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A Project Work Phase-1 Report

on

"Low Light Image Enhancement Using Deep Learning"

Submitted in partial fulfillment of the requirement for the award of the degree of

BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING

Submitted by

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CERTIFICATE

This is to certify that the project entitled **"Low Light Image Enhancement Using Deep Learning** "carried out by **Mr. Chunith Gowda G S (1VE18CS043), Mr. Charish Patel M N (1VE18CS041), Ms. Rashmi S (1VE18CS134) , Ms. Shirisha K S (1VE18CS146)** bonafide students of Sri Venkateshwara College of Engineering, in partial fulfillment for the award of Bachelor of Engineering in Computer Science and Engineering of **Visvesvaraya Technological University, Belgaum** during the academic year 2021-2022.

The project report has been approved as it satisfies the academic requirements in respect of **Project Work Phase-1** prescribed for the said Degree.

Signature of the Guide	**Signature of the HOD**	**Signature of the Principal**
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INTRODUCTION

Low contrast, poor visibility, and noise characterises images captured in low-light circumstances. These limitations provide a difficulty to both human vision, which favours high-visibility images, and many intelligent systems that rely on computer vision algorithms, such as all-day autonomous driving and biometric recognition. A significant number of techniques have been proposed to alleviate the degradation, ranging from histogram or cognition-based approaches to learning-based approaches. Deep learning approaches to image restoration and improvement, such as super-resolution, denoising, and deblurring, significantly rely on either synthetic or recorded corrupted and clean image pairs to train.

Images captured in a low light setting are prone to undesirable degradations such as poor visibility, low contrast, unexpected noise, and so on. Low-light image enhancement is still a difficult issue since it requires simultaneous manipulation of color, contrast, brightness, and noise given the low-quality input. In this work, a different method has been discussed for low light image enhancement by formulating it as a challenge of image-specific curve estimation. The non-reference loss functions that are used to manipulate the curve parameters and drive network's learning are also discussed. The proposed method makes no assumptions about reference images during training and also adapts well to a variety of lighting circumstances. Image enhancement is basically improving the interpretability or perception ofinformation in images for human viewers and providing better input for other automated image processing techniques. The principal objective of image enhancement is to modify attributes of an image to make it more suitable for agiven task and a specific observer. In this project we present a method for enhancement of such images which can be done using deep learning technique Convolutional Neural Networks (CNN). The input would be an image under low light conditions and output will be an enhanced versionof the input of better quality

LITERATURE SURVEY

[1] A REVIEW ON IMAGE ENHANCEMENT WITH DEEP LEARNING APPROACH (2018), Amanjot Kaur and Gagandeep. This paper aimed at enhancing the images using Deep neural networks. This method of enhancing the images is a lot time taking and includes numerous calculations for decreasing noise levels.

[2] AUTOMATIC IMAGE QUALITY ENHANCEMENT USING DEEP NEURAL NETWORKS (2019), This research proposes a novel dataset generation method for automated image enhancement research, and tests its usefulness with the chosen network design. This dataset generation method simulates commonly occurring photographic errors, and the original high-quality images can be used as the target data. This dataset design allows studying fixes for individual and combined aberrations.Limitation of this is the method only analyses the pixel values and image statistics without any information about context or semantics, the algorithm may fail to apply the enhancements in such a way that a human observer finds pleasing. More detail is provided on these photographic flaws and previously developed solutions are described alongside some demonstrations of the effects of these enhancements. It should be noted that even though this section is categorized as different operations, these flaws are not separate from each other and the enhancement methods often overlap. Many of the image enhancements are applied in the RGB color space, which is most often used to represent the pixel color values HSV is designed to represent individual aspects of human colorperception instead of separate color channels as in RGB.

[3] LOW CONTRAST IMAGE ENHANCEMENT USING CONVOLUTION NETWORK IN SIMPLE REFLECTION MODEL (2019), The proposed method consists of four steps in total. The first step is the low contrast estimation step that generates a low contrast probability map. The second step is a create contrast Gray scale step. The third step is a refining probability map step with obtained probability map and converted Gray scale image. The final step is an enhancement step that enhances low contrast image with refined probability map and converted Gray scale.

[4] DEEP LEARNING FOR IMAGE ENHANCEMENT AND VISIBILITY

IMPROVEMENT, this paper attempts to apply deep learning to image filtering, specifically low-light image enhancement. Work will then be done to produce a fully functioning image filtering system using deep learning, which will allow the network to be trained using Supervised Learning, and filtered output images to be saved to a file. Overall, the network was successful, producing output images which can clearly be seento be filtering low-light images. The network will need to be run for a greater amount of time to see the best possible results the network can output.

[5] GETTING TO KNOW LOW-LIGHT IMAGES WITH THE EXCLUSIVELY DARK DATASET (2018), This paper presents two contributions. First, is the Exclusively Dark dataset which is the largest collection of low-light images taken in visible light to-date with object level annotation. Secondly, it provides an object-focused analysis of low-light images using the state-of-the-art algorithms in both hand-crafted and learned features for a better understanding of low-light vision and its difference from vision with sufficient illumination.

PROBLEM IDENTIFICATION

Project Domain and Problem addressing:

The project mainly focuses on low light image enhancement and as the name suggests the domain of this project would be where the user needs an enhanced image. This couldbe a scenario where the user needs to preprocess the image before using it further. Considering cases like CCTV cameras installed for security purposes take images at lowlight conditions. If these images were to be enhanced, the system would be useful. Basically, any system that takes low light images as input can have this enhancing feature before processing the images.

