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## Image Deblurring Using Generative Adversarial Networks

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### ABSTRACT

With the increasing crime rate, CCTVs are being implemented on roads, highways etc. But for them to be useful they need to be sharp and not blurry. Sometimes, images taken by CCTV are blurred and are not useful. With new Neural Network like GANs, we can create a model of complex neural nets that can help in solving this problem. Using Generative Adversarial Networks, Images can be deblurred with significant improvement in quality. Some previous techniques used softening the images which don't generate good images. The aim of this paper is to develop a system that can perform deblurring task and without softening the image using Generative Adversarial Networks. A prototype system is developed and tested.

**Keywords:** GAN, Neural Networks, Deblurring, Image Processing

### INTRODUCTION

With the increasing number of CCTVs on the roads, there is need to develop a system which provides good deblurred images even on a low-quality camera. Also with more training, it can be used on high resolution images taken by phone or DSLR to produce outstanding result. Other methods of image deblurring is not as good as using a GAN. With good dataset, GANs can be used to multiple types of blur like motion blur, gaussian blur etc. It can be used in combination of other model like SRGAN which is used to improve the quality and size of the images. The problems solved by this project are:

#### A. Blurred Images

The proposed system is capable of performing deblurring operation that can be helpful in many numbers of cases. Whether the image is taken by CCTV or a photographer, it can help in both cases. The proposed system does not increase the size of the image but only deblur them.

#### B. High Camera Cost

It is expensive to install high quality CCTV throughout the city. Using the proposed system even a low-quality camera can be used, as the software will compensate for the hardware.

#### C. High Storage Cost

As discussed in my previous work where I created Image Enhancer, if the proposed system is used in addition to my previous work, then it can solve a lot of issues together like low quality images can be stored which save digital space but also deblurring can also be applied to that image to produce better result.

## PROPOSED SYSTEM

The proposed system will help in deblurring the image and also increase its sharpness. An image will be given to the system as an input and a deblurred image will be produce as an output with the same size as input.



Figure 1.

### A. Software and Libraries used

To implement different modules of the proposed system these libraries have been used :

#### i. Python 3

Python latest version is used in this project which is python 3.8.5. Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. Python is dynamic in nature while other languages like c, c++, java are not dynamic.

#### ii. Keras

Keras is an open-source library in Python that provides interface for building different neural networks. Keras works on top of Tensor Flow library and acts as an interface. Generative Adversarial Network is implemented using Keras that makes easy to add or remove layers from the model.

#### iii. Flask

Flask is a web framework written in python. Flask can be used to implement backend of a website with python. As the proposed system will have a web app at the front end. Its backend will be handled by Flask library.

## WORKING OF PROPOSED SYSTEM

The proposed system consist of three different modules.

The first module is Image Processing module. This module is used to process the image before and after the main algorithm to deblur images.

The second module is Image Deblurring module. This module is used to deblur the images.

The third module is Web module. It is used to access upload the images and show the output images.

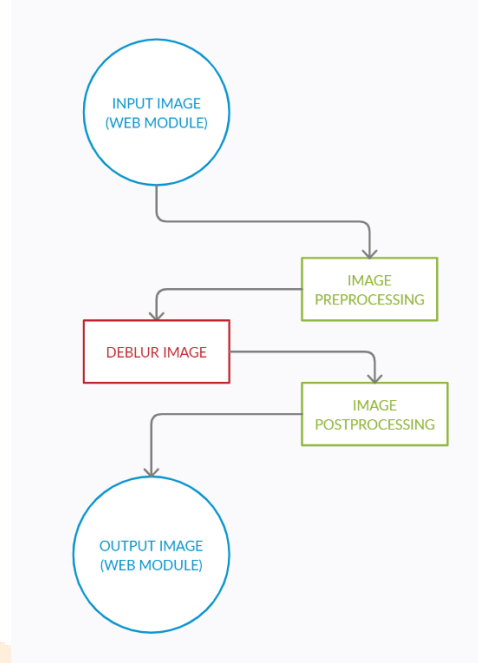


Figure 2

### A. Module 1: Image processing

This module is a very important step in using the proposed model. If the image is not preprocessed then the output will not be correct either. As the GANs do not work directly on images because they are trained with images that has values between -1 to 1. So, after the training if we want to pass the image to the network, we need to convert image pixel values from 0-255 to -1 to 1. Also, after the deblur, the output image is again in the range of -1 to 1 so postprocessing is also needed to get the final image.

### B. Module 2: Image Deblurring

This is the main model that deblur the input image and generate an output image. It uses a Neural Network to deblur the image. This neural network is generally used for image processing and it is called as Generative Adversarial Network. It uses perceptual loss and Wasserstein loss that helps in training the model better. In the generator part, it has more than 20 convolution layers which creates a deep net that helps in better output of the image.

The prototype model is trained on go pro large dataset which consist of deblurred and their normal counterpart images. It has more than 2100 images but because of computational limitations, the model is trained on a smaller number of images. With better hardware, more training can be done and output can be improved significantly.

### C. Module 3: Web Application

This module provides user interface. Flask is used to upload the image and pass it to the Image processing module and then again pass the processed image from image processing module to the frontend of the website. Flask works as an interface between frontend and backend. The frontend is developed using HTML, CSS, Bootstrap. The Processing time depends on the processing speed of the server.

Input Image:



Figure 3

Output Image:

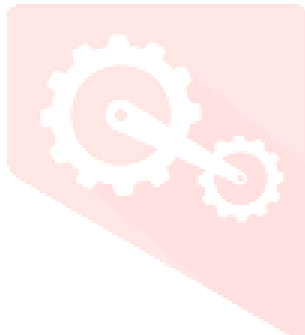
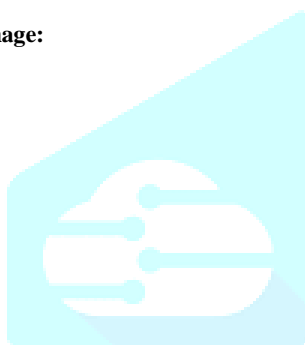


Figure 4

### FUTURE SCOPE

The proposed system can generate exceptional results if trained for more number of epochs. So, the generated results can be improved much more. Also, a number of new features can be added that can be helpful in CCTVs footage.

#### A. Night to Day Conversion

A feature can be added using the GANs to convert dark images or night images into day images which is also a famous application for GANs. This will help in using the CCTVs footage in a much better way.

### CONCLUSION

This system is capable of deblurring the images. The system is developed as a web app for users to interface. It takes an image which is passed to a neural network to deblur the image and output is generated and shown on the web app.

This system uses a specific type of neural network called Generative Adversarial Network. With better training better results can be achieved. In the future, other features like night to day conversion can be implemented and added as well.

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