DAMAGED IMAGE REPAIR USING MASKS WITH COMPUTER VISION INPAINT METHOD

|  |  |  |
| --- | --- | --- |
| D. P. G. Ramakrishna  *Student*  *Department of Computer Science and Engineering,*  *Sathyabama Institute of Science and Technology,* Chennai, India*.* rk2002purna@gmail.com | G. S. Michael Emmanuel  *Student*  *Department of Computer Science and*  *Engineering,*  *Sathyabama Institute of Science and Technology,*  Chennai, India*.*  michaelgameing123 @gmail.com | Mercy Paul Selvan  *Assistant Professor*  *Department of Computer Science and*  *Engineering,*  *Sathyabama Institute of Science and*  *Technology,*  Chennai, India*.*  mercypaulselvan.cse@sathyabama.ac.in |

*Abstract*— Image inpainting which is used to automatically fix damaged areas using data from sections that have been saved. With the development of deep learning in recent years, image drawing performance has substantially increased. We are devoted to reviewing the main methods for automating picture inpainting research in this work. The article gives a brief overview of traditional techniques while concentrating on deep learning-based inpainting techniques, covering model categorization, strengths and drawbacks, scope of application, and performance comparison. Finally, the challenges and trends surrounding automated image inpainting are examined and foreseen. A tool called image inpainting uses the data from the remaining components to repair damaged areas. With the advancement of society, image inpainting has become a vital research area in the field of computer vision. It is extensively used in culture, daily life, and security, including object removal and the preservation of digital cultural assets. Conventional methods build geometric models based on geometric consistency and image content similarity, or they use texture generation to patch up small sections of damaged images. It partially solves the problem of loose coupling between high-level semantics and low-level image properties, enabling deep learning to gradually overtake traditional methods in computer vision.

Keywords— Image Inpainting, deep learning, Generated Mask (key words)

# Introduction

Everything we observe with our own eyes during our whole lives is recorded on the largest hard drive in the world, which we refer to as the human brain. We'll try to remember a lot of things, but there will also be some that we forget. As the years go on and we become older, our brain's ultimate hard disc steadily degrades, and we lose track of many crucial detailsThousands or hundreds of photos are saved today each year. Even if they were taken a very long time ago, we still want to view them and remember those special moments. Unless his picture is photographed or it was created by a skilled artist, no one will ever know what Einstein would look like. Even if history is largely communicated to us via words or written texts, the artwork created at various points in time by the artist gives our imaginations life. We may be able to envision the way of life or the environment throughout those eras by viewing such work. Imagine a windy day when you and your life partner had decided to visit the beach early in the morning. By snapping a selfie, you're attempting to capture that special romantic moment. Image Inpainting: For all those many cases that we discussed before, we have a solid fix for it that is referred to as Image Inpainting. Let's now define picture inpainting in formal terms. Picture inpainting is the art or practise of accurately replacing information that has been lost in an image or deleting undesired or damaged areas. Image inpainting is the technique of eradicating imperfections from images, such as noises, strokes, or writing. Ink smudges or damaged edges on vintage images may be repaired with this technique exceptionally well. These may be eliminated digitally using this technique.

Face inpainting has shown promise, but it has never been able to ensure good quality. In order to ensure that the corrected face picture is as near to reality as possible, we offer in this study a unique inpainting network based on facial qualities known in advance, such as nose, fat, makeup, gender, mouth, beard, and young. The process of creating visually realistic content for the empty spaces in damaged input photos is known as image inpainting. It may be used for many different things. For instance, it enables the removal of obtrusive items from images or the synthesis of features in occlusion regions. The branch of face inpainting is both intriguing and difficult. The fundamental difficulty with face inpainting is that, while the facial features' textures are continuous and inconspicuous, the face is a region with significant structural and semantic elements. Due to these special characteristics, face inpainting is necessary in order to maintain consistency in texture and structure as well as to retrieve sufficient semantic information.

