. Using this methodology, a numerous variances in a dataset may be captured and replicated. They're great for picture retouching and synthesis. However, other applications are required to better grasp assistance and pharmaceutical treatment of danger and recovery. In figure 3, the obtained result with TCD (Texture Content Descriptors) can be observed.

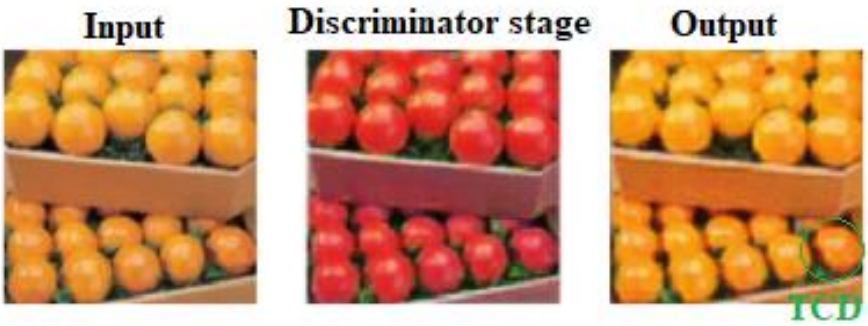

Figure 3. Obtained result with content descriptors

The label uploads photographs and findings, as seen in the above figure. In addition, there are two icons for classifying and detecting the freshness of the fruits entitled "classify" and "freshness." respectively. Table 1 contains the algorithm performance measure calculation with α value. The dataset size measured for the images is indicated as 300, 400 etc.

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Table 1. Computed performance metrics with GAN generated data

Proposed Training dataset size	Hidden layers				
	Without α	α=1	α=2	α=4	α=6
300	0.572	0.432	0.602	0.712	0.652
600	0.577	0.701	0.732	0.732	0.531
1000	0.624	0.634	0.649	0.746	0.631
1500	0.699	0.712	0.704	0.799	0.679

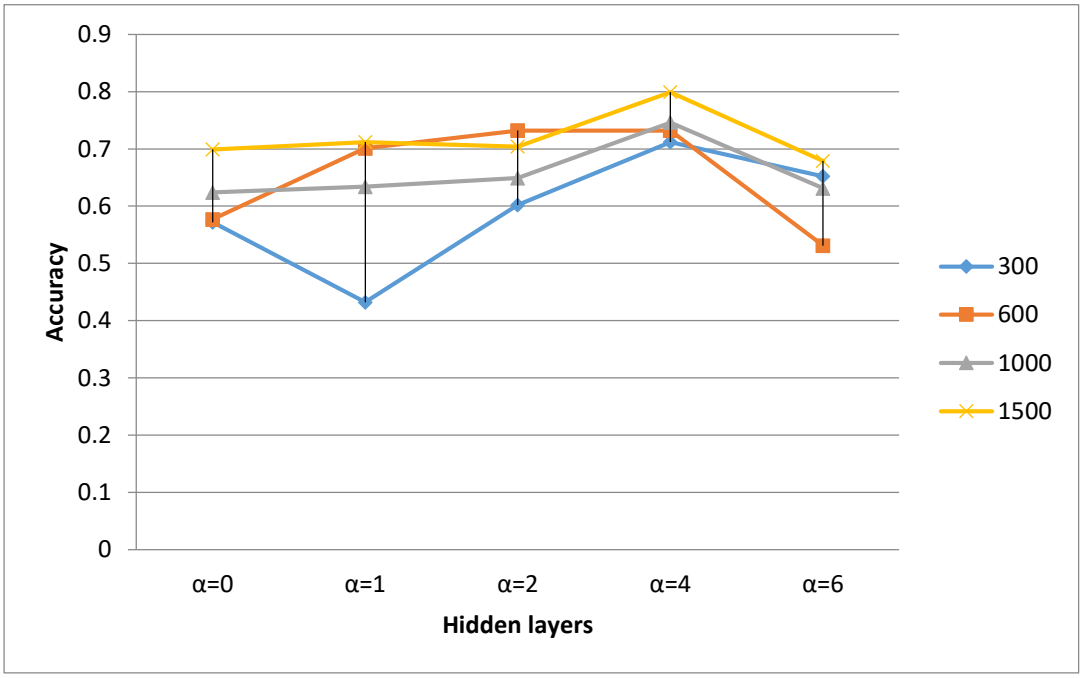

Figure 4. Overall performance chart of proposed algorithm

Generally, "α" indicates the size of the hidden layers in the proposed architecture and hidden layer number is directly proportional to "α" parameter. In training a GAN, the train size

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indicates how many pictures were utilized in the training process. An image classifier's performance is measured against the same benchmark set of photos. The Table 1 shows that on all training data sizes, GANs of size $\alpha = 4$ beat all other models, despite the intuition that smaller models may outperform bigger ones when given less training data. It is logical to do more research using mixed datasets of actual and synthetic data for models with $\alpha = 4$. As described in the textual content descriptors, a GAN approach depicts this. The recommended version's success has been shown by the enormous quantitative and qualitative outcome. Figure 4 shows overall performance measure chart. It proves that $\alpha = 4$ provide better accuracy than other values.

