Italian Resuscitation Council

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Federico Semeraro, FERC
Ospedale Maggiore Bologna

VIRTUAL REALITY

Italian Resuscitation Council

Disclosure

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Italian Resuscitation Council

EUROPEAN RESUSCITATION COUNCIL

EuReCa TWO European Registry of Cardiac arrest

President Italian Resuscitation Council
Educational Committee (SEC) BLS co-chair ERC
FERC European Resuscitation Council
EuReCa National Coordinator
A breathtaking picnic and Relive Project Coordinator
Star Wars & Star Trek addicted

Dedicated to the Next Generation

Andrea was born 20th November 2010

20th November 2010 6.35 his first photo with iPhone

23th November 2010 Andrea slept with music from iPod

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Captain's Log

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History of Virtual Reality

Taxonomy of Virtual Reality

Virtual Reality Healthcare & Education

Virtual Reality & CPR

VR CPR AED Italian Resuscitation Council

Future plans

Virtual Reality: definition

"an artificial environment which is experienced through sensory stimuli (as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment."

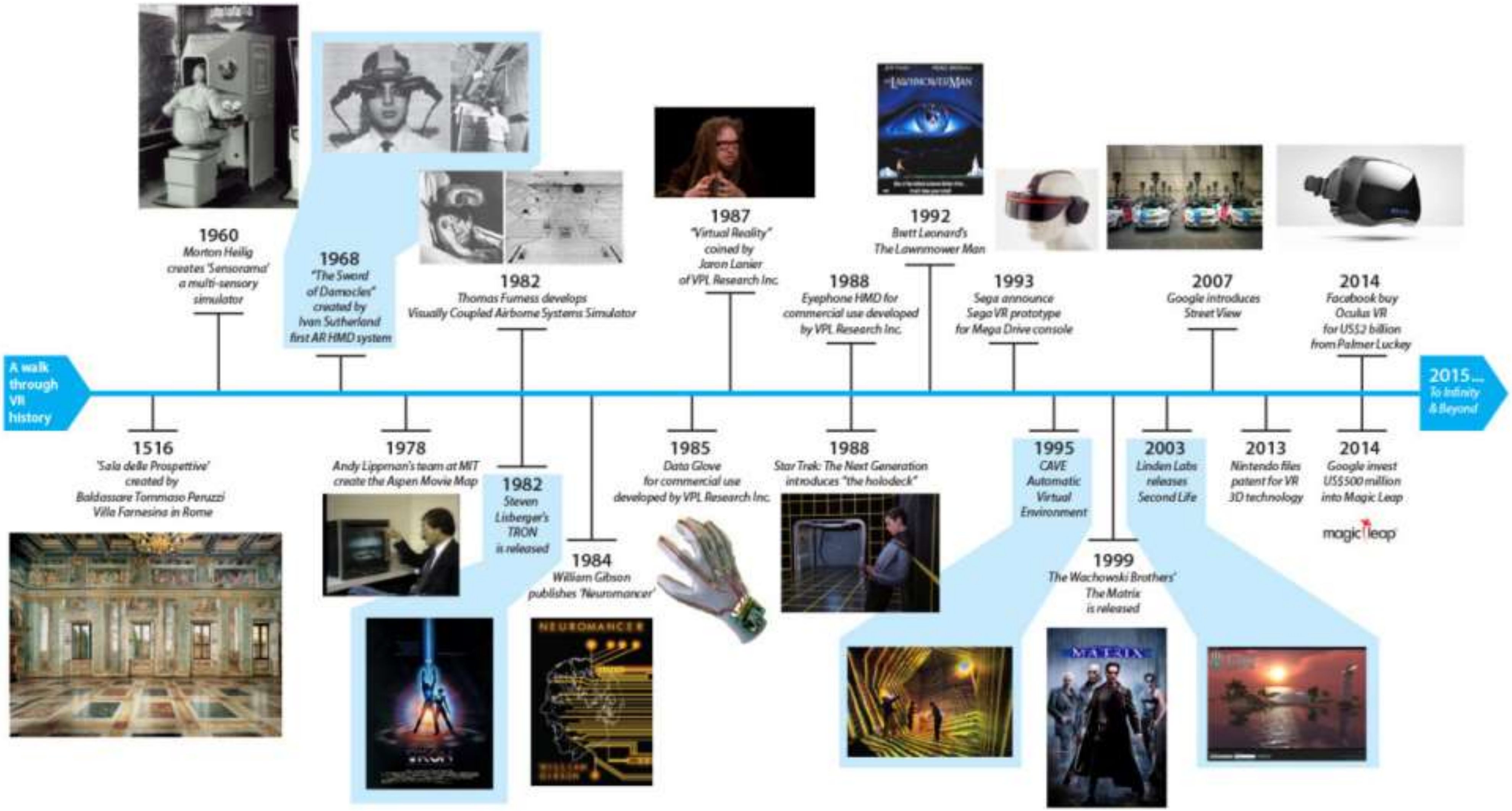
www.merriam-webster.com

Virtual Reality: the Father

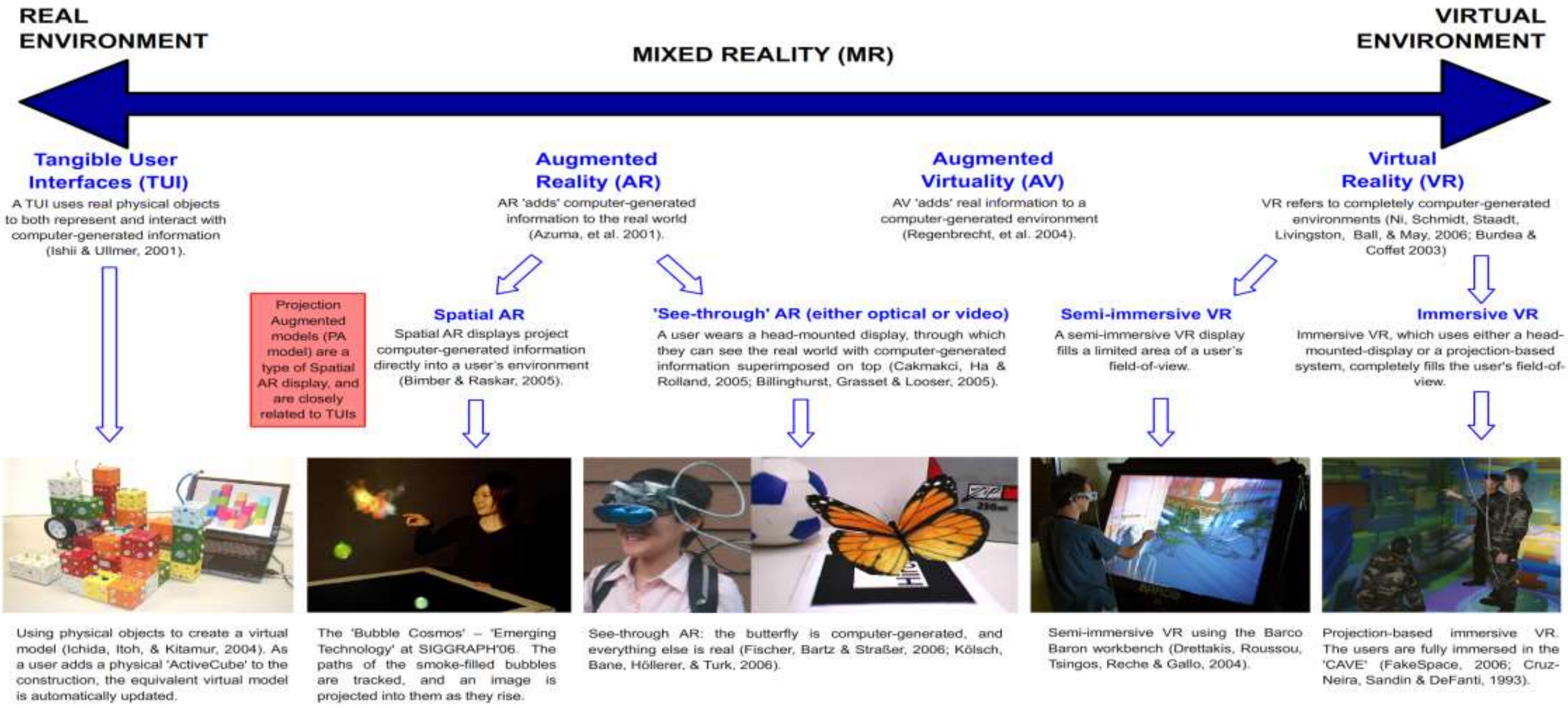
The term 'virtual reality' was coined by Jaron Lanier in 1987 during a period of intense research activity into this form of technology.

