PLAGIARISM SCAN REPORT

Words	625	Date	June 21,2021
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9.1 SUMMARY AND CONCLUSION
The project mainly tackles the problem of colorizing astronomical images and super-resolving them for astronomical inspection. We explore various methodologies proposed till date that efficient colorize and super-scale images with results that are significantly closer to the ground truth distribution. We scrape the data from Hubble Legacy Archive, Hubble Main website and Hubble Heritage project and created a filtered and clean dataset of 4700 images. We split the data and use 500 images, roughly 10% of the data for testing purposes. To compensate for the lack of data, we implement several pre-trained architectures and fine-tune their abstractions over our dataset to find the most effective solution.
For the colorizing model, we explore usage of U-net architectures starting from a basic U-net model and experiment with different color spaces and empirically confirm the superiority of L*a*b color space in image colorization problem. We use the state of the art ResNet-18 to provide as a backbone of the encoder and build a U-net around it. The pre-trained network over COCO dataset in RGB colorspace produces significantly weaker results as compared to the subsequent network in L*a*b colorspace. The best performing model turns out to be the ResNet18 U-net which is fine-tuned over our particular dataset to produce appealing and similar results to the ground truth.
The Super-resolution model is based largely on the SRGAN proposed by ?. We use the generator weights and sample results from the training set to inspect the results. It is found that the model performs really well on the pre-trained weights and we decide to fine-tune it to our application. After fine-tuning the model, we train other state of the art single image super-resolution models such as EDSR (?) and WDSR (?). These provide further insights into the problem and simultaneously, improve the results.
While studying and improving the performance of these models, we explore performance metrics of GANs and evaluation methodologies implemented to test out conditional GANs. It is evident that the loss curves of generator and discriminator do not provide us with any intuition about the model performance. We also discover that standard distance metrics cannot be used to evaluate GANs and quantitative methods that exist to evaluate GANs are unreliable. We prove so by contradiction of qualitative samples and quantitative measurements of the best performing architecture for colorization models. However, we observe that quantitative estimation is quite reliable for the problem of single image super-resolution and can be helped to determine which model is better suited for the task.
9.2 FUTURE SCOPE
Though we obtain moderately good results, a vast amount of algorithms still remain unscratched. A more powerful model such as SN-ResNext, EfficientNet and

more state-of-the-art models can be implemented and trained over millions of images from the Imagenet. With even more hardware resources and availability of data, we can explore computationally heavy models for a better approximation. An image stitching algorithm can be applied on the produced images to generate large scale astronomical images for scientific study. Colorization can be improved by the virtue of exploring different loss functions using weighted losses to reduce loss problem for low saturation regions. We can introduce a gradient penalty for the SRGAN architecture and include the WGAN (?) which will stabilize the discriminator to stay within the space of 1-Lipschitz function. Progressively growing GANs (?) can be applied so that the dimensions can be further improved with more stability and greater sharpness.

9.3 APPLICATIONS

The images are upscaled and colourized using a completely automated algorithm which uses Deep Learning. Generative Adversarial Networks are successfully used for the implementation. The algorithm can directly be applied for creating images that can be studied by astronomers. It is anticipated that this will aid the astronomers vastly in their efforts.

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