Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
International Conference on Innovative Techniques in Artificial Intelligence and Communication Technologies
May 2024 5(ICITAICT), 50–60

AI-POWERED RESTORATION OF VINTAGE FILMS INTO NEW CINEMA: HARMONIZING CREATION AND AUTOMATION

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DOI 10.29121/shodhkosh.v5.iICITAICT.2024.1329

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

The revival of classic films has made significant progress thanks to Artificial Intelligence-powered restoration methods. The AI produces a restored film with improved brightness, resolution and color while preserving the original film content through complex algorithms. The purpose of the research is to analyze the opinions of viewers and historians about films restored with artificial intelligence and to address the ethical issues associated with AI restoration. Data was collected on likes and dislikes of viewers of AI-restored movies on YouTube, and the survey analyzed 375 people watching the vintage movie and its restored version. Analysis results show that AI-restored movies have better resolution, color and sound quality than the original vintage footage. Historians argue that AI algorithms can change the historical meaning and authenticity of the original work and undermine the original artistic intent of old films. The difficulty with artificial intelligence is finding a balance between technical progress and maintaining creative and historical integrity, which requires strict ethical standards to prevent potential harm. Preserving the integrity and true historical accuracy of original content and maintaining public trust require transparent practices, rigorous authentication procedures, and careful navigation of copyright, ownership, and consent issues. The rights of content producers, communities and individuals must be respected to ensure that AI-assisted restoration is carried out responsibly and ethically. The power of artificial intelligence in the restoration of old films has great potential to preserve and celebrate our film heritage.

Keywords: AI-Power, Restoration, Upscaling, Historians, Ethics

1. INTRODUCTION

The development of artificial intelligence has opened up new possibilities for restoring old films and transformed the landscape of classic cinema. Using advanced algorithms, AI can automatically analyse and repair damaged or degraded footage, effectively improving the overall quality of old movies and giving new life to iconic movies of the past. One of the most exciting aspects of AI film restoration is its ability to intelligently improve the resolution of old films, and colorization techniques breathe new life into black and white films, making them more appealing to

contemporary audiences while maintaining artistic integrity from the originals.[1] With its remarkable ability to learn and adapt, AI has become an important tool in preserving film heritage and ensuring that classic films can be enjoyed for generations to come. In this article, we explore the possibilities and limits of artificial intelligence in this field and delve into the ethical aspects of its use. Together, this study will explore the capabilities of artificial intelligence (AI) in film restoration and how they can contribute to the preservation of our cultural heritage and historical accuracy.

2. THE POWER OF ARTIFICIAL INTELLIGENCE IN FILM RESTORATION

Artificial intelligence has revolutionized the field of film restoration and enhancement, providing unprecedented opportunities to restore old, damaged footage and improve the quality of existing films. Artificial intelligence algorithms can automatically repair scratches, dust and other defects on old film rolls. Artificial intelligence video recovery software is a cost-effective solution. Traditional restoration methods were laborious and time-consuming, requiring manual frame-by-frame editing and expensive equipment.[2] Unlike traditional recovery techniques, AI software can complete these tasks in a few hours at a lower cost. Artificial intelligence greatly speeds up this process by analysing patterns and intelligently filling in missing or damaged points. Colour techniques based on artificial intelligence can add colour to black-and-white films and breathe new life into classic films. Advanced algorithms can accurately predict and apply colours based on historical data and artistic principles, allowing filmmakers to maintain the original look and feel while updating images for modern audiences. Overall, AI is a powerful tool for restoring and enhancing films, offering filmmakers unprecedented opportunities to preserve and revive classic films. As AI technology advances, we can expect more innovations in this field, leading to even more impressive results in image restoration and enhancement. Preservation of visual artefacts is critical to protecting our cultural and personal history so that future generations can experience and connect with the past. The restored Fritz Lang's science fiction film Metropolis (1927) premiered at the 2010 Berlin International Film Festival to critical acclaim. The classic film "The Wizard of Oz" (1939) was extensively restored in 2014 for its 75th anniversary. Georges Méliès' stunning silent film A Trip to the Moon (1902) underwent a major restoration process in 2011 and celebrated its 109th anniversary. F. W. Murnau's silent horror film Nosferatu (1922) was restored in 2006 using artificial intelligence and traditional restoration techniques to bring the film's haunting images back to life.