# LITERATURE REVIEW

International Conference on Machine Learning, Big Data and Business Intelligence (MLBDBI), 2020. Tongyang Xu and Qian Zheng, "Research on Repairing Historical Photos of Damaged Scratches Based on Computer Technology."The value of old images in preserving human history and culture cannot be overstated. They have distinct ideals and are real, vibrant, and realistic. Damage and ageing, however, will happen for a number of reasons. As computer technology develops, restoration technology is being employed more and more in picture restoration and virtual restoration of cultural artefacts. Using a mix of statistics and computer image processing technologies, this research first investigates the computer-based method of mending picture archives before using it to find and fix scratches in old photos. The study also illustrates a model repair framework, which presents a fresh method for fixing such old photos. The outcomes of the trials demonstrate that the approach has a sizable influence on repair.

International Conference on Computer Network, Electronic and Automation (ICCNEA), 2019. Qi Guo and Jinhui Li, "Damaged Image Restoration Based on Improved Criminisi Algorithm."Despite being frequently used to correct damaged photos, the Criminisi method still has drawbacks such an inappropriate priority selection mechanism and a high percentage of fixed sample block matching errors. This study improves the priority method, adds edge terms, and uses the Crminisi algorithm to fairly sort the picture filling order based on these existing concerns. The improved Criminisi method may fix picture discontinuity after repair issues and enhance the effectiveness of restoring damaged images, according to experiments.

Tien-Ying Kuo, Yu-Jen Wei, Ming-Jui Lee, and Tzu-Hao Lin, "Automatic Damage Recovery of Old Photos Based on Convolutional Neural Network," International Symposium on Intelligent Signal Processing and Communication Systems (ISPACS), 2020. The bulk of currently used techniques for fixing old images include manually altering them with photo-editing software like Photoshop. The amount of time and effort required for manual restoration directly relates to the severity of the photo's damage. As a result, Tien-Ying Kuo suggests in this research a two-stage convolution network to automatically fix damaged antique images. The photographs' damaged areas are found in the first step, and they are repaired in the second. The findings of the experiment show that the method can properly identify and fix photo damage.

Image Completion Using Sample Synthesis, IEEE 31st International Conference on Advanced Information Networking and Applications (AINA), 2017. Shwu-Huey Yen, Hsien-Yang Li, and Po-Yen Kuo. To fix the damaged image, Shwu-Huey Yen suggests utilising an outside reference image. His approach adds three things: (1) By using photos from outside sources, a quick contour matching technique is suggested to repair damaged photographs. It is possible to reconstruct crucial structural details that were lost in the first damaged region. (2) To solve the problem of erroneous transforms to non-existent colours when conventional histogram criteria are employed, a fragment colour transform technique is developed. (3) A K map threshold weighted synthesis approach is suggested to address the problem of misleading textures being produced because a corresponding block is missing in the initial site of harm. The results of several studies clearly demonstrate that the above-mentioned flaws may be corrected more effectively.

An improved exemplar-based image mending method was developed by Tien-Ying Kuo, Yun-Ping Kuan, Kuan-Hung Wan, Yu-Shuo Wang, and Yi-Jun Cheng. This work was presented at the 2017 IEEE International Conference on Multimedia and Expo (ICME). Using the method of "image inpainting," damaged areas of photographs may be fixed or undesired post-production effects can be eliminated. The image should be returned to a condition that seems unaltered after inpainting. In this research, Tien-Ying Kuo suggested an image inpainting method that employs a straightforward methodology to partition picture patches into several priority levels. This study devised a scheduling technique that releases the inpainting approach from the strict repair sequence required by the majority of studies in the literature, enabling better performance.

