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## Survey on Image Inpainting Approach

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### ABSTRACT—

Nowadays, in our day-to-day life, image is one of the important and most common forms of information that is used in every domain of life. In addition, it is being a precious tool for monitoring the security of people and objects. So the need of automatic detecting and extracting of the image is an urgent demand. Various learning based approaches are showing impressive results in the task of filling missing parts in an image and in contrast at the same time most deep methods are strongly tied to the resolution of the images on which they were trained. Here we are going with a thorough study of various methods and techniques which can be helpful for us to gain the knowledge of image inpainting topic in brief. Image Inpainting is nothing but the art of repairing the old and deteriorated image. Image Inpainting has been prolonged for many years, and now it has achieved popularity due to various latest technologies in the image processing.

Keywords— Feature extraction, Convolutional Neural Network, Generative Adversarial Network, EdgeConnect

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### INTRODUCTION

Ancient literature is the great heritage of human wisdom. In order to better preserve and utilize these precious resources, scanning and digitizing methods are widely used in recent years. Digital image has the advantage of being easy to store, transmit, access, and also analyze using computer techniques. But in many cases, the ancient books could be some kind of defaced, and the missing or stained parts of content on the scanned images may cause problems when trying to extract useful information automatically. Therefore adopting image inpainting technologies become an alternative solution to deal with it. Image inpainting is nothing but a process of completing or recovering the regions of the image which are missed out in the image. Nowadays, in our day-to-day life, image is one of the important and most common forms of information that is used in every domain of life. In addition, it is being a precious tool for monitoring the security of people and objects. So the need of automatic detecting and extracting of the image is an urgent demand. The operation of inpainting depends on the type or domain of applications. For instance in image restoration, we focus on removing the scratch or text that can be found in the images in the same way in photo-editing application, we try to remove the unwanted object in that image or photograph. One of the Image Inpainting method which gives an outstanding performance to fill the corrupted areas and to remove the objects is Peak Signal-to-Noise Ratio (PSNR) and Structural Similarity (SSIM) metrics. This shows us the results when we include it in our particular method [1] Day-by-day new approaches come forward like EdgeConnect which is a two-stage adversarial model and works very well for reproducing the filled regions. It is mainly composed of Edge Generator and follows by an image completion network [10]

## LITERATURE SURVEY

Table-1: Literature Survey on Recent Image Inpainting Methods

Ref. No.	Paper Title and Publication Details	Pre-processing	Feature Extraction and Classification	Accuracy	Post Processing	Research Gap Identified
[1]	<b>An Iterative Image Inpainting Method Based on Similarity of Pixels Values</b> Uğur Erkan, Serdar Enginoğlu, Dang N. H. Thanh. 6th International Conference on Electrical and Electronics Engineering (ICEEE), (2019)	Should able to fill the corrupted area	To evaluate the inpainting quality, Peak Signal-to-Noise Ratio (PSNR) and Structural Similarity (SSIM) metrics are used	85%	It proposes the method in which every iteration step is surrounded by the boundary pixel values which are having the corrupted regions.	The use of edge information in boundary values or the division of the defective region into multiple parts can give better results
[2]	<b>Deep Two-Stage High- Resolution Image Inpainting</b> Andrey Moskalenko, Mikhail Erofeev and Dmitriy Vatolin. Creative Commons License Attribution 4.0 International (2020)	Filling missing parts in an image.	GIMP plugin that implements the method, which appears in the repository	80%	Making the almost resolution of the image, independent without the need for retraining	Train a new model using the proposed method, but in an end-to-end manner with dynamic shift size
[3]	<b>Pixel-wise Dense Detector for Image Inpainting</b> Ruisong Zhang, Weize Quan, Baoyuan Wu, Zhifeng Li and Dong-Ming Yan. It is published by John Wiley & Sons Ltd. (2020)	Adversarial loss and reconstruction loss are combined with tradeoff weights, which are difficult to time	Novel detection- based generative framework for image inpainting which adopts min-max strategy	75%	Balances the weight of the adversarial loss and reconstruction loss automatically rather than manual operation.	This framework may extend to other conditional generative tasks, e.g., image synthesis and image denoising.
[4]	<b>Zoom-to-Inpaint: Image Inpainting with High Frequency Details</b> Soo Ye Kim, Kfir Aberman, Nori Kanazawa, Rahul Garg, Neal Wadhwa, Huiwen Chang, Nikhil Karnad, Munchurl Kim, Orly Liba. arXiv:2012.09401v1 [cs.CV] 17 Dec 2020	The proportion of Neural Networks which helps to reconstruct low frequency which is more better than the high frequency	Constitutes a framework- agnostic approach for enhancing high-frequency detail	65%	Provides qualitative and quantitative evaluations along with an ablation analysis to show the effectiveness of the approach	The approach outperforms all other methods for small masks but not for large masks

