AUTOMATIC COLORIZATION OF GRAYSCALE IMAGES USING DEEP LEARNING FUSION TECHNIQUE AND ACCURACY ANALYSIS

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DECLARATION

I declare that this is my own work, and this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other University or Institute of higher learning, and to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgment is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature: Date:

The above candidate has carried out research for the Masters thesis under my supervision. I confirm that the declaration made above by the student is true and correct.

Name of Supervisor: Dr. A. M. Harsha S. Abeykoon

Signature of the Supervisor: Date:

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ABSTRACT

Recent advances in technology have opened up new ways for the automatic colorization of grayscale images using different deep-learning techniques. Automatic colorization plays a crucial role in various applications such as coloring low-light or night vision images, historical photo restoration, lights-out factories, medical imaging, and many more. Through an extensive review of the literature, colorization techniques were studied. Initially, different colorization methods and error calculations of colorized images were compared and analyzed. In recent years, Convolutional Autoencoder Neural Networks have outperformed in many fields of image generation, denoising, and style conversion which fully proves the potential of the use of Autoencoders in grayscale image colorization. Progressively, different parameters which affect the colorization were changed and compared. Building upon this knowledge, an improved algorithm using a fusion-based approach was developed. The algorithm concatenates local and global features of the image for plausible colorization results. The model was validated by demonstrating extensively using different types of images and is quantitively as well as qualitatively compared with several existing models. Seven types of error calculation methods are used in this thesis for comparison of the original and the predicted images. Furthermore, due to the lack of quantitative visual representation for the accuracy analysis of colorized images, a new concept of error analysis using heat maps is developed.

Keywords: Image colorization, Deep Learning, Convolutional Neural Network, Autoencoders, Accuracy Analysis, Heat Maps

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
AI	Artificial Intelligence
CNN	Convolutional Neural Network
OPAC	Online Public Access Catalogue
VGG	Visual Geometry Group
ReLU	Rectified Linear Unit
DLCNN	Deep Learning Convolutional Neural Networks
AE	Autoencoder
GAN	Generative Adversarial Networks
AMT	Amazon Mechanical Turk
PSNR	Peak Signal-To-Noise Ratio
MSE	Mean Squared Error
RMSE	Root Mean Square Error
CIE	Commission International de l´Eclairage
RGB	Red Green Blue
CCTV	Closed-Circuit Television
API	Application Programming Interface
GPU	Graphics Processing Unit
SPADE	Spatially Adaptive Denormalization

LIST OF APPENDICES