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Image and Video Colorization System

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Abstract: Given a grayscale image or video as input this project predicts the colorized version of that image and video. This project uses feed-forward CNN over LAB Colour space to predict the possible colour combination.
Keywords: CNN – Convolutional Neural Network, ANN – Artificial Neural Network, AI – Artificial Intelligence

I. INTRODUCTION

Automated colorization of grayscale images and videos has been subject to much research within the machine learning communities. We design and build a convolutional neural network (CNN) that accepts a grayscale image or a video as an input and generates a colorized version of the image/video as its output. The system generates its output based solely on images it has "learned from" in the past, with no further human intervention. The system is implemented as a feed-forward pass in a CNN at test time and is trained on over a million colour images.

II. ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems. These processes include learning (the acquisition of information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction.

A. Artificial Neural Networks

Artificial neural networks are one of the main tools used in machine learning. It was created to simulate the working of the human brain. Just like our brain contains neurons and each neuron transmit data in form of electrical signal and some neuron perform some tasks too, similarly an ARTIFICIAL NEURAL NETWORK (ANN) is also made up neurons that are connected to each other through some weighted links. Each neuron is responsible for computing some function which is then passed to next neuron for further computation via weighted links.

The last set of neurons are responsible for producing the output. A sample ANN is shown below: -

III. CIELAB COLOUR SPACE

The CIELAB colour space (also known as simply "lab" colour space) is a colour space defined by the international commission on illumination (CIE). It was created to improve the RGB colour space which was much biased towards the darker colours and does not work well for lighter colours. It expresses colour as three numerical values, l* for the lightness and a* and b* for the green–red and blue-yellow colour components. According to the LAB colour model two colours cannot be green and red at the same time, or yellow and blue at the same time i.e. no colour can be formed from the combination of either red and green or blue and yellow. The problem with RGB colour space is that it does not resembles the human vision perfectly. So it was less suitable for colorization task and a more appropriate model was required.

LAB model includes the lightness factor of the colour which RGB model excluded. So the LAB model can resemble the human vision better than RGB.

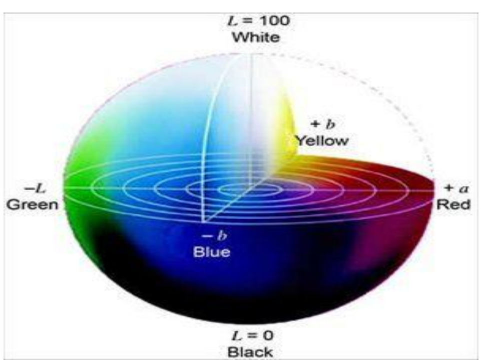

Fig. 1 CIELAB colour space model

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IV. OPERATING ENVIRONMENT

A. Operating System – Windows
B. Python version 3.6.8 or higher
C. Open CV version 4.0 or higher
D. KERAS AND TENSORFLOW Python libraries must be installed in the machine.

V. DATA PRE-PROCESSING

The model was designed over CIELAB colour space instead of RGB colour space. We used colorization_release_v2 as a reference model. Since RGB model was biased towards dark colours and didn't worked as expected for lighter colour we required class rebalancing during model training. We trained a convex hull of LAB for each combination of RGB colour space. Convex hull tells the range of "a+b" value corresponding to L value, and corresponding to the "a+b" value we predict range of a+b values. During the model training we included some extra images along with million image dataset which were used for class rebalancing. Example of images included to rebalance class is shown below: -

Fig. 2 Sample image used for model training

Such images are included for ever light colour to reduce the model's biasness towards darker colours.

VI. WORKING

The Artificial Intelligent (AI) approach is implemented as a feed-forward pass in a CNN ("Convolutional Neural Network") at test time and is trained on over a million colour images. First we need to change the colour channel from RGB to Lab colour. This can be done using CIELAB – CIEXYZ forward and backward transformation. In python this transformation can be done by using a simple OPENCV method cv2.cvtColor(image, cv2.COLOR_LAB2BGR).

A. Post Processing Steps

1) Grabbing the L channel of the B&W image,
2) Feeding the L channel to the trained model. The model will predict the plausible a, b combination as (a+b).
3) The predicted a and b values are then concatenated with the lightness factor(L) of the B&W images to get L(a+b).
4) Predicted L(a+b) is imposed over the B&W image to get the colorized image.

The model created is able to predict the colorized version of the given grayscale image. A grayscale image is given as input to the model and the model predicts the plausible a and b colour combination using the convex hull. When the predicted a and b factors are combined with the L factor of the image it produces the colorized image as output.

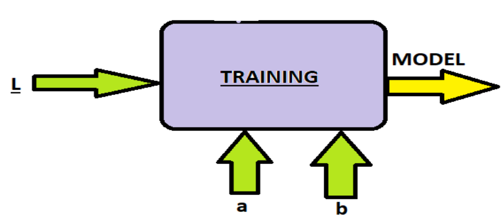

Fig. 3 Training model

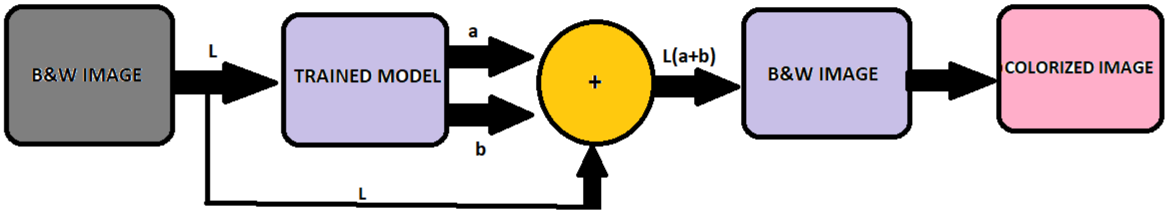

Fig. 4 Prediction Model

VII. VIDEO EXTENSION

A. Same model that was trained for Images is to be used for Video colorization.
B. Since the model cannot work effectively on moving images directly we need a way around.
C. So instead of taking whole video directly we take video frame by frame.
D. Each frame is given to the trained model and is colorized separately.
E. After colorization of each frame we combine all the colorized frames to get a colorized video.