[5]	Exploration of Image Inpainting approaches and challenges: A Survey Rishitha Reddy, B. LakshmiPriya , P. Vinuthna , K. Priyatham Reddy , D. Sritha  Reddy. International Journal of Computer Engineering in Research Trends(2022)	The various usefulness includes image quality improvement, coding and transmission without wires, image restoration, etc	Presents a surveyof the majority image inpainting techniques and summarizes them	80%	Comparisons that include the benefits and drawbacks of each method.	Researchers must focus moreon developing algorithms that can deal with both simple and complicated structures in the future.
[6]	Generative Image Inpainting with Contextual Attention Jiahui Yu, Zhe Lin, Jimei Yang, Xiaohui Shen, Xin Lu, Thomas S. Huang.	Ineffectiveness of convolotional neural networksin explicitly borrowing or	The contextual attention modulesignificantly improves image inpainting results	85%	The model is a feedforward, fully convolotional neural network which can process	Extend the method to veryhigh-resolutioninpainting applications
	arXiv:1801.07892v2 [cs.CV]21 Mar 2018	copying information from faraway spatial locations.	by learning feature representationsfor explicitly matching and attending to relevant background patches		images with multiple holes at arbitrary locationsand with variable sizes during the test time.	using ideas similar to progressive growing of GANs
[7]	Guidance and Evaluation: Semantic-Aware Image Inpainting for Mixed Scenes Liang Liao, Jing Xiao, Zheng Wang, Chia-Wen Lin and Shin'ichi Satoh, arXiv:2003.06877v3 [cs.CV]10 Jul 2020	Completing a corrupted imagewith correct structures and reasonable textures for a mixed scene	Semantic Guidance and Evaluation Network (SGE-Net) to iteratively refurbish the structural priors	90%	A novel SGE-Net with semantic segmentation guided scheme was proposed	Should focus more on the investigating the impact of segmentation accuracy on image inpainting.
[8]	PEPSI : Fast Image Inpainting with Parallel Decoding Network Min-cheol Sagong, Yong-goo Shin, Seung-wook Kim, Seung Park, Sung-jea Ko, CVF, 2019	The existing method requires numerous computational resources due toits two-stage process for feature encoding.	Presents Novel network structure, whichis commonly known as PEPSI: parallel extended-decoder path for semantic inpainting	82%	By using PEPSI method there canbe a reduction of convolution operations, which can be helpful to apply on the limited hardware	By reducing the parameters of the network, which can help to apply the restricted hardware systems.

