

2020 22nd Symposium on Virtual and Augmented Reality (SVR 2020)

**Porto de Galinhas, Brazil
7-10 November 2020**



IEEE Catalog Number: CFP2029P-POD
ISBN: 978-1-7281-9232-1

**Copyright © 2020 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:	CFP2029P-POD
ISBN (Print-On-Demand):	978-1-7281-9232-1
ISBN (Online):	978-1-7281-9231-4

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

2020 22nd Symposium on Virtual and Augmented Reality (SVR) **SVR 2020**

Table of Contents

Message from the General Chairs	xiii
Message from the Program Chairs	xiv
Message from the Tutorial Chairs	xv
Message from the Graduate Workshop Chairs	xvi
Message from the Workshop of Undergraduate Works Chairs	xvii
Message from the Pre-Symposium Chairs	xviii
Message from the Labs Presentation Chairs	xxix
Message from the XR eXperience Chairs	xx
Organizing Committee	xxi
Program Committee	xxii
Steering Committee	xxiv
Sponsors, Supporters, Organization	xxv

Session 1 - VR and AR Applications (In Portuguese)

Virtual Reality and Augmented Reality Applications in Agriculture: A Literature Review	1
<i>Monique Emídio de Oliveira (Universidade Tecnológica Federal do Paraná) and Cléber Gimenez Corrêa (Universidade Tecnológica Federal do Paraná)</i>	
Topological and Tactical Study of Terrains Modeled into a Synthetic Training Environment as a Military Educational Resource	10
<i>Raphael de Souza e Almeida (PUC-Rio), Greis Francy M. Silva-Calpa (PUC-Rio), Alexandre de Menezes Villarmosa (Marinha do Brasil), and Alberto Barbosa Raposo (PUC-Rio)</i>	
A Mapping of Visual SLAM Algorithms and Their Applications in Augmented Reality	20
<i>João Pedro Mucheroni Covolan (Universidade Estadual Paulista), Antonio Carlos Sementille (Universidade Estadual Paulista), and Silvio Ricardo Rodrigues Sanches (Universidade Tecnológica Federal do Paraná)</i>	
Laban Movement Analysis Applied to Human-Computer Interaction	30
<i>Rafael Suarez Ziegelmaier (Instituto Federal de Pernambuco), Walter Correia (Universidade Federal de Pernambuco), João Marcelo Teixeira (Universidade Federal de Pernambuco), and Francisco P. M. Simões (Instituto Federal de Pernambuco)</i>	
Volume Rendering: An Analysis Based on the HoloLens Augmented Reality Device	35
<i>Lucas S. O. Rezende (Centro Universitário Senai Cimatec), Paulo H. M. Sá (Centro Universitário Senai Cimatec), Márcio C. F. Macedo (Universidade Federal da Bahia), Antônio L. Apolinário Jr. (Universidade Federal da Bahia), Ingrid Winkler (Centro Universitário Senai Cimatec), and Marcelo A. Moret S. G. (Centro Universitário Senai Cimatec)</i>	

Session 2 - VR Evaluation and Testing

Eye-Tracking Data Analysis for Visual Exploration Assessment and Decision Making Interpretation in Virtual Reality Environments .39.....	<i>Abner Cardoso da Silva (Pontifical Catholic University of Rio de Janeiro), Cesar A. Sierra-Franco (Pontifical Catholic University of Rio de Janeiro), Greis Francy M. Silva-Calpa (Pontifical Catholic University of Rio de Janeiro), Felipe Carvalho (Pontifical Catholic University of Rio de Janeiro), and Alberto Barbosa Raposo (Pontifical Catholic University of Rio de Janeiro)</i>
Virtual Look Around: Interaction Quality Evaluation for Virtual Tour in Multiple Platforms.47..	<i>Adriel Rodrigues (Federal University of Pampa) and Jean Felipe Patikowski Cheiran (Federal University of Pampa)</i>
Understanding VR Software Testing Needs from Stakeholders' Points of View .57.....	<i>Stevão A. Andrade (Universidade de São Paulo), Alvaro Joffre U. Quevedo (Ontario Tech University Oshawa), Fatima L. S. Nunes (Universidade de São Paulo), and Márcio E. Delamaro (Universidade de São Paulo)</i>
Virtual Reality on Product Usability Testing: A Systematic Literature Review .67.....	<i>Fabio Freitas (Centro Universitário SENAI CIMATEC), Ingrid Winkler (Centro Universitário SENAI CIMATEC), Marcus Gomes (Centro Universitário SENAI CIMATEC), and Henrique Gomes (Independent)</i>
Investigating Users' Natural Engagement with a 3D Design Approach in an Egocentric Vision Scenario .74.....	<i>Eder de Oliveira (Fluminense Federal University), Esteban Walter Gonzalez (Fluminense Federal University), Daniela Gorski Trevisan (Fluminense Federal University), and Luciana Cardoso de Castro Salgado (Fluminense Federal University)</i>