2.1. OBJECTIVES

1) To check the capabilities and limitations of AI-powered restoration of vintage films
2) Whether Restoration Quality is satisfying the viewers:
   - Analysis of YouTube Likes and Dislikes of the Viewers of AI restored Vintage Films,
   - Analysis of satisfaction with the resolution, colorization, and audio quality of AI-restored vintage films. The study was done with 375 subjects, selected from the Tambaram area, Chennai, India.

3) To discuss ethical issues and historians' opinions about AI-powered restoration of vintage films

3. CAPABILITIES OF AI-POWERED RESTORATION OF VINTAGE FILMS

Vintage Film AI Restoration uses advanced machine learning algorithms to improve the quality of old and degraded images. AI models can scale low-resolution footage to a higher resolution with high clarity. By analyzing the patterns and textures of existing material, AI algorithms create additional pixels to improve overall resolution without compromising quality.[3] This is especially useful when remastering old movies for viewing on high-definition screens. AI-powered noise reduction algorithms can remove grain and other noise from footage, resulting in cleaner, sharper images. By separating the signal from the noise, these algorithms preserve important details.[4] Artificial intelligence algorithms can automatically detect and remove various defects from footage, such as scratches, dust, flickering, and blemishes. This process involves advanced image analysis and restoration techniques. Artificial intelligence algorithms can detect and remove film grain, vignetting, and ghosting in old films.[5] This process helps to achieve a cleaner and more visually appealing result. AI algorithms can intelligently add colour to black-and-white footage, restore it to its original colour, or apply colorization based on historical references. This process requires training models of large colours and original images to accurately predict colours.[6] AI algorithms can improve the overall quality of old footage by improving sharpness, contrast, and brightness. This helps restore details that may have been lost due to degradation over time. AI-powered frame interpolation can create new frames between existing frames, creating smoother motion in movies. This is particularly useful when restoring images at low frame rates or converting movies to higher frame rates for modern display technologies.[7] By predicting the movement between images, AI algorithms create smooth transitions that enhance the viewing experience. In cases where parts of the film are missing or damaged beyond repair, AI can reconstruct the missing content using machine learning algorithms. By analyzing the surrounding images and context, AI models can create reliable replacements for missing segments and maintain film continuity. AI can also be used to enhance and clean up old movie soundtracks. This includes removing noise, crackling, and distortion while maintaining the original sound quality. AI algorithms are designed to preserve the original aesthetics and characteristics of footage when restoring old movies. This requires careful adjustment to ensure that the returned footage remains true to the filmmaker's intentions.

All in all, restoring old films with artificial intelligence offers an effective and efficient solution to preserve cultural heritage and bring old images to modern audiences in high quality. These features will continue to evolve as AI technology advances, promising even more impressive results in the future. Technologies used by AI video recovery software can create new information from old material and restore its content. This ensures that damaged material can be reused and repaired, even if it was previously considered beyond repair. Artificial intelligence can analyze film content, identify objects, scenes, characters, and locations, and produce metadata that improves the organization and searchability of the film archive.[8] This metadata makes it easier for researchers, historians and filmmakers to access and study film heritage. Technologies based on artificial intelligence make it possible to automatically create subtitles and translate film dialogues into several languages. It makes classic films more accessible to different audiences around the

world, promotes cultural exchange, and preserves the linguistic diversity of film heritage.