www.jaronlanier.com

Virtual Reality History Timeline



Real-virtual continuum



Real-virtual continuum

Milgram, 1994

Augmented Reality vs Virtual Reality

	AR **Ehnances Reality**	**VR** **Replace reality**
Scene generation	Minimal rendering	Requires realistic images
Display devices	Non immersive Small field of view	Fully immersive Wide field of view
Sense of presence Suspension of disbelief	Low	High

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Augmented Reality

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Star Wars, 1977

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Augmented Reality

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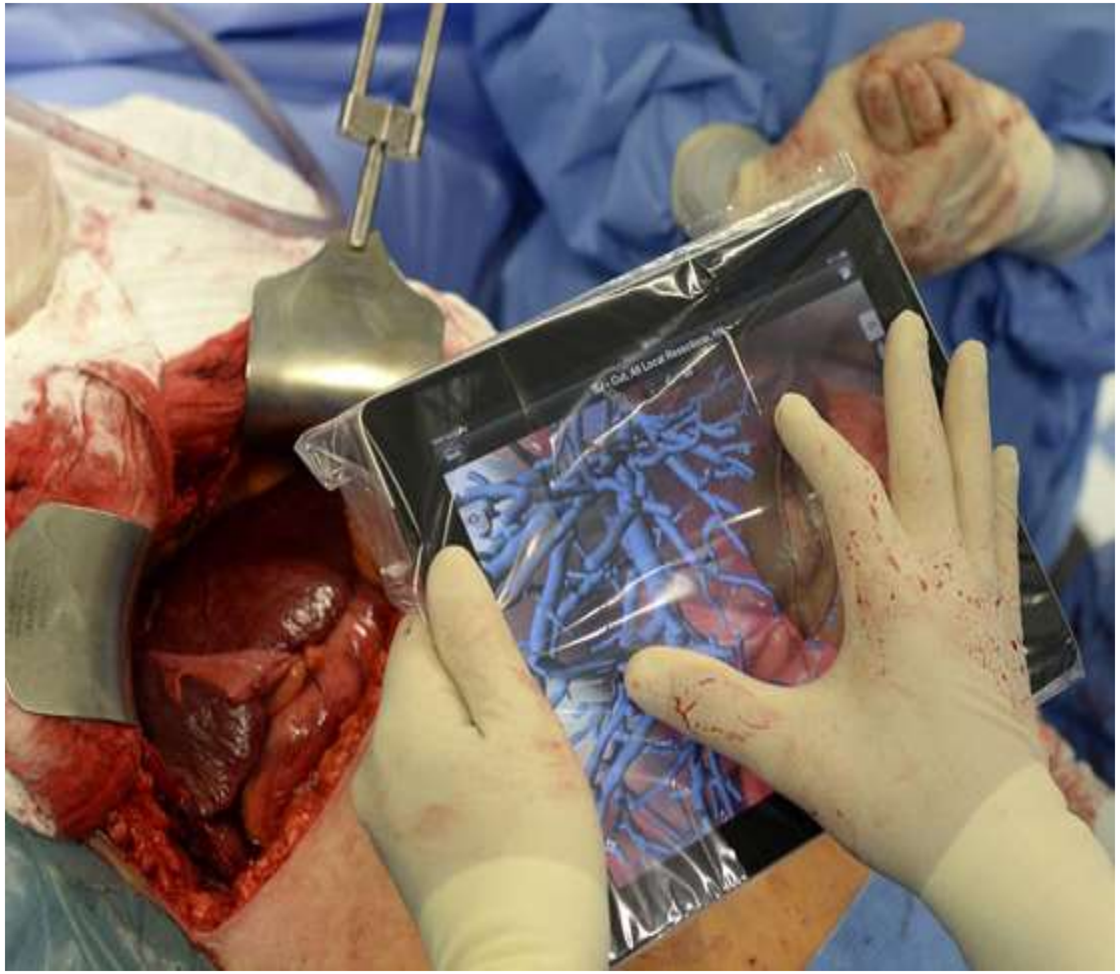
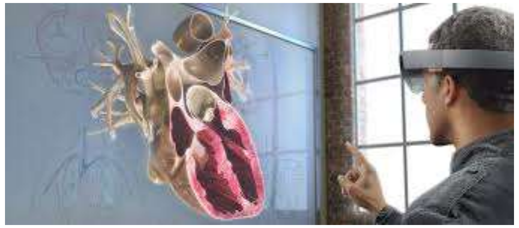
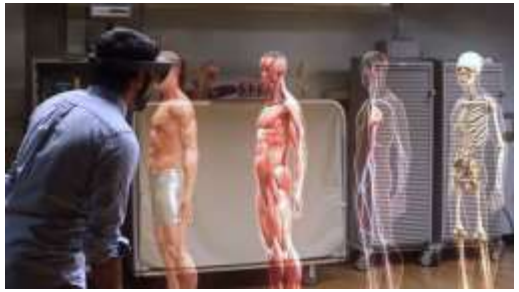
Star Wars, 1977 & Lenovo 2017

