Enhanced Image Vision and Resolution during Low Light Conditions using GANs

M Prakash, Aparna S, Yash Srivastava

Abstract— Low light computer vision is an arduous task because of the low signal to noise ratio and less photon count. This means that the images captured in low light experience noise, which can result in blurring of the image. Although there are multiple techniques to overcome the noise and blur, their results are bounded in undue conditions as in there is a drop in the video imaging at night. This low light enhancement is a daring task as there are multiple factors like brightness, de-noising, de-blurring, contrast must be handled at the same time. Even the development of a CNN has proved to perform poorly on such data. This paper uses a technique to take care of this issue using GANs. Our technique gives a platform to enhance the image captured in low light and increase its resolution giving out an enhanced super resolute image. To support the low light image processing, we have used a dataset of low-light images. This method can give promising results on the dataset, and display a break for the future work.

Keywords— Image Enhancement, Low Light, GAN, AI, Image Vision

I. INTRODUCTION

Ever since the field of artificial intelligence started evolving around new discoveries, convolution also networks have been playing a vital role. These deep convolution always neural networks have been used mostly in image For the past several years, deep convolutional neural networks have been applied in image processing such as object detection and tracking, image segmentation, classification, etc. They have created a revolution in the image vision field. Although this has been a breakthrough, the solution for low light image processing has ignored most research especially because of poor light condition and camera shaking. There is still an ample number of research papers owing to the contributions to the low light image enhancement task in the latest years. These approaches have proved to give good results under specific conditions but still have restraining factors. One big difficulty is the unavailability of suitable data for training and testing. The author proposes a new method to avoid the above mentioned dilemma, based on cross-domain algorithms. It is presumed that while long exposure or normal images belong to another domain which satisfy another distribution, the images from low-light environment belong to dark domain in a same distribution.

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We are using this cross domain method to solve this problem. The GANs make the cross-domain more attractive and considerable. GANs are usually engaged to deal with such issues. In all these years of research in the field of computer vision, image processing, computational photography, and graphics have proved to produce powerful translation systems. The approaches are categorized into supervised and unsupervised approaches. In supervised one, paired inputs and data are required to obtain higher performance. While, in the unsupervised method, paired inputs are not required as a requisite and one could instantly collect plenty of the unsupervised datasets. By the above mentioned analogy, we prefer supervised algorithm not only because of its higher performance, but also because of the fact that the unsupervised algorithm fails in giving accurate results in detail when dealing with complicated tasks. In this case, we implemented other supervised algorithms where in GANs have proved to give the best promising results than compared to other other algorithms like CNNs, Low Light Networks, etc.

II. LITERATURE SURVEY

A. Low-light Enhancement and Image Denoising

For the past few decades, researchers have been working and proposing multiple approaches and methods to enhance the low light image vision that have led to the rise of new methods in deep learning. These approaches have been categorized into image preprocessing and post processing. Some of the preprocessing algorithms include Histogram Equalization (HE), image enhancement using deep so volition always neural networks (DCNNs), Low light Net, etc. These methods usually remove the noise, apply filter to it and denoise it again. The denoised patches are again attached to the original image which removes the excess noise from the image. These methods have been found overwhelming because of their advantages. The previously proposed systems involve LLNet that use deep AutoEncoders for low light image, a weighted minimization algorithm for measuring reflectance and illumination from an image, a structure-aware smoothing model to enrich the illumination consistency of images, a deep AutoEncoder approach to learn features from low-light images and then enhance those images, a LightenNet which learns a mapping between weakly illuminated image and the corresponding illumination map to obtain the enhanced image and Meanwhile, a deep Retinex decomposition method which can learn to decompose the observed image into illumination as well as reflectance in a data driven technique without decomposing the ground truth of the image further.

The authors tried to amend the algorithm to make the process of image-brightening and de-noising more effective.

B. Generative Adversarial Networks

Recently Generative adversarial nets have attracted a lot of attention recently in the field of image-to-image translation. The original GAN consisted of two neural networks that played one-sum games with each other. Realistic synthetic samples are generated by the trained generative network from a noise distribution for the purpose of cheating the discriminative network. The discriminative network is expected to distinguish between real and generated fake samples. Various forms of data can also be used as input to the generator apart from the random samples from a noise distribution. The purpose of an Image-to-image translation algorithm is to transfer an input image from one specific domain to corresponding image in another domain. Isola et al. was the first to propose supervised GAN which used U-net for the generative network and made good results in domain transfer. Zhu et al. provided an unsupervised algorithmic rule that mapped pictures from one domain to another domain then mapped it back to the first domain, eventually using cycle-consistent loss to scale back the distinction. At the same time, Yi et al., Liu et al. and Kim et al. had placed stress on the domain transfer with unsupervised manners. What the authors attempting to look at was galvanized by those image-to-image translation approaches. We have a tendency to assume that pictures from dark environments with noise that were meeting a distribution and coming back from one specific domain, and also the high-quality pictures were from another domain. The recovery step is an image-to-image translation method. To the simplest of our information, applying generative somebody networks to the low-light image improvement and image de-noising still remains a gap space, the authors area unit the primary to propose such a unique technique to address the low light-weight image process and to get the results with exceptional expectations.