4. LIMITATIONS OF AI RESTORATION OF VINTAGE FILMS

While AI restoration of vintage films offers significant opportunities, it also has several limitations. The efficiency of AI algorithms is mostly dependent on the quality and quantity of available training data. If the input data is of poor quality or lacks diversity, the algorithms may struggle to produce accurate results.[9] Some restoration operations, such as repairing severe damage or restoring highly degraded material, may not exceed the capabilities of current AI algorithms. Complex healing problems often require manual intervention by human experts. AI algorithms can accidentally change the original artistic intent or aesthetic of old films during the restoration. Balancing restoration improvements with maintaining authenticity requires careful consideration and expertise. Artificial intelligence-powered restoration techniques can be computationally intensive and require significant processing power and time, especially for large restoration projects. This may limit the availability of the technology to smaller organizations or individuals with limited resources.[10] The restoration process involves subjective decisions about how to interpret and improve the material. Different people may have different preferences and opinions about the optimal restoration method, which can lead to possible disagreements or dissatisfaction with the results. Restoration of vintage films can involve consideration of legal and ethical considerations related to copyright, intellectual property rights and cultural sensitivity. AI algorithms must follow legal and ethical guidelines when processing and distributing copyrighted material.[11] As AI technology advances, it is imperative to maintain and update recovery algorithms to keep pace with changing standards and best practices. Failure to do so may result in outdated or degraded return results over time. AI colorization of black and white films is not without drawbacks, and historically inaccurate images can result from colorization without sufficient contextual information, such as flags or uniforms.[12] Despite these limitations, AI restoration remains a valuable tool for preserving and reviving old movies. Compared to traditional manual recovery methods, it offers significant improvements in efficiency and quality. Balancing the benefits and limitations of AI technology is essential to achieving successful restoration results while respecting the historical and artistic integrity of the original material.

5. METHODOLOGY

1) Old movie footage restored with AI are available on YouTube channels. Most of these are antique films and cult classic movies, being watched still by people including the current younger generation. Based on this, 15 AI-restored movies are included in this study. Data is collected based on Likes and Dislikes given by the viewers of the movies till April 2024.

The following are the selected AI-restored antique movies.

- Police 1916 - Charlie Chaplin Film - [60 FPS - Colour - 4K] - Old footage restoration with AI. In YouTube viewers: 65,783. Likes: 1000 Dislikes: 0 [13]
- Easy Street - Charlie Chaplin 1917 - [60FPS - Colour - 4K] - Old footage restoration with AI. In YouTube viewers: 10,783. Likes: 173 Dislikes: 0 [14]

- Nosferatu (1922) - Remastered with AI and Machine Learning. In YouTube viewers: 41,783. Likes: 993 Dislikes: 0 [15]
- Metropolis (1927) Full Movie|4K Color Restored. In YouTube viewers: 41,000. Likes: 1300 Dislikes: 0 [16]
- Chaplin Outtakes in 1914 Debut: Restored to Amazing Life. In YouTube viewers: 70,000. Likes: 2000 Dislikes: 0 [17]
- The Immigrant - Charlie Chaplin 1917 - [60FPS - Color - 4K] - Old footage restoration with AI. In YouTube viewers: 4,000. Likes: 94 Dislikes: 0 [18]
- Dracula in 4K Ultra HD | "I Am Dracula, I Bid You Welcome" | (90th Anniversary) Extended Preview. In YouTube viewers: 75,000. Likes: 94 Dislikes: 0 [19]
- Work - Charlie Chaplin 1915 - [60FPS - Color - 4K] - Old footage restoration with AI. In YouTube viewers: 3,700. Likes: 77 Dislikes: 0 [20]
- The Seashell and the Clergyman 1928 (Restored Full Movie). In YouTube viewers: 139,000. Likes: 2200 Dislikes: 0 [21]
- Charlie Chaplin Pranking Cameraman (1914) AI 60 FPS & COLORIZED. In YouTube viewers: 11,000. Likes: 217 Dislikes: 0 [22]
- Le Voyage Dans La Lune (A Trip to the Moon) Georges Méliès 1902 [Color 4K 60fps A.I. Restored Video]. In YouTube viewers: 10000. Likes: 167 Dislikes: 0 [23]
- Tokyo Japan 1940s - [60 FPS - Color - 4K] - Old footage restoration with AI and Machine Learning. In YouTube viewers: 17000. Likes: 413 Dislikes: 0 [24]
- Driving in Beverly Hills 1935 - [60 FPS - Color - 4K] - Old footage restoration with AI. In YouTube viewers: 29000. Likes: 542 Dislikes: 0 [25]
- Meet These Real Flappers 1929 in AI Restored Colorized Film. In YouTube viewers: 676000. Likes: 14000, Dislikes: 0 [26]
- By The Sea - Charlie Chaplin 1915 - [60FPS - Color - 4K] - Old footage restoration with AI. In YouTube viewers: 1200. Likes: 30, Dislikes: 0 [27]

An appreciation score is derived from the number of likes and dislikes.

