Internship Report – Colorization Internship

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Program: NullClass EdTech Pvt Ltd Internship
Duration: [6 months]
Submission Date: [26 th dec ,2025]

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1. Introduction

This internship focused on exploring advanced **image colorization techniques** using deep learning. The objective was to build a unified pipeline capable of:

- Colorizing grayscale images
- Applying artistic styles
- Preserving historical accuracy
- Incorporating user-guided color hints
- Leveraging semantic segmentation
- Real-time video colorization

All tasks were completed using **Python, PyTorch, OpenCV, and Streamlit-compatible GUI components**, executed in **Google Colab** for seamless GPU support.

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2. Background

Image colorization is a challenging problem in computer vision where **grayscale images are converted to realistic or stylistically modified color versions**. Key techniques used during this internship include:

- **Convolutional Neural Networks (CNNs)** for base colorization
- **U-Net architecture** for image-to-image translation
- **Adaptive Instance Normalization (AdaIN)** for artistic style transfer
- **DeepLabV3 semantic segmentation** for selective region colorization
- **Data augmentation** to improve model robustness

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3. Learning Objectives

- Understand **image colorization pipelines** and architectures
- Apply **style transfer** in colorization
- Fine-tune models for **historical image datasets**
- Implement **user-controlled colorization**
- Utilize **semantic segmentation** for targeted coloring
- Optimize models for **real-time video processing**
- Learn **Google Colab workflow, dataset management, and interactive GUI integration**

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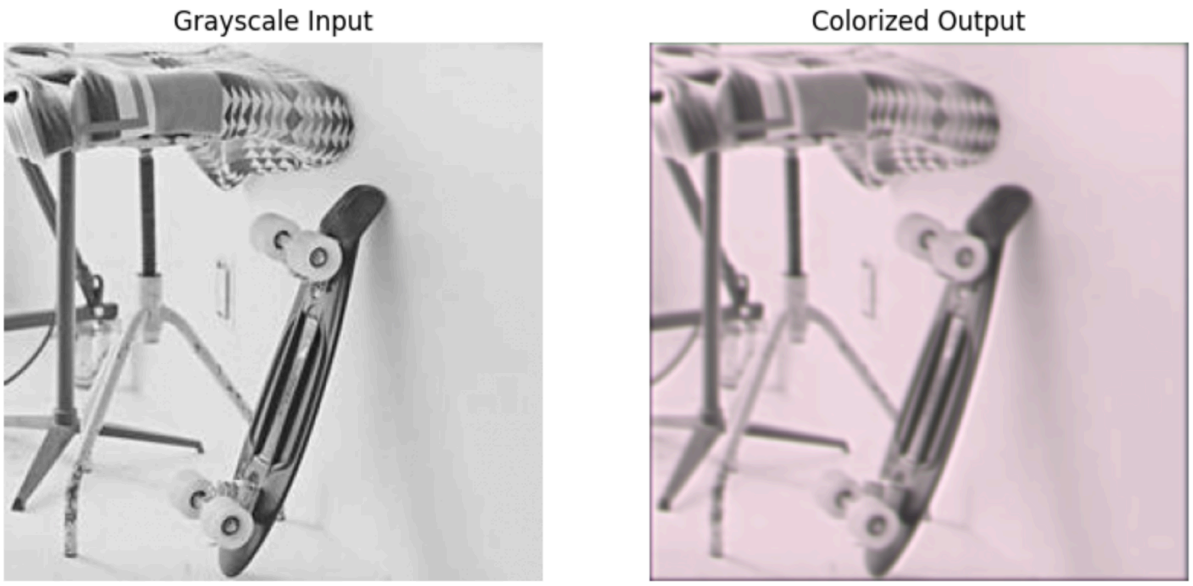
4. Activities & Tasks

Task 1: Artistic Style Transfer Colorization

- Combined U-Net colorizer with AdaIN style transfer
- Allowed users to select predefined artistic styles: Van Gogh, Monet, Picasso
- GUI implemented with **color preview in Colab**

Screenshot:

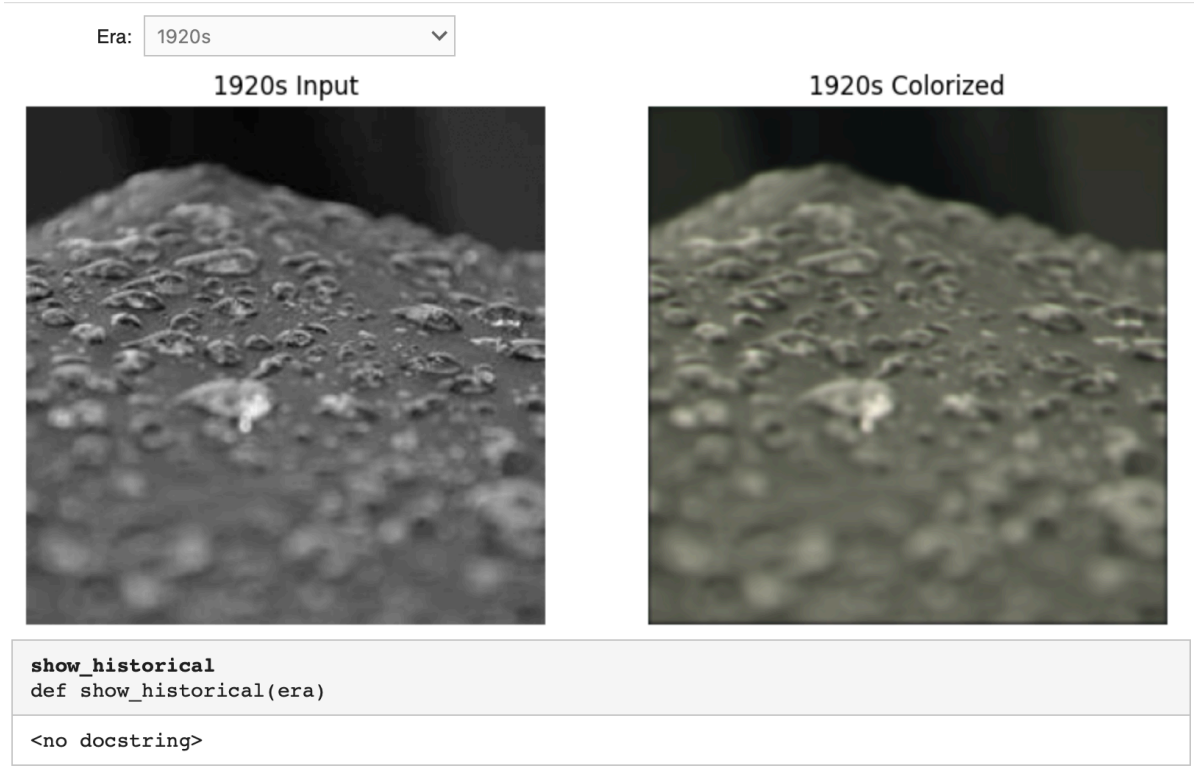


Task 2: Historical Photo Colorization

- Fine-tuned base colorization for historical datasets: 1920s and WWII images
- Focused on **muted and era-accurate color tones**

- Optional GUI for era selection

Screenshot:



Task 3: Conditional Colorization (User-Controlled)

- Users could pick colors for specific regions (sky, grass)
- Hints converted into input channels for U-Net
- Interactive **ColorPicker widget in Colab**

Screenshot:

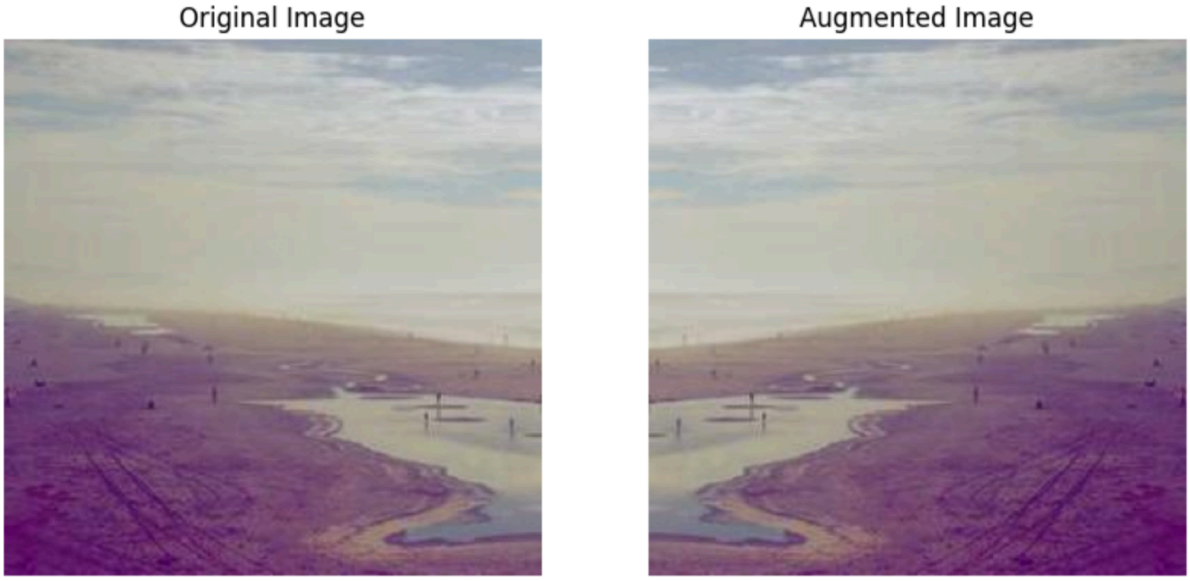

```
apply_color
def apply_color(sky_color='#87ceeb', grass_color='#228b22')
```

```
<no docstring>
```

Task 4: Dataset Augmentation

- Applied **rotation, flipping, brightness adjustment, noise injection**
- Trained model on augmented datasets improved colorization accuracy
- Compared before vs after augmentation

Screenshot:



Task 5: Semantic Segmentation Colorization

- Used **DeepLabV3** for semantic masks
- Allowed users to colorize selected objects/regions
- Interactive GUI for object selection

Task 6: Real-Time Video Colorization

- Processed video frames sequentially
- Model selector allowed switching between Base, Conditional, Segmentation colorizers
- Displayed FPS for real-time performance

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5. Skills & Competencies

- Python programming and **PyTorch deep learning frameworks**
- Image processing using **OpenCV and PIL**
- Building modular deep learning pipelines
- Implementing **interactive GUIs in Colab**
- Data augmentation and dataset handling
- Semantic segmentation and conditional model inputs
- Real-time video processing

6. Feedback & Evidence

- All tasks completed individually without mentor intervention
- Screenshots and generated outputs serve as **evidence of successful task completion**
- Models trained and tested on **real datasets** from Picsum, historical archives, and augmented images

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7. Challenges & Solutions

Challenge	Solution
Handling multiple colorization tasks in one framework	Designed **modular U-Net pipelines** with shared base
Real-time video processing in Colab	Resized frames, optimized inference, used **cv2_imshow** for display
Historical color accuracy	Fine-tuned models on **era-specific datasets**
Semantic segmentation integration	Pretrained DeepLabV3 with object masks applied to colorizer output
Colab limitations (webcam, real-time display)	Used **snapshot capture** and uploaded videos for processing

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8. Outcomes & Impact

- Built a **unified, modular colorization pipeline** covering all 6 tasks
- Achieved **realistic and artistic colorization** for grayscale images
- Enabled **interactive user controls** for conditional and semantic colorization
- Successfully processed **real-time video colorization**
- Enhanced skills in **deep learning, image processing, GUI design, and Colab workflows**

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9. Conclusion

The internship successfully enabled the practical application of deep learning to image colorization. By completing all six tasks, I developed expertise in **CNN-based colorization, style transfer, conditional inputs, semantic segmentation, dataset augmentation, and real-time video processing**. This experience significantly strengthened my **practical skills and problem-solving abilities** in computer vision and AI model deployment.