Real natural images and their textual descriptions are used as positive sample pairs in the training approach, while negative sample pairs are divided into two teams. The first consists of genuine images with text embedding that was not matched, while the second consists of synthetic images with text embedding that matched.

6. Conclusion

As a result, the correctness of the suggested approach in picture enlargement has been depicted. In many situations, the processing of synthetic data content descriptors are sufficient for improved computer vision. According to the finding, this method is error-free and accurate to a high degree. The performance measures are calculated and are shown in a table in conjunction with certain conventional frameworks. Though it is difficult to collect a large number of data labels, it is possible to obtain a modest number of those. Therefore, combining semi-supervised learning and GAN is one of the future direction. This has the potential to solve enormous consequences in the real world. In the future, this version may be upgraded by adding the ability to create few images in a single frame. In addition, the relative merits of recursive vs. one-shot training may be explored.

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References

[1] Ancy, C. A., and Maya L. Pai. "Brain Tumour Three-Class Classification on MRI Scans Using Transfer Learning and Data Augmentation." In Computational Vision and Bio-Inspired Computing, pp. 41-56. Springer, Singapore, 2021.

[2] X. Wang, Z. Cao, R. Wang, Z. Liu, and X. Zhu, "Improving human pose estimation with self-attention generative adversarial networks," IEEE Access, vol. 7, pp. 119668–119680, 2019.

[3] Khattar, Anuradha, and S. M. K. Quadri. "Deep Domain Adaptation Approach for Classification of Disaster Images." In Intelligent Data Communication Technologies and Internet of Things: Proceedings of ICICI 2020, pp. 245-259. Springer Singapore, 2021.

[4] W. Wang, A. Wang, Q. Ai, C. Liu, and J. Liu, "AAGAN: enhanced single image dehazing with attention-to-attention generative adversarial network," IEEE Access, vol. 7, pp. 173485–173498, 2019.

[5] Vigneshwari, K., and K. Kalaiselvi. "Review of Parallel Processing Methods for Big Image Data Applications." In International Conference on Communication, Computing and Electronics Systems, pp. 105-116. Springer, Singapore, 2020.

[6] W. Fang, Y. Ding, F. Zhang, and J. Sheng, "Gesture recognition based on CNN and DCGAN for calculation and text output," IEEE Access, vol. 7, pp. 28230–28237, 2019.

[7] Ananth, C., M. Karthikeyan, and N. Mohananthini. "Discrete Wavelet Transform Based Multiple Watermarking for Digital Images Using Back-Propagation Neural Network." In International Conference on Inventive Computation Technologies, pp. 441-449. Springer, Cham, 2019.

[8] A. T. Arslan and E. Seke, "Face depth estimation with conditional generative adversarial networks," IEEE Access, vol. 7, pp. 23222–23231, 2019.

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https://www.irojournals.com/itdw/
DOI: https://doi.org/10.36548/jitdw.2021.3.005

[9] Priyadarshini, R., Arvind Bharani, E. Rahimankhan, and N. Rajendran. "Low-Light Image Enhancement Using Deep Convolutional Network." In Innovative Data Communication Technologies and Application, pp. 695-705. Springer, Singapore, 2021.

[10] C. Xu, Y. Cui, Y. Zhang, P. Gao, and J. Xu, “Image enhancement algorithm based on generative adversarial network in combination of improved game adversarial loss mechanism,” Multimedia Tools and Applications, vol. 79, no. 13-14, pp. 9435–9450, 2020.

[11] Adam, Edriss Eisa Babikir, and A. Sathesh. "Construction of Accurate Crack Identification on Concrete Structure using Hybrid Deep Learning Approach." Journal of Innovative Image Processing (JIIP) 3, no. 02 (2021): 85-99.

[12] Z. Yu, Q. Xiang, J. Meng, C. Kou, Q. Ren, and Y. Lu, “Retinal image synthesis from multiple-landmarks input with generative adversarial networks,” BioMedical Engineering OnLine, vol. 18, no. 1, p. 62, 2019.

[13] Tesfamikael, Hadish Habte, Adam Fray, Israel Mengsteab, Adonay Semere, and Zebib Amanuel. "Simulation of Eye Tracking Control based Electric Wheelchair Construction by Image Segmentation Algorithm." Journal of Innovative Image Processing (JIIP) 3, no. 01 (2021): 21-35.

