Deep Learning Final Project - Image Colorization

➢ Introduction

In the present world, colorization of black and white images is accepted as an enhancement to the art form. Coloring grayscale images manually is a gradual and chaotic process. Colorization of a picture can take up weeks if done manually. Using deep learning techniques this issue can be resolved. This work is focused on converting grey-scale images to colored images that will provide more information content by re-mastering of historical images and improvement of surveillance feeds. Adding the color components can provide more insights about its semantics.

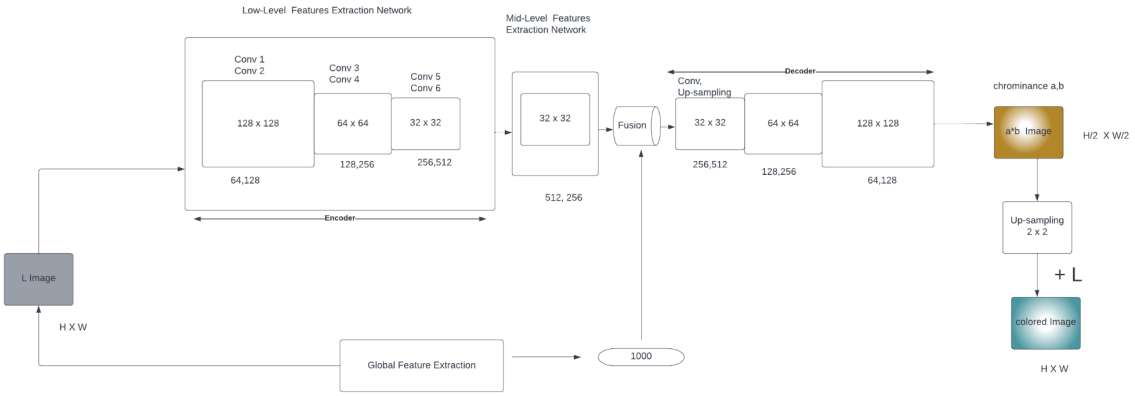
➢ Why would deep learning solve this?

As this problem mainly deals with finding patterns in images, Convolutional neural network can prove to be very useful for this as it has the potential to achieve high accuracy in detecting patterns over regression technique. In this project we train a deep Convolutional Neural Network from scratch with highlevel features . The purpose of our model is to estimate LAB components. The A and B components are the chromaticity coordinates and L indicates the value of lightness. The color of the reconstructed image are combined with luminous component to give the estimated color image. The convolutional layers are a set of small Conv2D layers that help us identify patterns in an image.

➢ Source of Data

We used dataset from Kaggle[3] for image colorization as source for training, validation and testing. We will be using 5000 coloured images from this source, for training and validation. For testing, we have a dataset of 739 black and white images.

➢ Network architecture



A Neural Network is a machine learning system based around the human brain, thus we create an Artificial Neural Network using algorithms enabling the computer to learn by incorporating new data and try to behave like the human brain. The units learn how to convert input into the desired output, e.g. Light Component of the picture is used to predict the A and B color chromatic component. The LAB image is then converted to RGB image to produce the desired output.The computer learns from training data, where the RGB image was converted to LAB form and the input X vector was a Luminous component and A, B is the Y(output) vector that is predicted. A task for a neural network is to recognize the chromatic components.

➢ Methodologies of problem solving

- Model construction
  - It includes the following steps :

    – Image Data is converted to LAB image.
    – Keras library is used to create Sequential model and building layers.
    – Feature extraction and calculating weighted parameters using Convolutional Neural Network.
  - Model training
    - Model is trained once it has been constructed appropriately. It includes training of model using training data and expected output for this data.

        - It’s look this way: model.fit(training_data, expected_output).
    - Model Testing
        - In this phase a another set of data is loaded.It is used to predict the corresponding colored image of the grayscale image with minimal loss. Model can be saved after the model training is complete, and it is understood that the model predicts image with minimal loss.
    - Model Evaluation
        - Finally, the saved model can be used in the real world. This means that the model can be used to evaluate new data.

- Model
    - The encoder approximates the function that maps the data from full input space to a meaningful lower dimensional coordinate system by taking advantage of the structure in data. Real data has structure which means we don’t need full input space to represent data. Information Loss takes place. Decoder reverse encoding process. Decoder has imperfect information training the whole network to minimize the reconstruction error. It Forces encoder and decoder to minimize reconstruction error by making them work together to find an efficient way to condense data into lower dimensions.

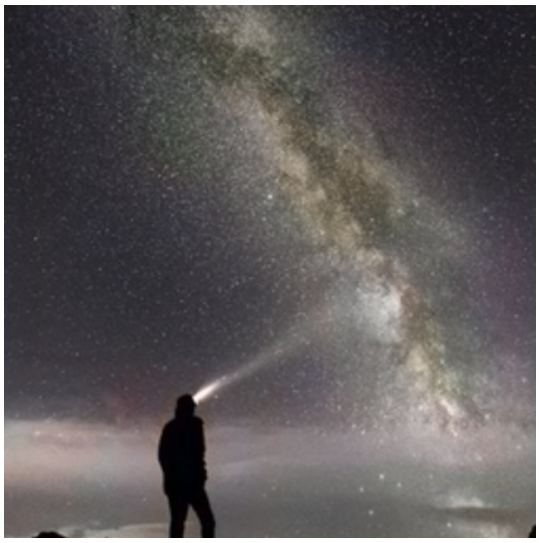
    - Model construction includes the following steps :
        - Resize the color images to 256 x 256
        - Load Color images and convert them to LAB form.
        - The input vector be Light component. – The output vector is A and B component.
        - X shape is 999 x 256 x 256x 1(1 is the light channel)
        - Y shape is 999 x 256 x 256x 2(2 is the A AND B channel)
        - We try to predict AB space and apply that to lightness
        - To bring it back to 256 we upscale in the decoder
        - Giving final output where A and B channels are reconstructed
        - Then convert LAB image to RGB

➢ Results

The project on Image Colorization using CNN was successfully able to convert black and white images into colored RGB scale images.

BLACK & WHITE

PREDICTED IMAGE





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➢ Conclusion

This report presents a detailed mapping analysis that elucidates the implementation of Image colorization using Deep Learning and proposes a plan for developing a system that can convert grayscale images to RGB images. This report tries to put forward a strong case for a minimum loss automatic colorizing system using fewer Dataset. The detailed system architecture is also provided.

➢ References

1. https://ieeexplore.ieee.org/document/9262377

2. https://www.researchgate.net/publication/347808375_Auto-Colorization_of_Historical_Images_Using_Deep_Convolutional_Neural_Networks
3. https://www.kaggle.com/datasets/aayush9753/image-colorization-dataset