Image Colorization using Neural Networks

A Project Work

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

BACHELOR OF ENGINEERING IN CSE (INFORMATION SECURITY)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING APEX INSTITUTE OF TECHNOLOGY

CHANDIGARH UNIVERSITY, GHARUAN, MOHALI - 140413, PUNJAB

Submitted by: Abhay Tomer 20BCS3566

Under the Supervision of Mr. Vipin Tiwari

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DECLARATION

I, 'Abhay Tomer ', student of 'Bachelor of Engineering in Information Security, 2020-2024 Department of Computer Science and Engineering, Apex Institute of Technology, Chandigarh University, Punjab, hereby declare that the work presented in this Project Work entitled 'Image colorization using Neural Network' is the outcome of our own bona fide work and is correct to the best of our knowledge and this work has been undertaken taking care of Engineering Ethics. It contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

Abbay Tomer UID: 20BCS3566

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Place: Chandigarh University

ABSTRACT

The report gives a brief detail about the project -Image colorization using Neural Network: Image colorization is inherently an ill-posed problem with multi-modal uncertainty for colorization of gray-scale abstract images. In this paper, we trained 3 models on different sets of images viz. abstract geometrical images and abstract fluid gradient images. Then we compared these models to a model trained on both sets of images.

ACKNOWLEDGEMENT

The research paper was written in accordance with the minor project “Image_colorizer” which colorizes images and has the additional functionality of adjusting attributes such as Saturation, Brightness, and Contrast.

We would like to express our gratitude to our Supervisor, Vipin Tiwari, who guided us through the project. We would also like to thank all the members of the group who supported and helped in different modules and parts of this project and research paper.

We would like to acknowledge the help provided by Chandigarh University and its staff. We would like to show our deep appreciation to Dilpreet Kaur for finalizing this project on Image colorization.

Table of Content

1) INTRODUCTION

A. Project Definition -

- Colored images contain more information than grayscale images. The Colored images have three pieces of information about the color of the image known as RGB. Although the gray image is 1-Dimensional as it contains only gray. Color image to be converted to grayscale and then converted into a colored image.

- The main purpose of Colorization is to make the gray images attractive to the viewer so that the colors are added to fit the photo scenes. The coloring process works to color each pixel in a gray image with a specific color. Coloring techniques used in this project are using a pre-trained model to predict the color of the greyscale image to the best of its ability. The problem of adding gradient color to a gray image is not the most accurate method.

B. Project Specifications -

- The language used: Python
- Modules used: Kivy UI Framework, Open-CV, Keras library, skimage, and TensorFlow.

C. Hardware Specification -

- the program runs on 4 threads and 200MB of ram so it can basically any pc running Windows NT-based operating system.

D. Software Used -

- The language used: Python 3.9 and kvlang 2.1.0
- Windows 10
- Pycharm IDE
- Spyder IDE

2) OBJECTIVES

Our main objective behind this project is to colorize images is to create neural network models and code implementation for an easy-to-use GUI.

A. It will have mainly three models and then we will compare all the image colorization models within themselves. The first model named model **V1** will be trained for processing geometrical abstract images. Our second model named **V2** is trained for fluid gradient abstract images and lastly, our third model **V12** is trained for both geometrical and fluid gradient abstract images. Then, we will take three images and compare these images to the above-explained models.

B. The second object is to make an interactable GUI that can be used to colorize images and also tweak the attributes such as saturation, brightness of the image, and contrast as well.

3) METHODOLOGY

In this project, we will train 3 CNN, the first one on abstract geometrical images. The second one will be trained on abstract Fluid gradient images and the third one will be trained on both i.e., abstract and gradient images. Then we will be comparing the result to the original images and also against each other to find out if a model trained on both image sets could potentially perform better.

The models will be trained using an autoencoder. The autoencoder will be trained on 350 images over 150 epochs (indicates the number of passes of the entire training dataset of the machine learning algorithm). However, the third model will be trained on 700 images over 100 epochs.

3.1 Autoencoder

It is a specific type of neural network in which both input and output are the same. The purpose of the autoencoder is to learn lower-dimensional representation for high-dimensional data, especially by reducing the dimensionality, by training the network to capture the most important parts of the input image(figure1).

3.1.1 Encoder

- The encoder transforms the input into a low-dimensional latent vector.

3.1.2 Bottleneck

- It contains the compressed knowledge representations of the data that is being fed.