Session 3 - Learning and Training

Virtual Playground: An Augmented Reality Application to Improve English Learning .83.....	<i>Luís F. B. Pereira (Federal University of Pernambuco), Manoela M. O. da Silva (Federal University of Pernambuco), Rafael A. Roberto (Federal University of Pernambuco), Veronica Teichrieb (Federal University of Pernambuco), and Patricia Smith Cavalcante (Federal University of Pernambuco)</i>
The Effect of Virtual Reality on Knowledge Transfer and Retention in Collaborative Group-Based Learning for Neuroanatomy Students .92.....	<i>Vinicius Souza (Federal University of Rio Grande do Sul), Anderson Maciel (Federal University of Rio Grande do Sul), Luciana Nedel (Federal University of Rio Grande do Sul), Regis Kopper (University of North Carolina at Greensboro), Klaus Loges (University of Vale do Rio dos Sinos), and Eliane Schlemmer (University of Vale do Rio dos Sinos)</i>
AVRA: Virtual Learning Environment with Virtual Reality Capabilities .102.....	<i>Daniel B. Domingueti (Federal University of São João del-Rei), Diego R. C. Dias (Federal University of São João del-Rei), and Dárlinton B. F. Carvalho (Federal University of São João del-Rei)</i>
A Proposed Learning Content for Teaching Handheld Augmented Reality in a Classroom Setting..111	<i>Neil Patrick Del Gallego (De La Salle University)</i>

Virtual Reality System for Industrial Motor Maintenance Training	.119.....
<i>Tainá Ribeiro de Oliveira (Instituto Federal do Espírito Santo), Tiago Fonseca Martinelli (Instituto Federal do Espírito Santo), Bianca Pina Bello (Instituto Federal do Espírito Santo), Juliana Davel Batista (Instituto Federal do Espírito Santo), Matheus Moura da Silva (Instituto Federal do Espírito Santo), Brenda Biancardi Rodrigues (Instituto Federal do Espírito Santo), Rafael Antonio N. Spinassé (Instituto Federal do Espírito Santo), Rodrigo Varejão Andreão (Instituto Federal do Espírito Santo), Mário Mestria (Instituto Federal do Espírito Santo), and Marcelo Queiroz Schimidt (Instituto Federal do Espírito Santo)</i>	
Augmented Reality in Medical Teaching-Learning Process Content: A Systematic Review	.129..
<i>Isabela Bianchi (Universidade de Passo Fundo), Alexandre Lazaretti Zanatta (Universidade de Passo Fundo), and Rafael Rieder (Universidade de Passo Fundo)</i>	