The formula for calculating an appreciation score is = $L/(L+D) \times 100$

L is the number of likes and D is the number of dislikes.

This formula gives you a percentage score representing the proportion of likes relative to the total likes and dislikes and multiplying by 100 converts it into a percentage format.

Figure 1

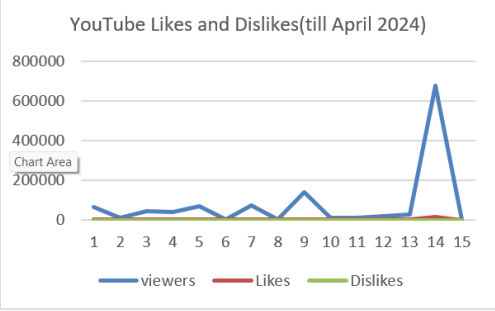
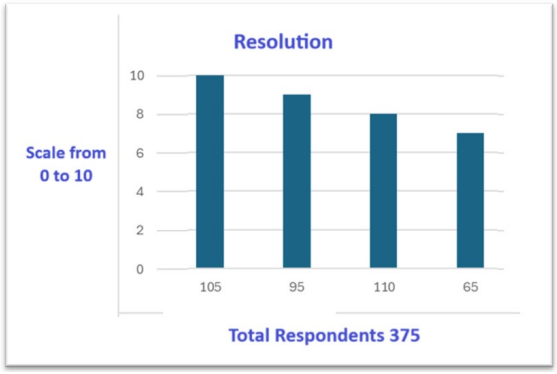


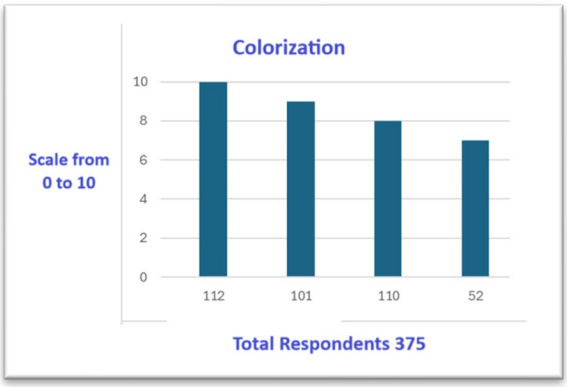
Figure 1 The Appreciation Score Was Calculated, and it is 100%.

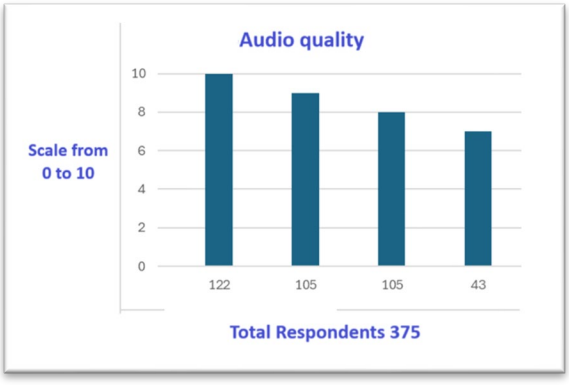
2) Survey investigation of respondents' satisfaction with AI-powered restoration of classic movies' resolution, colorization, and audio quality.

375 respondents were selected in the age group 50 to 60, and all are males, from Tambaram, Chennai, Tamil Nadu. The selected participants are those who still love old films.

Respondents were allowed to watch both the antique film's versions (the old version and its AI-restored version). Their satisfaction was measured on a scale of 1 to 10, separately for resolution, colorization, and audio quality.







The average rating is used as a satisfaction score.

Satisfaction Score = $\sum$Ratings/N

Where: $\sum$ Ratings are the sum of all individual satisfaction ratings. N is the number of respondents.