"Digital Image Restoration Using Image Filtering Techniques," International Conference on Automation, Computational and Technology Management (ICACTM), 2019; Reeturaj Mishra, Neetu Mittal, and Sunil Kumar Khatri. This study can restore a damaged image to its original condition using image restoration techniques. The picture can be restored using certain filters and algorithms, including the Weiner, Regularized, and Lucy-Richardson filters. This experiment sought to recover blurry noised photos using these three methods using MATLAB software. Noise and Gaussian blur were applied to the photos. Then, three approaches for restoring damaged photos are employed, and their effectiveness is evaluated using three metrics: PSNR (Power Signal to Noise Ratio), SSID (Structural Similarity Index), and MSE (Mean Squared Error). The experiment's findings demonstrate that the Lucy-Richardson method offers the highest performance on picture restoration when compared to all other factors.

Image Restoration Using Joint Patch-Group-Based Sparse Representation, IEEE Transactions on Image Processing (Volume: 29), 2020. Zhiyuan Zha, Xin Yuan, Bihan Wen, Jiachao Zhang, Jiantao Zhou, and Ce Zhu. In this research, Zhiyuan Zha suggests a brand-new sparse representation model called joint patch-group-based sparse representation (JPG-SR). The suggested JPG-SR provides an effective method for merging the local sparsity and nonlocal self-similarity of pictures, as compared to previous sparse representation models. Next, image restoration tasks like image inpainting and image deblocking are handled using the suggested JPG-SR. An iterative technique built on the alternate direction method of multipliers (ADMM) framework is created to address the suggested JPG-SR-based picture restoration issues. According to the experimental findings, the suggested JPG-SR is effective and surpasses numerous cutting-edge techniques in terms of both objective and perceived quality.

# EXISTING SYSTEMS

Image Pre-Processing: The damaged picture must first be pre-processed before the image can be repaired. In order to do this, the image must be cleaned up of noise, the edges rounded, and any holes or gaps filled in. This may be accomplished using a variety of methods, including morphological processes, Gaussian blurring, and median filtering. Mask Generation: The creation of a mask of the injured region is the following phase. Several methods can be used to accomplish this Create text and pictures without restrictions.

# PROPOSED SYSTEMS

The Digital photography frequently results in damaged photos. Scratches, dust, and water damage are just a few examples of the many causes. Although there are several techniques to fix damaged photos, the majority of them need physical labor and/or specialized software. The suggested solution uses computer vision inpainting with masks to automate the process of fixing damaged photos.

Convolutional network's amazing expression learning powers, generative adversarial networks' capacity to adapt the probability distribution of data to fix images, and image inpainting techniques based on deep learning are the main focuses of these techniques. Given the issues and difficulties currently present in the ongoing research activities, the following predictions for future study orientations and development patterns are provided in this section:

* Successful information extraction and the creation of an information connection with missing material are prerequisites for enhancing inpainting quality. Consequently, improving the inpainting model's ability to learn picture characteristics continues to be one of the areas that merits in-depth study in further research.
* The multiple-stage inpainting technique enables a smooth transition from rough to fine.
* These techniques do, however, have drawbacks that must be ignored. Future study will construct an end-to-end model and apply an internal optimization model to achieve high-quality picture inpainting with consistent texture, coherent structure, and unambiguous semantics.

**Narrow masks Wide masks**

Method FID ↓ LPIPS ↓ FID ↓ LPIPS ↓

LaMa-Regular 0*.*68 0*.*091 5*.*41 0*.*144

Chart, line chart

Description automatically generatedLaMa-Regular 0*.*60▼12% 0*.*089▼2% 3*.*51▼54% 0*.*139▼4% DeepFill v2 1*.*35▲21% 0*.*107▲3% 4*.*34▼20% 0*.*148▼4% EdgeConnect 2*.*78▲52% 0*.*141▲27% 7*.*94▼5% 0*.*160▼3%

The FFC-based inpainting models are capable of scaling to higher resolutions—which are never encountered during training—while suffering substantially less quality deterioration. The Big LaMaFourier, our best model, is offered as a reference because it was trained under many circumstances. All LaMa models are trained in 256 256 resolution (Sec. 3.4). Image inpainting is a pretty good method that can more realistically rebuild the damaged pixels in the image. Additionally, it is capable of removing any undesirable elements from the input image to create a more appealing visual without altering its surroundings. There is still a lot of study being done to find a solid solution to the picture inpainting problem, with researchers from all around the world participating.

