



Article

Integration of 3D Gaussian Splatting and Neural Radiance Fields in Virtual Reality Fire Fighting

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Abstract: Neural radiance fields (NeRFs) and 3D Gaussian splatting have emerged as promising 3D reconstruction techniques recently. However, their application in virtual reality (VR), particularly in firefighting training, remains underexplored. We present an innovative VR firefighting simulation system based on 3D Gaussian Splatting technology. Leveraging these techniques, we successfully reconstruct realistic physical environments. By integrating the Unity3D game engine with head-mounted displays (HMDs), we created and presented immersive virtual fire scenes. Our system incorporates NeRF technology to generate highly realistic models of firefighting equipment. Users can freely navigate and interact with fire within the virtual fire scenarios, enhancing immersion and engagement. Moreover, by utilizing the Photon PUN2 networking framework, our system enables multi-user collaboration on firefighting tasks, improving training effectiveness and fostering teamwork and communication skills. Through experiments and surveys, it is demonstrated that the proposed VR framework enhances user experience and holds promises for improving the effectiveness of firefighting training.

Keywords: neural radiance fields; 3D Gaussian splatting; fire; immersive virtual reality



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1. Introduction

Frequent occurrence of fires poses significant threats to both human lives and property. The causes of fires frequently stem from factors such as a lack of sufficient safety awareness, negligent fire prevention practices, and inadequate familiarity with the proper use of fire extinguishing equipment [1]. Therefore, it is imperative to prioritize enhancing public awareness and implementing comprehensive fire safety training programs. Although fire drills are a prevalent and efficacious approach, they can impose significant demands on resources, necessitating substantial allocations of manpower, materials, and financial assets [2]. Moreover, the creation of realistic fire scenarios for drills can potentially engender safety hazards, while logistical support complexities often impede broader accessibility to such training programs for diverse populations. Consequently, conventional fire drills may inadequately address comprehensive societal needs. To meet these challenges, there is an increasing need for pioneering fire safety education methods that effectively guide individuals to overcome the limitations of traditional drills.

Utilizing virtual reality (VR) technology allows for the recreation of necessary scenarios in a virtual environment, providing users with interactive platforms to engage with characters or objects via interactive devices, facilitating task completion. In industrial production, VR technology is progressively employed for workforce training, process simulation, and quality assurance [3]. However, a significant challenge in these applications

Reality And Radiance

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Reality and Radiance Emilia Fogelklou-Norlind, 1985 *Her Master's Tools?* Caroline Vander Stichele, Todd C. Penner, 2005 This collection of essays originating in the SBL International Meetings in Berlin 2002 and Cambridge 2003 explores the current reception of historical criticism in feminist biblical studies pushing the boundaries of past study and opening new vistas for future research By framing the discussion in the context of the current reevaluation of both historical criticism and feminist exegesis the contributors highlight the ongoing need to engage methodological issues In addition a strong postcolonial emphasis throughout the volume challenges the hegemony of Western biblical interpretation promoting a format of dialogue and engagement The collection brings together diverse cultural and geographical perspectives on biblical criticism with over ten countries represented Consisting of Western and non Western perspectives female and male scholars junior and senior voices in the field and a range of feminist scholars situated alongside postcolonial and gender critics this collection reveals not only the multiplicity of perspectives but also the various transitions in scholarship that have taken place over the past thirty years Volume contributors include Roland Boer Athalya Brenner Ann Graham Brock Kristin De Troyer Esther Fuchs Archie Chi Chung Lee Joseph Marchal John Marshall Hjamil Mart nez V zquez Madipoane Masenya ngwana Mphahlele Judith McKinlay Priscilla Geisterfer Nyvlt Jorunn kland Todd Penner Vernon Robbins Susanne Scholz Hanna Stenstr m and Caroline Vander Stichele Paperback edition is available from the Society of Biblical Literature www.sbl-site.org

Modeling from Reality Katsushi Ikeuchi, Yoichi Sato, 2012-12-06 This book summarizes the results of our modeling from reality MFR project which took place over the last decade or so The goal of this project is to develop techniques for modeling real objects and or environments into geometric and photometric models through computer vision techniques By developing such techniques time consuming modeling process currently undertaken by human programmers can be semi automatically performed and as a result we can drastically shorten the developing time of such virtual reality systems reduce their developing cost and widen their application areas Originally we began to develop geometric modeling techniques that acquire shape information of objects environments for object recognition Soon this effort evolved into an independent modeling project virtual reality modeling with the inclusion of photometric modeling aspects that acquire appearance information such as color texture and smoothness Over the course of this development it became apparent that environmental modeling techniques were necessary when applying our techniques to mixed realities that seamlessly combine generated virtual models with other real virtual images The material in his book covers these aspects of development The Gnostic Path to Spiritual Reality , *Advances in Artificial Reality and Tele-Existence* Ronghua Liang, Zhigeng Pan, Adrian Cheok, Michael Haller, Rynson W.H. Lau, Hideo Saito, 2006-11-20 This book constitutes the refereed proceedings of the 16th International Conference on Artificial Reality and Telexistence ICAT 2006 held in Hangzhou China in November December 2006 The 138 revised papers cover anthropomorphic intelligent robotics artificial life augmented reality distributed and

collaborative VR system motion tracking real time computer simulation virtual reality as well as VR interaction and navigation techniques

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Computer Vision - ACCV 2024 Minsu Cho, Ivan Laptev, Du Tran, Angela Yao, Hongbin Zha, 2024-12-07 This 10 volume LNCS conference set constitutes the proceedings of the 17th Asian Conference on Computer Vision in Hanoi Vietnam held during December 8 12 2024 The 270 full papers together included in this volume were carefully reviewed and selected from 839 submissions The conference presents and discusses new problems solutions and technologies in computer vision machine learning and related areas in artificial intelligence

Spatial Augmented Reality Oliver Bimber, Ramesh Raskar, 2005-08-08 Like virtual reality augmented reality is becoming an emerging platform in new application areas for museums edutainment home entertainment research industry and the art communities using novel approaches which have taken augmented reality beyond traditional eye worn or hand held displays In this book the authors discuss spatial augmented reality approaches that exploit optical elements video projectors holograms radio frequency tags and tracking technology as well as interactive rendering algorithms and calibration techniques in order to embed synthetic supplements into the real environment or into a live video of the real environment Special Features Comprehensive overview Detailed mathematical equations Code fragments

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