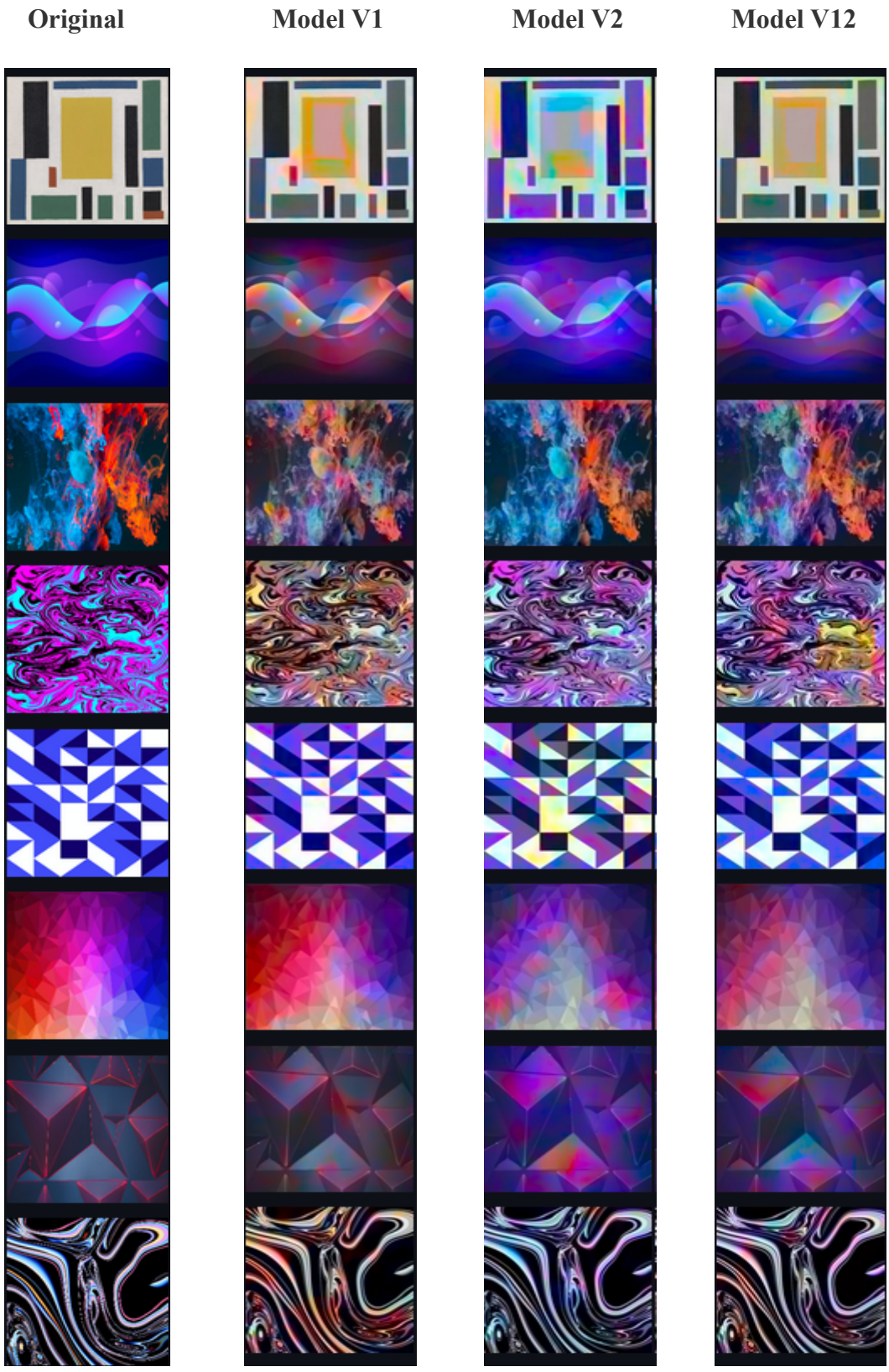
3.1.3 Decoder

- It reconstructs the input from the latent vector as much as possible.

3.2 CIE LAB Color Space

- CIE lab also knowns as LAB color space has 3 channels where L stands for lightness ranging from 0(black) to 100(white), A stands for red/green value [green(-ve) to red(+ve)] and B stands for blue/yellow [blue(-ve) to yellow(+ve)].Using LAB color space we can easily get grayscale images as in the first channel only L(lightness) is there. It also reduces color channels to only 2 (green-red, blue-yellow) with respect to RGB colorspace which has 3.