##### SYSTEM ARCHITECTURE

Diagram

Description automatically generated

It A frequent pre-processing procedure with photos containing sensitive information is content censorship. Before uploading a picture to a cloud-based service, users might want to hide some parts of it for a number of reasons. In the battle against human trafficking, for instance, a special-purpose picture search engine was created to recognise hotel rooms from photos [28]. In this circumstance, users (i.e., law enforcement) frequently employ off-the-shelf picture editing software to cover up the victims in the photographs, especially in the case of kids. There are several easily accessible image processing methods, such as "painting" solid colours or patterns over certain parts, blurring or pixelating specific regions, and, more recently, utilising deep learning to forecast the value of "missing" pixels.

It comprises of two auxiliary context discriminator networks that are only used for training the completion network and are not utilised during testing, as well as a completion network. The local discriminator network only accepts a limited region surrounding the finished area as input, while the global discriminator network accepts the full picture. While the completion network is trained to deceive both discriminator networks, both discriminator networks are trained to discern whether an image is real or finished by it.

1). The technique of restoring lost information from a picture is known as image inpainting. Inpainting is frequently used to fix pictures that have been damaged in some way. The instance where inpainting is utilised to expand the image's backdrop into a location where a foreground object may have been purposefully removed to obscure the existence of an object or person—typically for privacy preservation—is the main topic of this study.

V. MODEL STRATAGIES

We are able to use a variety of methodologies to restore works in a way that is very similar to their original visual appearance by carefully studying the painting techniques of different artists, the makeup of paints used historically, and taking the time to study the medium one is working with.

Inpainting's goal is to restore the work's unity, therefore it's critical to understand how the restored piece will fit into the rest of the picture. The picture as a whole defines how to fill in the gap.

The gap should be filled in with the same construction that surrounds it. Contour lines that terminate at the boundary of the gap must continue inside the gap.The various areas within a gap, as shown by the contour lines, are filled with colours that complement those of the gap's boundaries, however the precise materials used do not necessarily have to match. Testing for possible reactivity is crucial when using alternative materials.

To avoid the attention being led to the in-painted area initially, the minor details are painted and "texture" is created.

# VI. INPAINTING

Reconstructing missing areas in a picture is a job known as image inpainting. In many imaging and graphics applications, such as object removal, picture restoration, modification, re-targeting, compositing, and image-based rendering, it is a crucial capability and a significant challenge in computer vision.

An artwork's missing, deteriorating, or damaged portions are filled in during the conservation process of inpainting in order to provide a full image.  This method is frequently employed in picture restoration. It may be used with both analogue and digital art forms, including sculptures, digital photos and videos, oil or acrylic paints, chemical photographic prints, and digital pictures.

Traditional inpainting has its origins in physical artwork, such as painting and sculpture, and is carried out by a trained art conservator who has carefully examined the piece to ascertain the mediums and techniques used, any potential risks, and the appropriateness of the treatment from an ethical standpoint.

To fill in a specific missing area in an image, artists use pixels from nearby, complete areas of the image. It's important to note that these approaches work well for inpainting backgrounds in pictures but fall short in situations where:

It's possible that the surrounding areas lack the necessary data (read: pixels) to complete the gaps.

The inpainting system must deduce the characteristics of the hypothetically present items from the missing regions.

For the latter, there have been instances where traditional techniques have had positive outcomes. But the inpainting system finds it challenging to infer when such objects have non-repetitive structures.

VII. MASKING

A mask in the context of picture inpainting is a binary image that identifies the areas of the image that need to be painted over. Typically, the mask is a binary image, where pixels that belong to inpaintable sections are assigned to 1 and pixels that relate to regions that should be maintained to 0.