Session 4 - Health Applications

Proxy Haptics for Surgical Training	.134.....
<i>Mahdi Rahmani Hanzaki (University of Alberta) and Pierre Boulanger (University of Alberta)</i>	
Real-Time Approach for Gait Analysis using the Kinect v2 Sensor for Clinical Assessment Purpose	.144.....
<i>Alexandre de Queiroz Burle (Universidade Federal de Pernambuco), Thiago Buarque de Gusmao Lafayette (Universidade Federal de Pernambuco), José Roberto Fonseca (Universidade Federal de Pernambuco), Veronica Teichrieb (Universidade Federal de Pernambuco), and Alana Elza Fontes Da Gama (Universidade Federal de Pernambuco)</i>	
Minimizing Cybersickness in Head-Mounted Display Systems: Causes and Strategies Review	.154
<i>Thiago Porcino (Universidade Federal Fluminense, ISI SVP Firjan), Daniela Trevisan (Universidade Federal Fluminense), and Esteban Clua (Universidade Federal Fluminense)</i>	
Juxtopia® CAMMRAD Prepare: A Wearable AI-AR Platform for Clinical Training Emergency First Response Teams	.164.....
<i>Jayfus T. Doswell (The Juxtopia Group, Inc.), Justin Johnson (The Juxtopia Group, Inc.), Brandon Brockington (The Juxtopia Group, Inc.), Aaron Mosby (The Juxtopia Group, Inc.), Saboor Salaam (The Juxtopia Group, Inc.), and Arthur Chinery (The Juxtopia Group, Inc.)</i>	
Low Back Pain Attenuation Employing Virtual Reality Physiotherapy	.169.....
<i>Tatiana Ortegon-Sarmiento (Universidad Militar Nueva Granada), Lima Penuela (Universidad Militar Nueva Granada), and Alvaro Uribe-Quevedo (Ontario Tech University)</i>	
REANIME a Neonatal Resuscitation Simulator for Evaluating Team Training	.174.....
<i>Ana Carolina C de Oliveira (Universidade Federal da Paraíba), João Agnaldo Nascimento (Universidade Federal da Paraíba), Sérgio Ribeiro Santos (Universidade Federal da Paraíba), Sandra M. D. de Queiros (Instituto Cândida da Vargas), Patricia Karla G. Brito (Instituto Cândida da Vargas), and Adriana Z. Clericuzi (Universidade Federal da Paraíba)</i>	

Session 5 - XR Applications

Augmented Reality for Manual Assembly in Industry 4.0: Gathering Guidelines .179.....	
<i>Salvador S. Agati (Santa Catarina St. University), Rudieri D. Bauer (Santa Catarina St. University), Marcelo da S. Hounsell (Santa Catarina St. University), and Aleksander S. Paterno (Santa Catarina St. University)</i>	
Manual PCB Assembly using Augmented Reality Towards Total Quality .189.....	
<i>Rudieri Dietrich Bauer (Universidade do Estado de Santa Catarina), Salvador Sergi Agati (Universidade do Estado de Santa Catarina), Marcelo dá Silva Hounsell (Universidade do Estado de Santa Catarina), and André Tavares da Silva (Universidade do Estado de Santa Catarina)</i>	
A Systematic Review of Rapid Prototyping Tools for Augmented Reality .199.....	
<i>Gabriel Freitas (Pontifical Catholic University of Rio Grande do Sul), Marcio Sarroglia Pinho (Pontifical Catholic University of Rio Grande do Sul), Milene Selbach Silveira (Pontifical Catholic University of Rio Grande do Sul), and Frank Maurer (University of Calgary)</i>	
PRISME: Toward a Model Linking Tangible Interaction and Domain-Specific Tasks in Mixed Reality Environments .210.....	
<i>Jean-Michel Fazzari (BCOM, Ecole Nationale d'ingénieur de Brest), Sébastien Kubicki (Ecole Nationale d'ingénieurs de Brest), and Ronan Querrec (Ecole Nationale d'ingénieurs de Brest)</i>	
Analysis of XR Research in Brazil from 21 Years of SVR Publications .220.....	
<i>João Marcelo Teixeira (Universidade Federal de Pernambuco) and Fabiana Frata Furlan Peres (Universidade Estadual do Oeste do Paraná)</i>	

