

2021 IEEE 7th International Conference on Virtual Reality (ICVR 2021)

**Foshan, China
20 – 22 May 2021**



**IEEE Catalog Number: CFP21AW9-POD
ISBN: 978-1-6654-4621-1**

**Copyright © 2021 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP21AW9-POD
ISBN (Print-On-Demand):	978-1-6654-4621-1
ISBN (Online):	978-1-6654-2309-0
ISSN:	2331-9542

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

2021 IEEE 7th International Conference on Virtual Reality (ICVR 2021)

Table of Contents

Preface.....	viii
Conference Committee.....	ix

► Image Analysis and Processing

Research on the Method of Underwater Swimming Motion Capture	1
<i>Jin Yang, Tianzeng Li, Zhiya Chen, Xiaodong Li</i>	
Real Time Hand Gesture Recognition Using Leap Motion Controller Based on CNN-SVM Architecture	5
<i>Aamrah Ikram, Yue Liu</i>	
Multi-scale Image Decomposition Using a Local Statistical Edge Model.....	10
<i>Kin-Ming Wong</i>	
Project MultiLeap: Fusing Data from Multiple Leap Motion Sensors.....	19
<i>Tomas Novacek, Christian Marty, Marcel Jirina</i>	
Emotion Recognition from Body Movements with AS-LSTM	26
<i>Haiyan Zhang, Pengfei Yi, Rui Liu, Dongsheng Zhou</i>	
Anchor-Based 6D Object Pose Estimation	33
<i>Zehao Liu, Hao Wang, Fuchang Liu</i>	
Shot Segmentation Method Based on Image Similarity and Deep Residual Network	41
<i>Baolin Ming, Desheng Lyu, Dengsha Yu</i>	
Research on Real-Time Rendering of Reflection Caustics in Water Scenes	46
<i>Huiling Guo, Sai Wang, Yong Tang, Ying Li, Jing Zhao</i>	
Semantic-Driven 3D Scene Construction Based on Spatial Relationship and Case-Base	54
<i>Hui Liang, Kailu Lv, Yusheng Sun, Qian Zhang, Mingge Pan, Jian Chang</i>	
DeblurSLAM: A Novel Visual SLAM System Robust in Blurring Scene	62
<i>Jiandong Guo, Rongrong Ni, Yao Zhao</i>	

▶ **Computer Graphics and Image Application**

Video–Geographic Scene Fusion Expression Based on Eye Movement Data 69
Xiaozhi Wang, Yujia Xie, Xing Wang

User Interface Research in Web Extended Reality..... 76
Yongkang Xing, Jethro Shell, Conor Fahy, Kexin Guan, Qian Zhang, Tiande Xie

Hand Pose Estimation from RGB Images Based on Deep Learning: A Survey 82
Yang Liu, Jie Jiang, Jiahao Sun

An Approach to Dynamic Gesture Recognition Based on Instantaneous Posture..... 90
Xizhong Yang, Kaiqi Chen, Huagen Wan

Kernel Attention Based Multi-scale Adaptive Graph Convolutional Neural Network for Skeleton-Based 96
Yanan Liu, Hao Zhang, Dan Xu

Autonomous Landing Point Retrieval Algorithm for UAVs Based on 3D Environment Perception..... 104
Zhanpeng Gan, Huarong Xu, Yuanrong He, Wei Cao, Guanhua Chen

A Novel Extrinsic Calibration Method of a Camera-And-LiDAR System..... 109
Yujian Cai, Yinwei Zhan, Wanting Deng

3D Reconstruction of Weak Feature Indoor Scenes Based on Hector SLAM and Floorplan Generation 117
Xuan Zhang, Zheng Fang, Zhengda Lu, Jun Xiao, Xiaolong Cheng, Xiaopeng Zhang

Motion Estimation with L_0 Norm Regularization 127
Jun Chen, Zemin Cai, Xiaohua Xie, Jianhuang Lai

▶ **Virtual Technology and Human-Computer Interaction**

A Comparative Performance Study on Immersive Analytics to Support Everyday Use 135
Bo Sun, Benjamin Weidner, Aleksandr Fritz