[9]	<b>StructureFlow: Image Inpainting via Structure-aware Appearance Flow</b> Yurui Ren, Xiaoming Yu, Ruonan Zhang Thomas H. Li, Shan Liu Ge Li, 11 Aug 2019	The fine grained structures are unable to reconstruct using the maximum image inpainting methods	The appearance flow was used to sample features from relative regions	83%	It proposes a two-stage model which splits the inpainting task into two parts: structure re-construction and texture generation	The structure-aware framework for recovering corrupted images with meaningful structures and vivid textures should be more efficient
[10]	<b>EdgeConnect: Generative Image Inpainting with Adversarial Edge Learning</b> Kamyar Nazari, Eric Ng, Tony Joseph, Faisal Z. Qureshi, Mehran Ebrahimi, arXiv:1901.00212v3 [cs.CV] 11 Jan 2019	Almost all the methods not work well to reconstruct the reasonable structures.	A two stage adversarial model EdgeConnect is used	75%	Implements a good approach using EdgeConnect for reproducing filled regions.	Should work on fully convolutional generative model that can be extended to very high-resolution inpainting applications with an improved edge generating system
[11]	A critical survey of state-of-the-art image inpainting quality assessment metrics  Muhammad Ali Qureshi, Mohamed Deriche, Azedine Beghdad, Asjad Amin, ELSEVIER, 2017	The quality assessment of inpainting images continues to be a complex and challenging problem.	A performance comparison of different metrics in terms of correlation performance and computational complexity is defined	85%	A new technique of which is the description of existing metrics their good and bad performance on real images from public image dataset is provided	Video inpainting is a challenging problem when there is a need to remove and track undesired objects in videos or movies
[12]	Research into an Image Inpainting Algorithm via Multilevel Attention Progression Mechanism Peng Li and Yuantao Chen, 3 March 2022	Structural disorder and blurred texture details	Proposed method compressed the high-level features into multiscale compact features according to scale size	85%	Produce higher quality repair results compared with classic main stream methods	Improve the complexity of the algorithm and its running time

**ALGORITHMIC SURVEY**

Table-2: Algorithmic Survey of Research Studies

Sr. No	Paper Title	Algorithms Used	Time Complexity	Accuracy	Advantages
[1]	<b>An Iterative Image Inpainting Method Based on Similarity of Pixels Values</b> Uğur Erkan, Serdar Enginoğlu, Dang N. H. Thanh. 6th International Conference on Electrical and Electronics Engineering (ICEEE), 2019	Peak Signal-to-Noise Ratio (PSNR) and Structural Similarity (SSIM)	-	95%	The proposed inpainting method gives an outstanding performance to fill the corrupted areas and to remove objects.
[2]	<b>Generative Image Inpainting with Contextual Attention</b> Jiahui Yu, Zhe Lin, Jimei Yang, Xiaohui Shen, Xin Lu, Thomas S. Huang. arXiv:1801.07892v2 [cs.CV] 21 Mar 2018	Training the dataset	-	90%	The contextual attention module significantly improves image inpainting results by learning feature representations for explicitly matching and attending to relevant background patches
[3]	<b>Research into an Image Inpainting Algorithm via Multilevel Attention Progression Mechanism</b> Peng Li and Yuantao Chen, 3 March 2022	Image Inpainting Algorithm via multilevel attention progression mechanism	-	90%	Accurate pixel-level reconstruction of image
[4]	<b>Robust Algorithm for Exemplar-based Image Inpainting</b> Wen-Huang Cheng, Chun-	Exemplar-based inpainting algorithm	-	85%	Adapt any image contents of different characteristics
	Wei Hsieh, Sheng-Kai Lin, Chia-Wei Wang, Ja-Ling Wu, 2005				
[5]	A Convolution Based Image Inpainting	[A] PDE Alorithm [B] Texture Synthesis [C] Convolutional-Filter Based	-	80%	1. PDE Algorithm is helpful to connectedges or isophotes. 2. Texture Synthesis Algorithm helps to fill damaged or missed regions 3. Inpaint an image by convolving the neighborhood of damaged pixels with proper kernel

**LIVE SURVEY:**

NVIDIA Developer and Data Scientists provides efficient data loading and processing of n-dimensional tag image file format which enhances image processing capabilities. cuCIM(Compute Unified Device Architecture Clara Image) gives the data scientists and researches the ability to load and decode larger image data quickly using dedicated image loader.

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**CONCLUSION:**

This paper provides information about the current methodologies, which helps for image inpainting approach. In future there will be more drastic change in these methods and more new methods will be discovered for better results. Most of the methods are not supporting to the real images in the present era, For overcoming through this problem latest technologies should be studied thoroughly to have better results. Therefore, a simple method of image inpainting approach is used in our proposed system to achieve one-step ahead.