Session 6 - Tracking and 3D Reconstruction

Development of an Efficient 3D Reconstruction Solution from Permissive Open-Source Code .232	
<i>Victor Gouveia de M. Lyra (Universidade Federal de Pernambuco), Adam H. M. Pinto (Universidade Federal de Pernambuco), Gustavo C. R. Lima (Universidade Federal de Pernambuco), João Paulo Lima (Universidade Federal Rural de Pernambuco), Veronica Teichrieb (Universidade Federal de Pernambuco), Jonyberg Peixoto Quintino (Universidade Federal de Pernambuco), Fabio Q. B. da Silva (Universidade Federal de Pernambuco), André L M Santos (Universidade Federal de Pernambuco), and Helder Pinho (SiDi)</i>	
VEM-SLAM - Virtual Environment Modelling through SLAM .242.....	
<i>Gustavo Magalhaes Moura (Federal University of Juiz de Fora), Marcelo Bernardes Vieira (Federal University of Juiz de Fora), and Rodrigo Luis de Souza da Silva (Federal University of Juiz de Fora)</i>	
Comparison of RGB-D Sensors for 3D Reconstruction .252.....	
<i>José Gomes da Silva Neto (Universidade Federal de Pernambuco), Pedro Jorge da Lima Silva (Universidade Federal de Pernambuco), Filipe Figueiredo (Universidade Federal de Pernambuco), João Marcelo Xavier Natário Teixeira (Universidade Federal de Pernambuco), and Veronica Teichrieb (Centro de Informática)</i>	
Comparing Algorithms for Accurate Tracking in Virtual Reality with a Low-Cost MIMU .262..	
<i>Júlia Tannús (Federal University of Uberlândia) and Eduardo Naves (Federal University of Uberlândia)</i>	
Optimizing and Automating Computerized Photogrammetry for 360° 3D Reconstruction .267..	
<i>Júlia Tannús (Federal University of Uberlândia)</i>	

Comparison of OpenCV Tracking Algorithms for a Post-Stroke Rehabilitation Exergame .272...
Júlia Tannús (Federal University of Uberlândia)

Session 7 - Games in Health (In Portuguese)

- A Serious Game using Virtual Reality for Treatment of Amblyopia .277.....
Alex Silva do Prado (Instituto Militar de Engenharia) and Jauvane C. de Oliveira (Laboratório Nacional de Computação Científica)
- LABORAL: A Hand Stretching Game Using Gesture-Interactions .285.....
Samantha de Carvalho Rodrigues (Universidade de Fortaleza), Yvens Reboucas Serpa (Saxion University of Applied Sciences), Maria Andreia Formico Rodrigues (Universidade de Fortaleza), and Maria Socorro Pequeno Leite Alves (Universidade de Fortaleza)
- Game Over: Death Representations in Virtual Reality Environments .296.....
Vinícius Ferreira Galvão (Universidade Federal de Mato Grosso), Rayane Vitorassi Toledo (Universidade Federal de Mato Grosso), Danilo Barros dos Santos (Universidade Federal de Mato Grosso), Cristiano Maciel (Universidade Federal de Mato Grosso), and Eunice Pereira dos Santos Nunes (Universidade Federal de Mato Grosso)
- Application of Serious Games Based on Virtual Reality for Rehabilitation of Patients with Parkinson's Disease through a Wrist Orthosis .306.....
Luciene Chagas de Oliveira (Universidade Federal de Uberlândia), Edgard Afonso Lamounier Jr. (Universidade Federal de Uberlândia), Adriano Oliveira Andrade (Universidade Federal de Uberlândia), Renato Aquino Lopes (Universidade Federal de Uberlândia), Samila Carolina da Costa (Universidade Federal de Uberlândia), Igor Silvano de Oliveira (Universidade de Uberaba), José Antonio Serra Carneiro (Universidade Federal de Uberlândia), Pedro Daibert (Universidade de Uberaba), and Alexandre Cardoso (Universidade Federal de Uberlândia)