Issues and Challenges:

The major issue for the project would be the collection of datasets and training the model. Datasets of images under various lighting conditions are required for training the model. Images under low lighting conditions and corresponding images under good lighting conditions are to be collected and annotated. They have to be segregated for testing, training and validation.

Need for ML based solutions:

Image enhancement can be very well done by ML. The enhancement of images includeschanging various features of pixels of an image like brightness, saturation, contrast etc. This can be efficiently done using deep learning techniques like CNN. This will assure minimum loss and maximum quality output.

OBJECTIVES AND METHODOLOGY

OBJECTIVES:

The objectives of the project are

- To illuminate the images captured in low light conditions.
- Minimize the image quality degradation after enhancement.
- Coping up with diverse lighting conditions such as non uniform and poor lighting conditions.
- To brighten up the image while preserving the inherent color and details.

METHODOLOGY:

The proposed system makes use of AGBSN(Attention based Broadly Self-guided Network) to better exploit image multi-scale information. Information extracted at low resolution is gradually propagated into the higher resolution sub-networks to guide the feature extraction processes

The proposed system has GSA of Conv + ReLU layers. The framework is implemented with PyTorch. Each layer consists of 32 convolution kernels with size 3x3, and the weights of these kernels do not change during the convolution process. The output of the first Is passed to layer roughly depicts the location of low-level features in the original image. On this basis, another convolution operation is carried out, and the output will be the activation map representing higher-level features.

Firstly, we pass the input image through a Conv+PReLU layers to obtain a main feature map with 32 channels. Then instead of Pixel Shuffle and PixelUnShuffle,DWT and IDWT are used to generate multiscale inputs. ABSGN uses wavelet transform to transform the main feature map to three smaller scales

3 Main Functions Of GSA:

- **Activation layer**

The activation layer is vital in a deep CNN because the nonlinearity of the activation layer introduces nonlinear characteristics to a system which has just undergone linear computation. We have adopted a rectified linear unit for its advancement in improving the training speed without obvious changes in accuracy.

- **Max-pooling operation**

The pooling operation is helpful to reduce the number of parameters, decreasing the training cost by a meaningful extent. The pooling operation can also cut down the possibility of overfitting, helpful to suppress noise. For the model, we have set the kernel size to 2 for each max-pooling operation.

- **Upsampling layer**

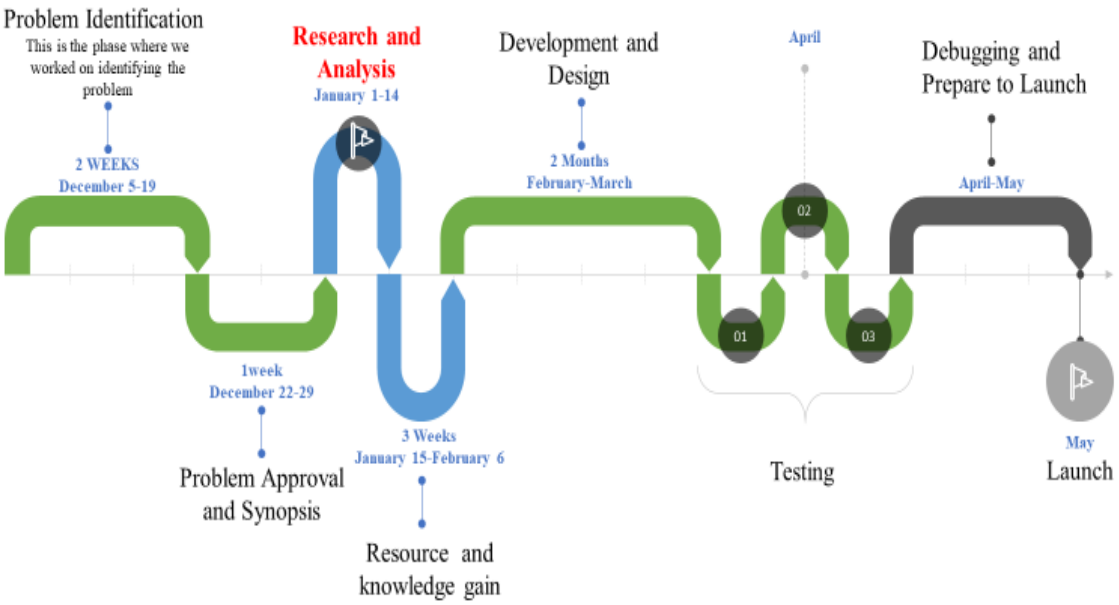
Max Pooling layer is followed by upsampling layer, that will double the dimensions of input.

As for the full resolution level, we add more MGDB to reuse the main feature map, which enhance the feature extraction capability of ABSGN,after merging information from all the scales, we use two Conv+PReLU layers to acquire the final output as the restored image

APPLICATIONS

- The implementation can be used to Enhance the Low lighted images into actual normal image or images taken in dark to attain clarity.
- Enhance image in both computer vision and human vision.
- Used to restore images in cameras.
- Autonomous driving vehicles can use low light image enhancement to restore original image during night times which will help self-driving during night times.
- Human Face recognition can use the proposed system
- CCTV surveillance camera.

PROJECT PLANNING



CONCLUSION

- The proposed project serves as a standalone convolutional neural network model for low light image enhancement.
- Many real time applications like CCTV surveillance systems, animal detection systems, theft detection systems etc., face the drawback of under performance when used in low light conditions.
- The proposed model can be integrated with these real time systems as a pre-processing unit, which leads to the improvement in performance and proper utilization of the potential of the model.