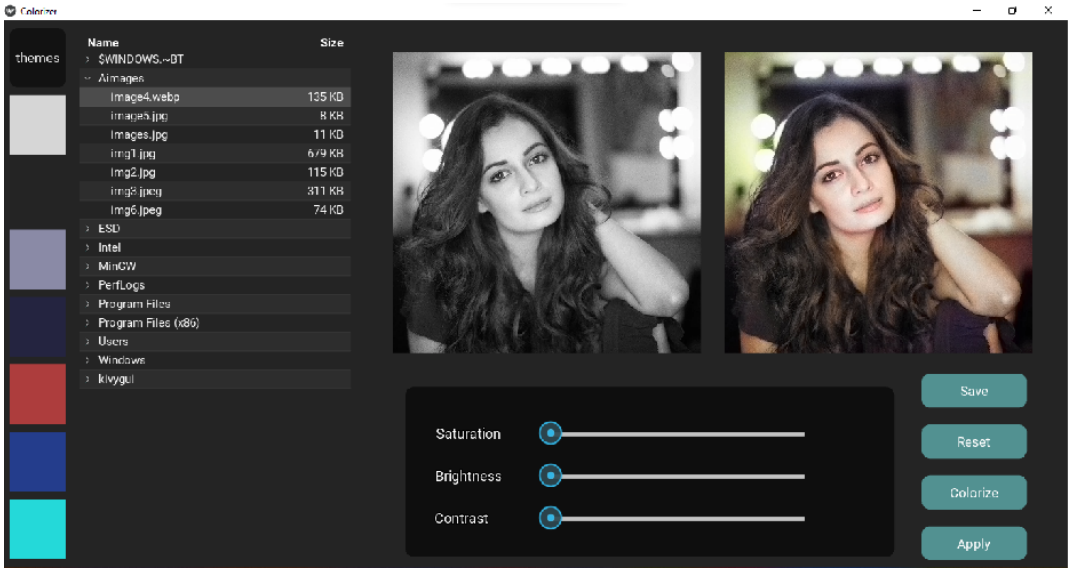
4) RESULTS AND DISCUSSION



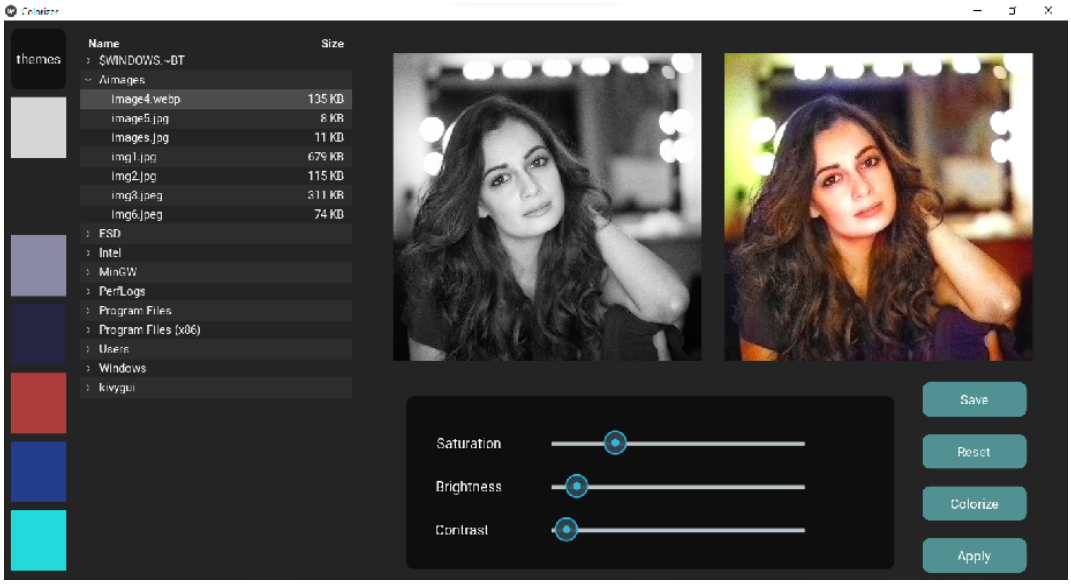
The trained models do an excellent job of reproducing the images from greyscale to colorized images.

Model V1 does good job coloring geometrical images as it was trained on geometrical images yet is able to produce acceptable results when exposed to fluid images.
Model V2 does an outstanding job in colorization of Fluid gradient images but on the contrary, when subjected to geometrical abstract images the results produced are displeasing.
Model V12 being trained on both the data sets proves excellent in producing fluid gradient images but lacks finesse when colorizing abstract geometrical images. But provides a better result than model V2.