Session 8 - Virtual Environments

- Virtual Reality Simulations for Hospital Fire Evacuation: A Systematic Literature Review .313.
Victor Biagiotti Saint Martin (Fédéral University of Überlândia), Eduardo Gabriel Queiroz Palmeira (Federal University of Überlândia), Victor Barbosa Gonçalves (Federal University of Überlândia), Leonardo Nery Carrijo dos Santos (Federal University of Überlândia), José Júlio Morais Melazzo (Federal University of Überlândia), Edgard Afonso Lamounier Jr. (Federal University of Überlândia), and Alexandre Cardoso (Federal University of Überlândia)
- Components of the LMA as a Design Tool for Expressive Movement and Gesture Construction321
Rafael Suarez Ziegelmaier (Instituto Federal de Pernambuco), Walter Correia (Universidade Federal de Pernambuco), João Marcelo Teixeira (Universidade Federal de Pernambuco), and Francisco P. M. Simões (Instituto Federal de Pernambuco)
- Escape Room Virtual Reality: A Tool for Diagnosis and Treatment of Attention Deficit Disorder .331.....
Andrés Felipe Bejarano (Universidad de los Andes), Juan Diego Correa (Universidad de los Andes), and Pablo Figueroa (Universidad de los Andes)

Automotive Marketing Research and Virtual Reality: A Systematic Literature Review .339.....	
<i>Alexandre Henriques (Centro Universitário SENAI CIMATEC) and Ingrid Winkler (Centro Universitário SENAI CIMATEC)</i>	
Spring Stepper: A Seated VR Locomotion Controller .346.....	
<i>Christopher Carmichael (Ontario Tech University), Marco Valdez Balderas (Ontario Tech University), Bill Ko (Ontario Tech University), Atiya Nova (Ontario Tech University), Angela Tabafunda (Ontario Tech University), and Alvaro Uribe-Quevedo (Ontario Tech University)</i>	
Prototyping Virtual Reality Interactions in Medical Simulation Employing Speech Recognition .351.....	
<i>Jacky Yang (Ontario Tech University), Michael Chan (Ontario Tech University), Alvaro Uribe-Quevedo (Ontario Tech University), Bill Kapralos (Ontario Tech University), Norman Jaimes (Universidad Militar Nueva Granada), and Adam Dubrowski (Ontario Tech University)</i>	

Session 9 - Health Applications (In Portuguese)

Virtual Acupuncture System Based on Physics Engine and Force Feedback .356.....	
<i>Pedro Paulo Macedo Neto (Universidade de Fortaleza), Marie C. L. Nasser Aguiar (Instituto de Prevencao do Cancer do Ceara), and Maria Andreia Formico Rodrigues (Universidade de Fortaleza)</i>	
Virtual Reality in Postural Therapy: A Systematic Review .363.....	
<i>Igor Andrade Moraes (Federal University of Uberlandia), Eduardo Gabriel Queiroz Palmeira (Federal University of Uberlandia), Marianna Ferreira Andrade (Federal University of Uberlandia), Edgard Afonso Lamounier Jr. (Federal University of Uberlandia), and Alexandre Cardoso (Federal University of Uberlandia)</i>	
Virtual Environments for Therapeutic Rehabilitation .371.....	
<i>Raquel Ellem Marcelino de Oliveira (Laboratório Nacional de Computação Científica), Carina da Cruz Teixeira (Laboratório Nacional de Computação Científica), and Jauvane Cavalcante de Oliveira (Laboratório Nacional de Computação Científica)</i>	
Serious Game for Chronic Subdural Hematoma Neurosurgery using Virtual Reality .381.....	
<i>Antonio Tales Faustino da Silva (Universidade de Uberaba), José Antonio Serra Carneiro (Universidade de Uberaba), Luciene Chagas de Oliveira (Universidade de Uberaba), Arthur Dourado Amaral (Universidade de Uberaba), Mackley Magalhães da Silva (Universidade de Uberaba), Ramon Gaspar Andrade (Universidade Federal de Uberlândia), and Victor Aparecido Pereira (Universidade de Uberaba)</i>	
Evolution of VRET to Assist in the Treatment of Phobias: A Systematic Review .386.....	
<i>Julie S. Pereira (Instituto Federal do Sudeste de Minas Gerais), Leonardo M. Faêda (Universidade Federal de Viçosa), and Alessandra M. Coelho (Instituto Federal do Sudeste de Minas Gerais)</i>	