The respondents' satisfaction score for resolution is 8.64 out of 10 (86.4%)

The respondents' satisfaction score for colorization is 8.73 out of 10 (87.3%)

The respondents' satisfaction score for audio quality is 8.82 out of 10 (88.2%)

6. ETHICAL ISSUES IN AI RESTORATION OF VINTAGE FILMS

Ethical issues in AI restoration of vintage films include various aspects such as preservation of authenticity, historical accuracy, cultural representation, consent, ownership, potential bias and discrimination. Artificial intelligence algorithms can accidentally change or distort the original content of vintage movies during the restoration process. In the original framework, there is a risk of losing historical accuracy or important cultural and artistic nuances. Preserving the integrity and authenticity of historic objects while enhancing their quality is a delicate balance that restoration professionals must carefully navigate. Vintage films often reflect the social norms, values, and perspectives of the time they were created. Artificial intelligence restorations may inadvertently reinforce or perpetuate the stereotypes, prejudices, or cultural sensitivities of the source material. Restoration professionals must consider the cultural context of films and take steps to avoid distortion or damage when using automated restoration techniques. Restoration of old films often involves the use of copyrighted material, which raises questions of ownership and consent. It is necessary to obtain appropriate permission from the rights holders and consider the wishes of filmmakers, artists, and cultural communities related to the material. Transparency in the return process and its potential impact on the original content are crucial for ethical integrity and respect for intellectual property rights. AI algorithms can inherit biases in the training data used to develop them, leading to unintended consequences in the recovery process. Bias based on race, gender, ethnicity, or other characteristics can manifest themselves in normalization results, perpetuate stereotypes, or marginalize certain groups. Restorers must be vigilant in recognizing and mitigating biases in AI algorithms to ensure equitable and impartial treatment of all individuals appearing in old films.[28] Old films may contain individuals whose privacy rights must be respected, especially if they did not consent to the filming or distribution. Artificial intelligence-based restoration techniques, such as face enhancement or recognition, raise concerns about the inadvertent exposure or exploitation of individuals featured in the material. Protecting the privacy and dignity of people depicted in vintage films requires careful consideration and adherence to ethical standards. Addressing these ethical issues requires collaboration between restoration practitioners, ethicists, historians, stakeholders, and society to define acceptable boundaries and ensure that AI is a valuable tool in preserving our cinematic heritage.[29] The difficulty is finding a balance between technical progress, creative integrity, and historical authenticity. Adherence to ethical standards and respect for the rights and dignity of all parties involved in the restoration process of vintage films can only be ensured by implementing transparent practices, integrating various perspectives, and prioritizing ethical principles during the restoration process.

7. HISTORIANS' VIEWS ON AI RESTORATION OF OLD FILMS

Some historians see AI restoration as a revolutionary tool for preserving and reviving historical materials. They appreciate the ability of AI algorithms to improve the visual and audio quality of old movies, making them more accessible and appealing to modern audiences. Artificial intelligence restoration can reveal hidden details, improve clarity, and breathe new life into deteriorating footage, enriching our understanding of the past. However, some historians have expressed concern

about the impact of AI restoration on the authenticity and integrity of the original films.[30] Frame interpolation, motion stabilization techniques, and reconstruction of missing content with machine learning algorithms are not accepted by historians and are criticized as weakening historical accuracy. There is a delicate balance between enhancing the viewing experience and preserving the authenticity of historic items, which historians advise restorers to carefully consider. Thus, they recommend using a combined method to restore movies, where AI-based algorithms are combined with traditional manual restoration techniques. They believe that the use of artificial intelligence technology combined with human expertise allows greater flexibility, creativity, and control of the restoration process. By combining automatic restoration with manual procedures, historians can achieve more nuanced and faithful restoration results while minimizing the risk of unwanted changes. Historians stress the importance of considering legal considerations when using artificial intelligence-based restoration techniques and stress the need to respect copyright laws, intellectual property rights and cultural sensitivities when restoring old films. Historians also emphasize the ethical responsibility to accurately represent historical events and contexts in restored material, avoiding distortions or misinterpretations resulting from automatic restoration processes. Historians encourage continued research, collaboration, and dialogue between restoration practitioners, AI experts, and historians to advance responsible AI-assisted restoration. By sharing knowledge, expertise, and best practices, stakeholders can address challenges, improve techniques, and ensure that AI-based restoration is consistent with the principles of historic preservation, authenticity, and heritage.[31] In general, historians recognize the significant potential of AI-assisted restoration to enrich our understanding of the past, while acknowledging the complexities and nuances involved in preserving historical images. By approaching these challenges thoughtfully and collaboratively, historians and restoration practitioners can harness the power of artificial intelligence to protect and celebrate our film heritage for future generations.