Real-Time Virtual Simulation and Motion Realization of Electric Drive Vehicle Based on Virtual Reality Fusion 144
Changle Sun, Qinwen Jiang, Hongwang Du, Jiajia Wang, Wei Xiong

Gamification of Upper Limb Virtual Rehabilitation in Post Stroke Elderly Using SilverTune- A Multisensory Tactile Musical Assistive System..... 149
Zhiqiang Luo, Ponraj Durairaj, Cheng Mun Lau, Yuichiro Katsumoto, Ellen Yi-Luen Do, Ahmad Sapon Bin Zainuddin, Kensaku Kawauchi

Haptic Simulation System for Liver Surgery Based on Variable Virtual Stiffness Optimization 156
Yi Li, Xinhua Zhou, Hong Li, Ledan Qian

The Evaluation Framework of User Experience in Educational Virtual Reality Games: The Case of ilab-x Platform.....	161
<i>Wuheng Zuo, Ziru Wu, Zhaohao Lu, Qing Liu</i>	
Research on the Application of Immersive Early Childhood Education.....	166
<i>Zhigeng Pan, Zhixiang Huang, Kaige Gui, Zhengwei Yao</i>	
VR Implementation in User-Interactive Simulation Environments.....	172
<i>Nickolas DeVito, Lucien Ngalamou</i>	
Children’s Early Educational Game under the Background of Chinese Three Kingdoms Culture — To Borrow Arrows with Thatched Boats	180
<i>Hui Liang, Fanyu Bao, Yusheng Sun, Qian Zhang, Mingge Pan, Jian Chang</i>	
► Virtual Technology and Application	
Research on Swimming Training Based on Numerical Simulation and VR Technology	189
<i>Zhiya Chen, Tianzeng Li, Jin Yang</i>	
Design and Implementation of a Virtual Costume Museum	194
<i>Shang Shuyuan, Tian Xia</i>	
Comparative Analysis of Circuit Gait Training vs Virtual Reality Based Gait Training in Improving Gait among Stroke Patients	202
<i>Ain Quratul, AslamMemoona, Ahmad Zafran, Malik Arshad Nawaz, Tian Liu, Jue Wang</i>	
The Development of Port Safety Training Platform Based on Virtual Reality Technology.....	207
<i>Weikai Liu, Lingpeng Cheng, Zhiping Liu, Yanfang Yang, Li Li</i>	
Implications of the Use of Virtual Reality in Heritage Conservation.....	215
<i>Anna Vichnevetskaia</i>	
User Embodiment Comparison of Semi-Autonomous and Fully-Captured Avatar Movements in Virtual Reality.....	223
<i>Thomasset Vincent, Weistroffer Vincent, Fraise Philippe</i>	
Head-Movement Analysis of 360° Affective Experience	231
<i>Minaxi Goel, Priyanka Srivastava, Mayank Agrawal, Rishabh Singhal, Runa Chand, Arayil Ramesh Bajjesh</i>	
VR Technology and Application in Martial Arts	240
<i>Zeng Yuqing, Cao Mingliang, Zhang Haoyang, Zhong Yong</i>	
Research on Gesture Recognition and Interaction of Virtual Collaborative Disassembly Training.....	246
<i>Zhaoyong Hu, Shuquan Sun, Yueming Wu, Hansheng Yan, Teng Zhu</i>	
Research of VR-BCI and Its Application in Hand Soft Rehabilitation System	254
<i>Chen Pengcheng, Gao Nuo</i>	

▶ **Virtual Reality and Virtual Technology**

Visual Fatigue Assessment Model Based on Eye-Related Data in Virtual Reality 262
Xiao-lin Chen, Wen-jun Hou

User Visual Attention Behavior Analysis and Experience Improvement in Virtual Meeting 269
Ding Bohao, Lyu Desheng

Space Make the Virtual a Reality: A Web-Based Platform for Visualization and Analysis with Earth Observation Satellite Data..... 279
Wei Wan, Zhenkun Yang, Xingqiang Du, Xinwei Zhao

Virtual Tutor and Exploratory Guidance Environment in Virtual Experiment..... 286
Li Yongheng, Cao Mingliang, Xu Huyu, Zeng Yuqing, Pan Zhigeng

Research on the Central Integration Technology for the Rehabilitation of Lower Limb Based on the Virtual Environment 293
Zewei Li, Zhaoyong Hu, Yingping Jiang, Xiaoya Zhang, Hanwu He