Session 10 - Rendering and Visualization

ARRay-Tracing - A Middleware to Provide Ray Tracing Capabilities to Augmented Reality Libraries .391.....	
<i>Lidian T. Pereira (Federal University of Juiz de Fora), Wellington Cataldo R. Junior (Federal University of Juiz de Fora), Jairo F. Souza (Federal University of Juiz de Fora), and Rodrigo L. S. Silva (Federal University of Juiz de Fora)</i>	

Rendering Optimizations for Virtual Reality Using Eye-Tracking	398
<i>Shawn Matthews (Ontario Tech University), Alvaro Uribe-Quevedo (Ontario Tech University), and Alexander Theodorou (NeuroFit VR Inc.)</i>	
Photorealism in Low-Cost Virtual Reality Devices	406
<i>Wellington Cataldo R. Junior (Federal University of Juiz de Fora), Lidiane T. Pereira (Federal University of Juiz de Fora), Marcelo F. Moreno (Federal University of Juiz de Fora), and Rodrigo L. S. Silva (Federal University of Juiz de Fora)</i>	
Authoring and Visualization Tool for Augmented Scenic Performances Prototyping and Experience	413
<i>Victor Rogério Sousa Ferreira (Universidade Federal do Maranhão), Lisle Faray de Paiva (Universidade Federal do Maranhão), Anselmo Cardoso de Paiva (Universidade Federal do Maranhão), Regis Costa de Oliveira (Universidade de Lisboa), Mónica Sofia Santos Mendes (Universidade de Lisboa), and Ivana Marcia Oliveira Maia (Federal Institute of Education, Science, and Technology of Maranhao)</i>	
Moveillance: Visualizing Electric Machines	420
<i>Steve Mann (MannLab Canada), Danson Evan Garcia (University of Toronto), Phillip V. Do (University of Toronto), Derek Lam (MannLab Canada), and Pete Scourboutakos (MannLab Canada)</i>	

Session 11 - Machine Learning in VR and Ergonomics

Autonomous Foraging with SARSA-Based Deep Reinforcement Learning	425
<i>Anderson Mesquita (Federal University of Ceará), Yuri Nogueira (Federal University of Ceará), Creto Vidal (Federal University of Ceará), Joaquim Cavalcante-Neto (Federal University of Ceará), and Paulo Serafim (Instituto Atlântico)</i>	
Helicopter Visual Signaling Simulation: Integrating VR and ML into a Low-Cost Solution to Optimize Brazilian Navy Training	434
<i>Antônio L. C. Doneda (Instituto Militar de Engenharia) and Jauvane C. de Oliveira (Laboratório Nacional de Computação Científica)</i>	
3D Visualization of Temporal Data: Exploring Visual Attention and Machine Learning	443
<i>Leonardo Souza Silva (Escola Politécnica da Universidade de São Paulo), Renan Vinicius Aranha (Escola Politécnica da USP), Matheus A. O. Ribeiro (Escola de Artes, Ciências e Humanidades da Universidade de São Paulo), Ricardo Nakamura (Escola Politécnica da Universidade de São Paulo), and Fatima L. S. Nunes (Escola de Artes, Ciências e Humanidades da Universidade de São Paulo)</i>	
A Tracker Selection Model for Augmented Reality Applications	453
<i>João Marcelo Teixeira (Universidade Federal de Pernambuco) and Veronica Teichrieb (Universidade Federal de Pernambuco)</i>	
Ergonomic Analysis Supported by Virtual Reality: a Systematic Literature Review	463
<i>Adailton Gonçalves da Silva (Centro Universitário SENAI CIMATEC), Ingrid Winkler (Centro Universitário SENAI CIMATEC), Marcus Mendes Gomes (Centro Universitário SENAI CIMATEC), and Ubiratan Melo Pinto Junior (Universidade Federal da Bahia)</i>	
Virtual Reality and Human-Centred Workplace Design: Practices of Workers and Ergonomists	479
<i>Florence Bazzaro (UBFC - UTBM), Sébastien Chevriaux (UBFC - UTBM), and Marjorie Charrier (UBFC - UTBM)</i>	