VIII. RESULTS

Fig. 5 Colorization done by the project(result).

The complete working project can be found at https://github.com/vaibhav174/Image-And-Video-Colorization

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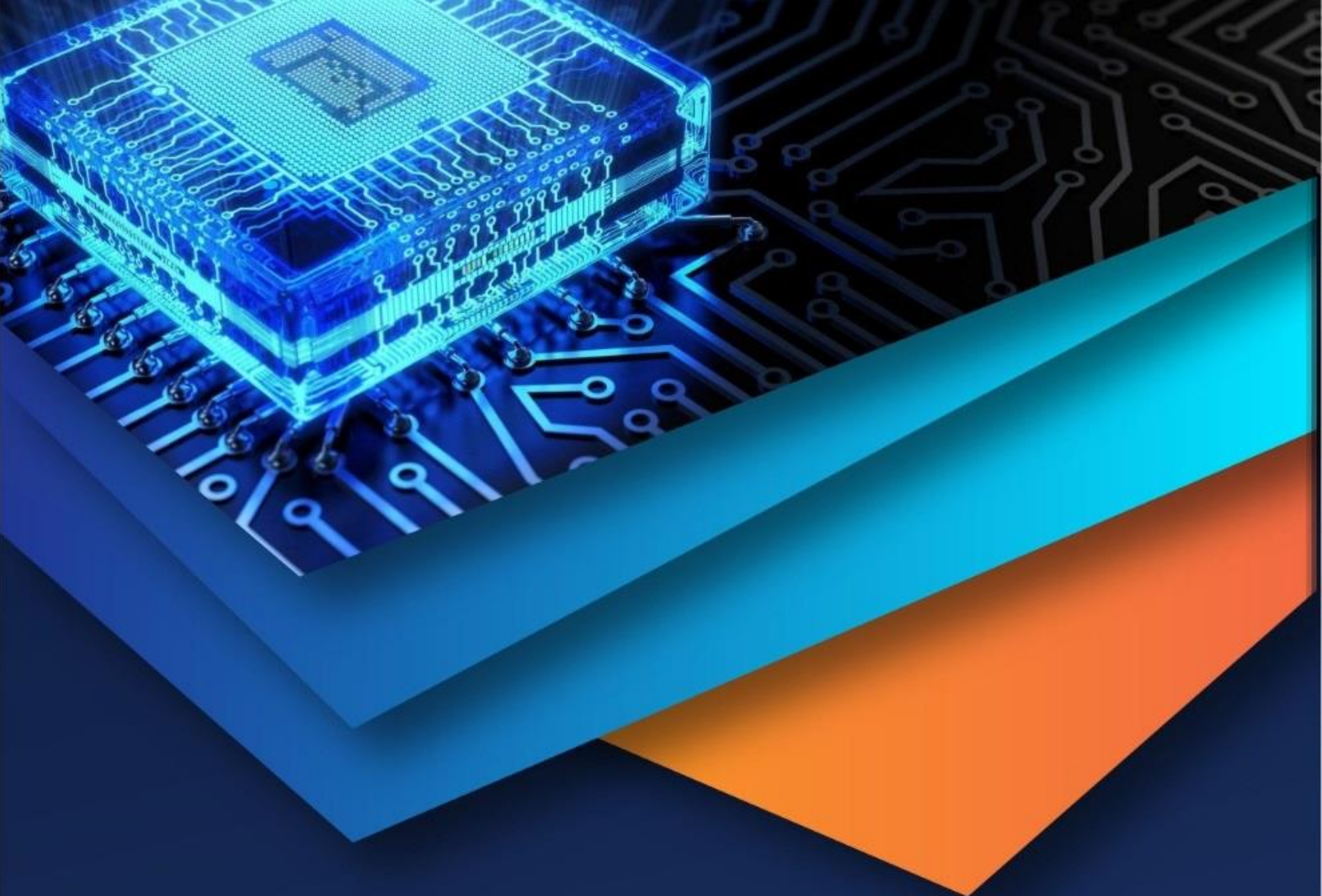
REFERENCES

[1] Cheng, Z., Yang, Q., Sheng, B.: Deep colorization. In: Proceedings of the IEEE International Conference on Computer Vision. 415–423
[2] R. Dahl. Automatic colorization. http://tinyclouds.org/colorize/, 2016.
[3] X. Glorot and Y. Bengio. Understanding the difficulty of training deep feedforward neural networks. In International conference on artificial intelligence and statistics, pages 249–256, 2010.
[4] Dahl, R.: Automatic colorization. In: http://tinyclouds.org/colorize/. (2016)
[5] K. He, X. Zhang, S. Ren, and J. Sun. Deep residual learning for image recognition. arXiv preprint arXiv:1512.03385, 2015.
[6] M. J. Huiskes and M. S. Lew. The mir flickr retrieval evaluation. In Proceedings of the 1st ACM international con ference on Multimedia information retrieval, pages 39–43. ACM, 2008.
[7] S. Ioffe and C. Szegedy. Batch normalization: Accelerating deep network training by reducing internal covariate shift. arXiv preprint arXiv:1502.03167, 2015.
[8] D. Kingma and J. Ba. Adam: A method for stochastic optimization. arXiv preprint arXiv:1412.6980, 2014.



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