Augmented Reality (AR)







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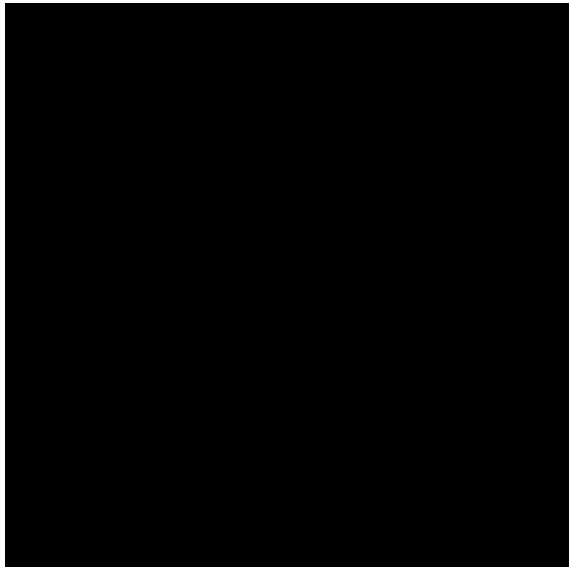
Virtual Reality (VR)





Augmented Reality (AR)



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Virtual Reality (VR)

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VR Advanced Life Support

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Journal of Biomedical Informatics 51 (2014) 49–59

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Journal of Biomedical Informatics

journal homepage: www.elsevier.com/locate/yjbin

Collaborative virtual reality based advanced cardiac life support training simulator using virtual reality principles

Prabal Khanal [a,*], Akshay Vankipuram [a], Aaron Ashby [a], Mithra Vankipuram [b], Ashish Gupta [c], Denise Drumm-Gurnee [d], Karen Josey [d], Linda Tinker [d], Marshall Smith [d]

Background: Advanced Cardiac Life Support (ACLS) is a series of team-based, sequential and time constrained interventions, requiring effective communication and coordination of activities that are performed by the care provider team on a patient undergoing cardiac arrest or respiratory failure. The state-of-the-art ACLS training is conducted in a face-to-face environment under expert supervision and suffers from several drawbacks including conflicting care provider schedules and high cost of training equipment.