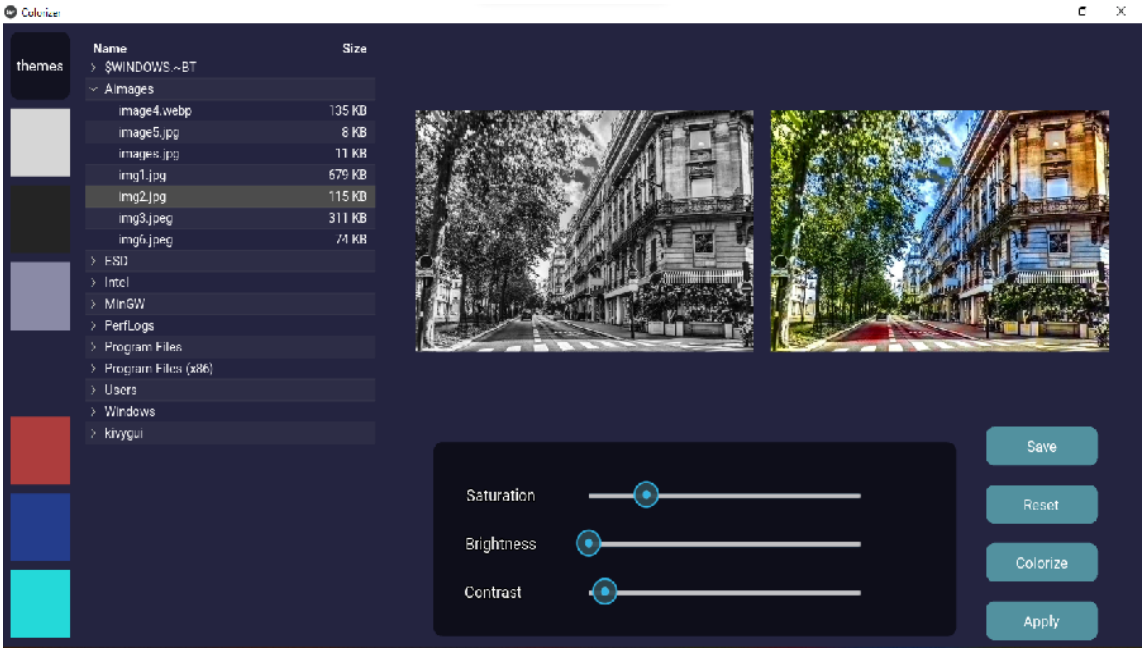
GUI Implementation:



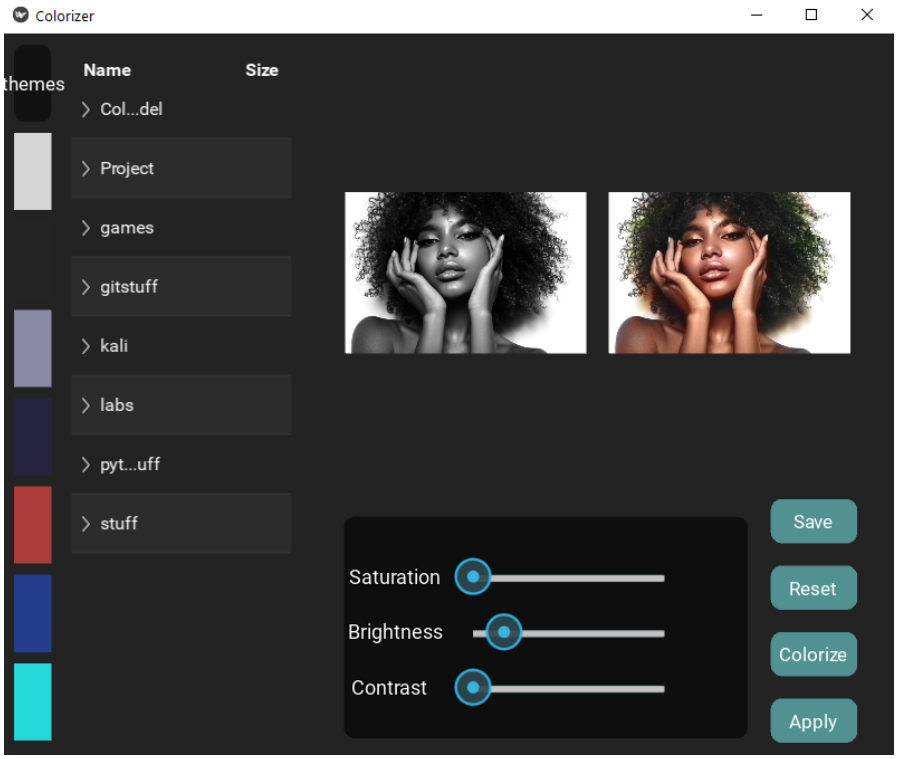
- you can select an image from the drop-down menu, and hit colorize to get a colorized image.



- The saturation, brightness, and contrast of the colorized image can be changed using the sliders



- You can also change the theme of the application to your liking.



- The application is also responsive and GUI changes according to the dimensions of the application window

5) CONCLUSION

In conclusion, this is a project that uses the basic knowledge and concepts of Python but with using an open-source tool like OpenCV. All the information is researched and developed by our team. We were successfully able to develop this project which is an amazingly easy-to-use colorizer.

And also completed the research paper based on image colorization.