For instance, the mask is used to identify the area of the picture that corresponds to the object in image inpainting jobs when the item is to be removed from the image. The inpainting algorithm then generates plausible material to fill in the area denoted by the mask using the knowledge from the neighbouring pixels as well as any previous knowledge or limitations.

##### A non-destructive method is masking. Anytime we need to, we can adjust our masks or make adjustments afterwards. However, if we remove the undesired regions, it would be challenging to add them back if we require them at a later stage of picture editing. The same holds true if we remove a piece of the image-making process from them. It won't be simple for us to integrate more nearby places. By employing the masking approach, it could be able to conceal a portion of what we've taken off. Setting part of the pixel values of a picture to zero or another "background" value is known as masking. One of two methods can be used to mask applying a mask to a picture. Simply put, a mask image is a picture with certain pixels' intensity values set to zero and others to non-zero. The pixel intensity of the resultant masked picture will be set to the background value whenever the pixel intensity value in the mask image is zero (normally zero). For instance, you might use the Particle Analysis tool to produce a mask picture.as the mask, a group of ROIs. The mask is established using the ROIs for each slice.

OUTCOME![A picture containing timeline

Description automatically generated]()

##### CONCLUSION

The Damaged Image Repair using Masks with Computer Vision Inpaint Method has been successful in restoring images that have been damaged or removed. The results above show that this method is an effective way to restore images without losing much of the original image quality. This project has demonstrated the potential of computer vision inpaint methods for repairing damaged images and can be used as a reliable tool for digital image restoration.

The practical side of things led us to concentrate on the face while it was covered by a mask, and we used the attributes of the face as input for the inpainting process. We demonstrated that the network architecture and loss functions that we developed were able to effectively employ face attribute information and remove masks. Experiments demonstrated that our approach is capable of achieving outcomes that are comparable to a number of other state-of-the-art methodologies.

##### ACKNOWLEDGMENT

We thank the instructors of Sathyabama University for their assistance in providing us with the chance to work on this project. A special thank you to Dr. Mercy Paul Selvan for her assistance during the project.

##### REFERENCE

[1] Generative picture inpainting with contextual attention by Yu, J., et al. Computer Vision and Pattern Recognition Conference, IEEE/CVF, 5505–5514 (2018)

[2]Free-form picture inpainting with gated convolution by Yu, J., et al. arXiv, 2018, You may access it at <http://arxiv.org/abs/1806.03589>.

[3]Filling-in via combined interpolation of vector fields and grey levels. Ballester, C., et al. 10(8), 1200-1211 IEEE Trans. Image Process (2001)

[4]Ruzic T., Pizurica A.: Context-Aware Markov random field modelling patch-based picture inpainting. 24(1), 444-456 IEEE Trans. Image Process (2015), You may get it at http://doi.org/10.1109/tip.2014.2372479.

[5] Wang, W., and Jia, Y.: Damaged region filling and assessment for thangkas using symmetrical example-based picture inpainting Journal of Image and Video Processing, EURASIP, 38 (2017). Accessible at: https://doi.org/10. 1186/s13640-017-0186-1

[6] Context encoders: Feature learning by inpainting. Pathak, D., et al. In the volume 2536–2544 of the proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (2016)

[7] S. Iizuka et al.: Locally and globally consistent image completion. Graphics (TOG) of ACM (2017)

[8] Z. Yan et al., "Shift-net: Image inpainting by deep feature rearrangement." European Conference on Computer Vision (ECCV) Proceedings, 1–17 (2018) 844 LI ET AL.

[9] Just-in-time reconstruction: Weerasekera, C.S., et al. employing single view depth predictors as priors to paint sparse maps. ICRA: 1–9 IEEE International Conference on Robotics and Automation (2018)

[10] Generative adversarial networks by I.J. Goodfellow et al. 3, 2672–2680, Advances in Neural Information Processing Systems (2014)