

Simplifying NeRF: Creating an Intuitive Web-Based 3D Scene Interface

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Department of Mathematics,
Informatics and Statistics
Institute of Informatics



Artificial Intelligence and
Machine Learning

Masters Thesis

Simplifying NeRF: Creating an Intuitive Web-Based 3D Scene Interface

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Supervisors

Prof. Dr. Sylvia Rothe and Cristoph Weber

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Abstract

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

Abstract (German)

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Acknowledgement

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Introduction

1.1 Background

The present state of NeRF research presents significant advancements that have greatly influenced the field of 3D scene modeling and rendering. This section provides an overview of the current research landscape, highlighting key NeRF frameworks and relevant projects, and identifying the challenges and opportunities that inform our research objectives.

Two prominent NeRF frameworks with user interfaces, namely Instant NGP [Mül+22] and Nerfstudio [Tan+23], have emerged as leaders in enabling users to explore and manipulate 3D scenes. These frameworks offer features such as real-time scene rendering, adjustable training parameters, and the creation of camera trajectories for video rendering.

However, the utilization of these interfaces often demands a high level of technical expertise, as they are designed to complement, rather than replace, command-line interfaces. Users must engage with terminal-based processes for tasks such as video data preprocessing, model training, and rendering output.

Additionally, several innovative projects have expanded the NeRF landscape. Notably, CLIP-NeRF [Wan+22], Instruct-NeRF2NeRF [Haq+23], Text2LIVE [Bar+22], and SINE [Bao+23] have introduced text-based editing approaches, broadening the possibilities for manipulating NeRF models. PaletteNeRF [WTX22] focuses on color editing, while NeRF-Editing [Yua+22] enables mesh editing.

This research aims to identify key challenges and opportunities in NeRF frameworks and interfaces, as demonstrated by these significant contributions. This knowledge will guide the development of a user-friendly, web-based interface and integrated editing plugins, with the ultimate goal of enhancing the accessibility and usability of NeRF frameworks for a broader user base.

1.2 Overview of NeRF

1.3 Research Objectives

The research objectives of this study are as follows:

1. **Exploration of NeRF Interaction Capabilities:** This study aims to explore the existing interaction capabilities within NeRF frameworks comprehensively. It involves an analysis of the current state of NeRF interfaces and an investigation into user engagement, visualizations, and manipulation of NeRF scenes.
2. **Development of a Web-Based User Interface:** Building on insights gained from the exploration phase, the primary objective is to design and implement a user-friendly web-based interface for NeRF.
3. **Streamlined NeRF Creation and Manipulation:** The central goal is to simplify the process of NeRF creation and manipulation, eliminating the need for users to deal with complex command-line interfaces or extensive local setup. The web-based interface will provide an intuitive and efficient user experience.
4. **Integration of Diverse Editing Plugins:** To enhance the creative potential of NeRF, various editing plugins will be integrated into the web-based interface. The objective is to expand the functionality and versatility of the NeRF framework.

The research aims to advance NeRF frameworks' capabilities and accessibility, making them accessible to a broader audience and fostering innovation in 3D scene modeling and rendering.

1.4 Research Question

1. **Enhancing NeRF Frameworks:** How can a web-based interface improve the user experience and accessibility of NeRF frameworks, and what impact will these enhancements have on user-friendly NeRF creation and manipulation?
2. **Overcoming Technical Challenges:** What technical challenges and limitations are associated with current NeRF frameworks and interfaces, and how can innovative design and technology choices in a web-based interface overcome these challenges?
3. **Innovative Editing Integration:** How can novel editing approaches be seamlessly integrated into a web-based NeRF interface to enhance creativity and usability, and how do these methods compare with traditional NeRF editing techniques?

Related Work

” *A picture is worth a thousand words. An interface is worth a thousand pictures.*

— **Ben Shneiderman**
(Professor for Computer Science)

2.1 Existing Methods for creating NeRFs

2.2 Review of tools and technologies in film and VFX

2.3 User Research

2.4 Conclusion

“ *Users do not care about what is inside the box,
as long as the box does what they need done.*

— **Jef Raskin**
about Human Computer Interfaces

3.1 Research Design

3.2 Initial User Research

3.2.1 Participant Selection Criteria

3.2.2 Interview Methodology

3.2.3 Key Findings

3.3 Prototype Development

3.3.1 Technical Specifications

3.3.2 Design Considerations

3.4 User Testing

3.4.1 Quantitative Analysis

3.4.2 Qualitative Analysis

Technical Implementation

” *Innovation distinguishes between a leader and a follower.*

— **Steve Jobs**
(CEO Apple Inc.)

4.1 System Architecture

4.2 Frontend Development

4.3 Backend Development

4.4 Challenges and Solutions

4.5 Lessons Learned

4.6 Future Directions

Results

5.1 Analysis of User Experience Questionnaire

5.2 Findings from Qualitative User Testing

5.3 Integration and Findings

Conclusion

6.1 Key Findings

6.2 Contributions to the Field

6.3 Future Work

Example Appendix

A.1 Interview Questions

A.2 User Experience Questionnaire

A.3 User Testing Results

A.4 Prototype Documentation

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This thesis was typeset with \LaTeX 2_ε. It uses the *Clean Thesis* style developed by Ricardo Langner. The design of the *Clean Thesis* style is inspired by user guide documents from Apple Inc.

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