III. PROPOSED WORK

A. Problem Statement

There has been many issues because of image vision carried out in a low light environment. The implementations to solve this problem mostly involve CNNs. However, the results have not been satisfactory. To get the desired effective output, we are implementing GANs, which is a supervised algorithm. This gives the solution to the problem statement of solving the enhancement and resolution of low light images. One real life example is the automated cars. In the recent AI development, scientists and researchers have designed and modelled self -driving cars. These cars do not have a driver and use computer vision and sensors that help them drive efficiently. They are designed to use image vision that analyzes the captured image or video for the presence of any object on the path, and automates the driving accordingly. In this case, if the car is driven in dim light environment there are chances that could lead to accidents (both major and minor). To prevent this, enhanced mage vision can be implemented to increase the efficiency and accuracy of the technology. Enhanced image vision does not only play a vital role in the field of AI, but can also play an important role in everyday technology. The proposed system works on the principle of GANs which is responsible for denoising, deblurring, manipulating the contrast, colors and most importantly in the high resolution. The GANs does the mapping of the low resolution to high resolution, which is said to give superior and promising results than the super resolution CNNs.

B. Losses

In the case of GANS, there are three loss functions. The first one is the discriminator loss function D for the input, discriminator loss function for the encoded latent variables G and the traditional loss function L1 which is for the pixel wise loss. Here L1 is considered the main while the other two are not explicit. Since the discriminator is the loss function for the generator as its job is to identify the original and the fake data by comparing the generated image and the original image, binary cross entropy is also used to check on the generator GANs can possibly use a neural network as its loss function for a different neural network.

C. Data

The data that we have used for this project include images that have been captured in the low light environment. These images in the data are pixelated and contain low resolution images because of the low light environment. The data has all colors in a single channel. The data is packed and trained and fed into the network which then the network classifies and generates a new set of data. The discriminator checks both these two data and reconstructs the image and gives an output with a higher quality image.

D. Objective and Scope

- Improving the methodology to reduce the chances of low quality image vision which helps us in providing a robust and a fine solution.
- This can further be applied for not only images, but also for video and audio sources.
- To use the data efficiently and effectively.
- This can also be used by security systems such as surveillance cameras for maintaining a safe environment.
- This can be used in automation systems for the development of technology not only in the field of computer science but also in other fields.
- Since we are using GANs, the newly generated data can be used for future research purpose and development
- Since the quality of the image increases, the goals and scope of computer vision like image segmentation, object detection, localization of objects, tracking of object using image sequence, perform pattern recognition, projective geometry of image, image processing and other fields is increased.
- The idea of this project can be implied in medical sciences (medical imaging) and in biological computing.
- To improve the scope of visual effects, broadcasting and cinematography.

E. Implementation

The input image clicked in a low light environment with low resolution is passed through the generative adversarial network. Since the GAN contains smaller neural networks within, the image enhancement and the super the networks within do resolution. The network generates instances of the data and passes the super resolution image as an output

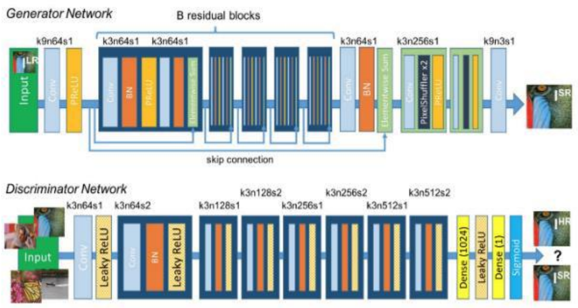

Figure 4: Architecture of Generator and Discriminator Network with corresponding kernel size (k), number of feature maps (n) and stride (s) indicated for each convolutional layer.

F. Abbreviations and Acronyms

AI	-	Artificial Intelligence
CNN	-	Convolutional Neural Network
GAN	-	Generative Adversarial Network
DCNN	-	Deep Convolutional Neural Network
HE	-	Histogram Equalization
LLNet	-	Low Light Net

G. Figures and Tables

Sl.No	***Networks***
1	GANs
1.	CNNs
2	LLNets
3	DCNNs

Fig. 1.based on the performance

IV. RESULT AND DISCUSSION

As mentioned above, GANs have proved to give effective results for image enhancement and resolution. Although there are more new methods to implement this, GANs are proved to give accurate and precise results than other image vision algorithms as till date

V. CONCLUSION

We have presented a GAN model that has proved to achieve a better quality of image than the previous methods. GANs can learn and conclude whether the image looks real than the other images, thus leading the generator to retrieve more comprehensive textures of the image. This method offers well-built management and thus replace more precise and realistic textures and give a strong output.

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