Virtual Reality in Foreign Language Learning: A Review of the Literature..... 302
Ming Li, Zhigeng Pan, Yawen Sun, ZhengWei Yao

Spatial Knowledge Acquisition in Virtual and Physical Reality: A Comparative Evaluation 308
Diego Monteiro, Xian Wang, Hai-Ning Liang, Yiyu Cai

Virtual Reality Training Environment for Electric Systems 314
Zhenjun Jiang, Yang Yang, Qingshu Yuan, Pengfei Leng, Yanyan Liu, Zhigeng Pan

Design and Realization of Production Practice System for Tandem Hot Strip Rolling Based on VR 319
Youzhao Sun, Jiaqi Chen, Quan Yang

▶ **Augmented Reality**

An Interactive Mixed Reality Platform for Inquiry-Based Education 324
Yongning Zhu, Zeru Lou, Ting Ge, Tianxiang Wu, Yuxi Wang, Tianran Tan, Jianmin Wang

An Improved YOLOv3 Object Detection Network for Mobile Augmented Reality 332
Quanyu Wang, Zhi Wang, Bei Li, Dejian Wei

Research on Interaction Design of Chemical Inquiry Virtual Experiment Based on Augmented Reality Technology 340
Ge Ting, Wang Jianmin, Zhu Yongning, Chen Qiuyu

Attention-Enhanced CNN for Chinese Calligraphy Styles Classification..... 352
Jiulong Zhang, Wenhong Yu, Zhixiao Wang, Junhuai Li, Zhigeng Pan

An Intelligent Filling Method for Answers Based on Augmented Reality	359
<i>Ye Lili, Yang Pengfei, Teng Guodong, Ding Dandan, Yao Zhengwei</i>	
Real-Time Instance Segmentation Tracking Algorithm in Mixed Reality	368
<i>Dengsha Yu, Zifei Yan, Baolin Ming</i>	
Research on Augmented Reality Technology of Helicopter Aided Navigation Based on Lidar	373
<i>Liu Kai, Li Jun-Jie, Wu Jing, Wu Xiao-Jun</i>	
Evaluating an Augmented Reality-Based Partially Assisted Approach to Remote Assistance in Heterogeneous Robotic Applications	380
<i>Davide Calandra, Alberto Cannavo, Fabrizio Lamberti</i>	
▶ Electronic Information Technology and Engineering	
A Lightweight Network for Outdoor Illumination Estimation on Mobile Devices	388
<i>Fuyu Ma, Yinwei Zhan, Haidong Gao</i>	
The Design of a Tangible Table Based on an Array of Vertically Moving Blocks	394
<i>Seyed Ebrahim Esmaeili, Asma Lulu, Fay Sharar, Farah Kheder, Reham Kablaoui</i>	
Research on Improvement and Optimization of Washout Algorithm for Moving Platform Navigation Simulator	400
<i>Yufei Wang, Xiaofeng Sun, Helong Shen, Yong Yin</i>	
Real Time Hand Gesture Recognition Applied for Flight Simulator Controls.....	407
<i>Zhuang Qianzheng, Li Xiaodong, Ren Jie, Qiao Yuanyuan</i>	
An Improved MPS Method for Fluid Simulation of Dam Break	412
<i>Feng Bian, Xiaofeng Sun, Senhao Wang</i>	
Development and Application of Marine Environment Data Visualization Technology	420
<i>Jun Fu, Teng Lv</i>	
An Improved GRU Network for Human Motion Prediction.....	427
<i>Weijie Yu, Rui Liu, Dongsheng Zhou, Qiang Zhang, Xiaopeng Wei</i>	
Historical Data Trend Analysis in Extended Reality Education Field	434
<i>Yongkang Xing, Zhanti Liang, Jethro Shell, Conor Fahy, Kexin Guan, Bingnan Liu</i>	
The Technology of Mixing Blood and Water Based on SPH.....	441
<i>Wei Zeng, Zelong Zhang, Yanni Zou</i>	
A Virtual Companion Empty-Nest Elderly Dining System Based on Virtual Avatars	446
<i>Rui Dai, Zhigeng Pan</i>	

Author Index