[14] D. Rui, G. Guo, X. Yan, B. Chen, Z. Liu, and X. He, “BiGAN: collaborative filtering with bidirectional generative adversarial networks,” in Proceedings of the 2020 SIAM International Conference on Data Mining, pp. 82–90, Cincinnati, OH, USA, May 2020.

[15] Mansimov, Elman, Emilio Parisotto, Jimmy Lei Ba, and Ruslan Salakhutdinov. "Generating images from captions with attention." arXiv preprint arXiv:1511.02793 (2015).

[16] Xu, Tao, Pengchuan Zhang, Qiuyuan Huang, Han Zhang, Zhe Gan, Xiaolei Huang, and Xiaodong He. "Attngan: Fine-grained text to image generation with attentional generative adversarial networks." In *Proceedings of the IEEE conference on computer vision and pattern recognition*, pp. 1316-1324. 2018.

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https://www.irojournals.com/itdw/
DOI: https://doi.org/10.36548/jitdw.2021.3.005

[17] Zhang, Han & Xu, Tao & Li, Hongsheng & Zhang, Shaoting & Wang, Xiaogang & Huang, Xiaolei & Metaxas, Dimitris. (2017). StackGAN++: Realistic Image Synthesis with Stacked Generative Adversarial Networks. IEEE Transactions on Pattern Analysis and Machine Intelligence. PP. 10.1109/TPAMI.2018.2856256.

[18] Huang, He, Philip S. Yu, and Changhu Wang. "An introduction to image synthesis with generative adversarial nets." arXiv preprint arXiv:1803.04469 (2018).

[19] Sharma, Shikhar, Dendi Suhubdy, Vincent Michalski, Samira Ebrahimi Kahou, and Yoshua Bengio. "Chatpainter: Improving text to image generation using dialogue." arXiv preprint arXiv:1802.08216 (2018).

[20] Hinz, Tobias, Stefan Heinrich, and Stefan Wermter. "Generating multiple objects at spatially distinct locations." arXiv preprint arXiv:1901.00686 (2019).

[21] Qiao, Tingting, Jing Zhang, Duanqing Xu, and Dacheng Tao. "Mirrorgan: Learning text-to-image generation by redescription." In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, pp. 1505-1514. 2019.

[22] R. Girshick, J. Donahue, T. Darrell, and J. Malik. Rich feature hierarchies for accurate object detection and semantic segmentation. In Computer Vision and Pattern Recognition (CVPR), 2014 IEEE Conference on, pages 580–587. IEEE, 2014.

[23] Adam, Edriss Eisa Babikir. "Survey on Medical Imaging of Electrical Impedance Tomography (EIT) by Variable Current Pattern Methods." Journal of ISMAC 3, no. 02 (2021): 82-95.

[24] A. Makhzani, J. Shlens, N. Jaitly, I. Goodfellow, and B. Frey, “Adversarial autoencoders,” 2016, https://arxiv.org/abs/1511.05644.

[25] Dutta, Sayantan, and Ayan Banerjee. "Highly Precise Modified Blue Whale Method Framed by Blending Bat and Local Search Algorithm for the Optimality of Image Fusion Algorithm." Journal of Soft Computing Paradigm (JSCP) 2, no. 04 (2020): 195-208.

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[26] Manoharan, J. Samuel. "Capsule Network Algorithm for Performance Optimization of Text Classification." Journal of Soft Computing Paradigm (JSCP) 3, no. 01 (2021): 1-9.

[27] Y. Mroueh, T. Sercu, and V. Goel, “Mcgan: mean and covariance feature matching gan,” in Proceedings of the International Conference on Machine Learning, pp. 2527–2535, Sydney, Australia, August 2017.

[28] Ranganathan, G. "A Study to Find Facts Behind Preprocessing on Deep Learning Algorithms." Journal of Innovative Image Processing (JIIP) 3, no. 01 (2021): 66-74.

[29] A. Martin, C. Soumith, and B. L´eon, “Wasserstein generative adversarial networks,” Proceedings of the 34th International Conference on Machine Learning, PMLR, vol. 70, pp. 214–223, 2017.

[30] Kumar, T. Senthil. "Study of Retail Applications with Virtual and Augmented Reality Technologies." Journal of Innovative Image Processing (JIIP) 3, no. 02 (2021): 144-156.

[31] Hamdan, Yasir Babiker. "Construction of Statistical SVM based Recognition Model for Handwritten Character Recognition." Journal of Information Technology 3, no. 02 (2021): 92-107.

[32] Smys, S., Joy Iong Zong Chen, and Subarna Shakya. "Survey on Neural Network Architectures with Deep Learning." Journal of Soft Computing Paradigm (JSCP) 2, no. 03 (2020): 186-194.

[33] Manoharan, J. Samuel. "A Novel User Layer Cloud Security Model based on Chaotic Arnold Transformation using Fingerprint Biometric Traits." Journal of Innovative Image Processing (JIIP) 3, no. 01 (2021): 36-51.

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