8. RESULTS AND DISCUSSION

The quality of the AI restoration plays an important role in how viewers perceive the content. If the restoration is well executed and enhances the viewing experience without compromising the authenticity of the original film, it is likely to receive positive feedback. Viewers often appreciate restoration efforts that preserve the authenticity and integrity of the original film. If an AI restoration respects the historical context, artistic vision, and cultural significance of the vintage film, it is more likely to receive a positive reception. A vintage film's popularity, historical importance, and content appeal can influence YouTube likes and dislikes. Movies with iconic scenes, famous actors, or important historical events can capture the attention and engagement of viewers. YouTube community engagement with content, including comments, sharing, and discussions, can provide insight into viewer preferences and feelings about old movies restored by AI. Clear communication from the uploader about the restoration process, the changes made to the original film, and the goals of the restoration project can help manage viewer expectations and build trust and appreciation for the content. Overall, analyzing the likes and dislikes of AI-restored vintage movies on YouTube can provide valuable information about audience preferences and such content. However, it is important to interpret this information in conjunction with other factors and consider the broader context of the restoration project and the historical and cultural significance of the vintage film.

While AI certainly has many advantages in film restoration, it also comes with problems and difficulties. The possibility of over-automation and the resulting loss of human contact are two major concerns. Film restoration is an artistic endeavor that requires a deep tremendous understanding of the context, aesthetics, and purposes of the film. This is not just a technical task. Thanks to their experience and intuition, rehabilitators can make more subjective decisions than algorithms. A central part of film restoration is artistic interpretation. Professionals can perform an in-depth analysis of the visual and audio components of a film and draw complex conclusions about colour grading, contrast, and audio quality. To ensure that the restoration faithfully reflects the original intention of the director, they can also consider the historical and cultural background of the film. These arbitrary decisions, supported by an aesthetic sensibility and a deep understanding of film as an art form, add complexity and integrity to the restoration process. AI algorithms also cannot match the flexibility and improvisation shown by human restorers. Human experts can adapt their approach and procedure to the characteristics of each film, ensuring that the restoration procedure is adapted to the requirements of the image. Currently, it is very difficult for AI to achieve this level of adaptability without significant training in different cultural environments and film genres. Another problem with AI-based restoration is the potential for overcorrection or the creation of unwanted artefacts. If the training data is flawed or insufficient, the algorithms may inadvertently reproduce or amplify those errors. Human experts, on the other hand, can critically evaluate the results and make the necessary corrections, which guarantees significantly better-quality control.

9. CONCLUSION

As technology advances, AI-assisted restoration will continue to be important to preserving our shared film history. It pays tribute to the memories and stories preserved in old films. Artificial intelligence algorithms can use machine learning and neural networks to revive fading memories and restore their visual clarity. This ensures that the past is preserved and brought to future generations. Compared to traditional methods, AI can return material faster and cheaper. Artificial intelligence has opened new possibilities in film restoration and brought with it both excitement and ethical issues. However, frame interpolation, colorization and reconstruction using artificial intelligence require careful attention to historical accuracy, as the technology comes with both opportunities and risks. Most viewers of this YouTube channel appreciate the results of the careful and skilful restoration of old film footage. A significant added value was found in artificial intelligence colouring when viewers gained a better understanding of life about a hundred years ago and realized that life was never black and white. Artificial intelligence-assisted film restoration represents a remarkable fusion of human creativity and technological innovation, aligning the art of film preservation with the possibilities of automation.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

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