Objective: The major objective of the study is to describe, including the design, implementation, and evaluation of a novel approach of delivering ACLS training to care providers using the proposed virtual reality simulator that can overcome the challenges and drawbacks imposed by the traditional face-to-face training method.

Methods: We compare the efficacy and performance outcomes associated with traditional ACLS training with the proposed novel approach of using a virtual reality (VR) based ACLS training simulator. One hundred and forty-eight (148) ACLS certified clinicians, translating into 26 care provider teams, were enrolled for this study. Each team was randomly assigned to one of the three treatment groups: control (traditional ACLS training), persuasive (VR ACLS training with comprehensive feedback components), or minimally persuasive (VR ACLS training with limited feedback components). The teams were tested across two different ACLS procedures that vary in the degree of task complexity: ventricular fibrillation or tachycardia (VFib/VTach) and pulseless electric activity (PEA).

Results: The difference in performance between control and persuasive groups was not statistically significant ($P = .37$ for PEA and $P = .1$ for VFib/VTach). However, the difference in performance between control and minimally persuasive groups was significant ($P = .05$ for PEA and $P = .02$ for VFib/VTach). The pre-post comparison of performances of the groups showed that control ($P = .017$ for PEA, $P = .01$ for VFib/VTach) and persuasive ($P = .02$ for PEA, $P = .048$ for VFib/VTach) groups improved their performances significantly, whereas minimally persuasive group did not ($P = .45$ for PEA, $P = .46$ for VFib/VTach). Results also suggest that the benefit of persuasiveness is constrained by the potentially interruptive nature of these features.

Conclusions: Our results indicate that the VR-based ACLS training with proper feedback components can provide a learning experience similar to face-to-face training, and therefore could serve as a more easily accessed supplementary training tool to the traditional ACLS training. Our findings also suggest that the degree of persuasive features in VR environments have to be designed considering the interruptive nature of the feedback elements.

VR & AR CPR: article

JOURNAL OF MEDICAL INTERNET RESEARCH Creutzfeldt et al

Original Paper

Cardiopulmonary Resuscitation Training in High School Using Avatars in Virtual Worlds: An International Feasibility Study

Johan Creutzfeldt[1], MD; Leif Hedman[1,2], PhD; LeRoy Heinrichs[3], MD, PhD; Patricia Youngblood[4], PhD; Li Felländer-Tsai[1], MD, PhD

[1]Department of Clinical Science, Intervention and Technology, Karolinska Institutet, Stockholm, Sweden
[2]Department of Psychology, Umeå University, Umeå, Sweden
[3]Innovation in Learning, Inc., Los Altos Hills, CA, United States
[4]Division of Clinical Anatomy, Department of Surgery, Stanford University School of Medicine, Palo Alto, CA, United States

JOURNAL OF MEDICAL INTERNET RESEARCH Siebert et al

Original Paper

Adherence to AHA Guidelines When Adapted for Augmented Reality Glasses for Assisted Pediatric Cardiopulmonary Resuscitation: A Randomized Controlled Trial

Johan N Siebert[1*], MD; Frederic Ehrler[2*], PhD; Alain Gervaix[1], MD; Kevin Haddad[1], RN; Laurence Lacroix[1], MD; Philippe Schrurs[3], MD; Ayhan Sahin[3], MD; Christian Lovis[2], MPH, FACMI, MD; Sergio Manzano[1], MD

[1]Geneva Children's Hospital, Department of Pediatric Emergency Medicine, University Hospitals of Geneva, Geneva, Switzerland
[2]Division of Medical Information Sciences, Department of Radiology and Medical Informatics, University Hospitals of Geneva, Geneva, Switzerland
[3]Geneva Medical Center, University Hospitals of Geneva, Geneva, Switzerland

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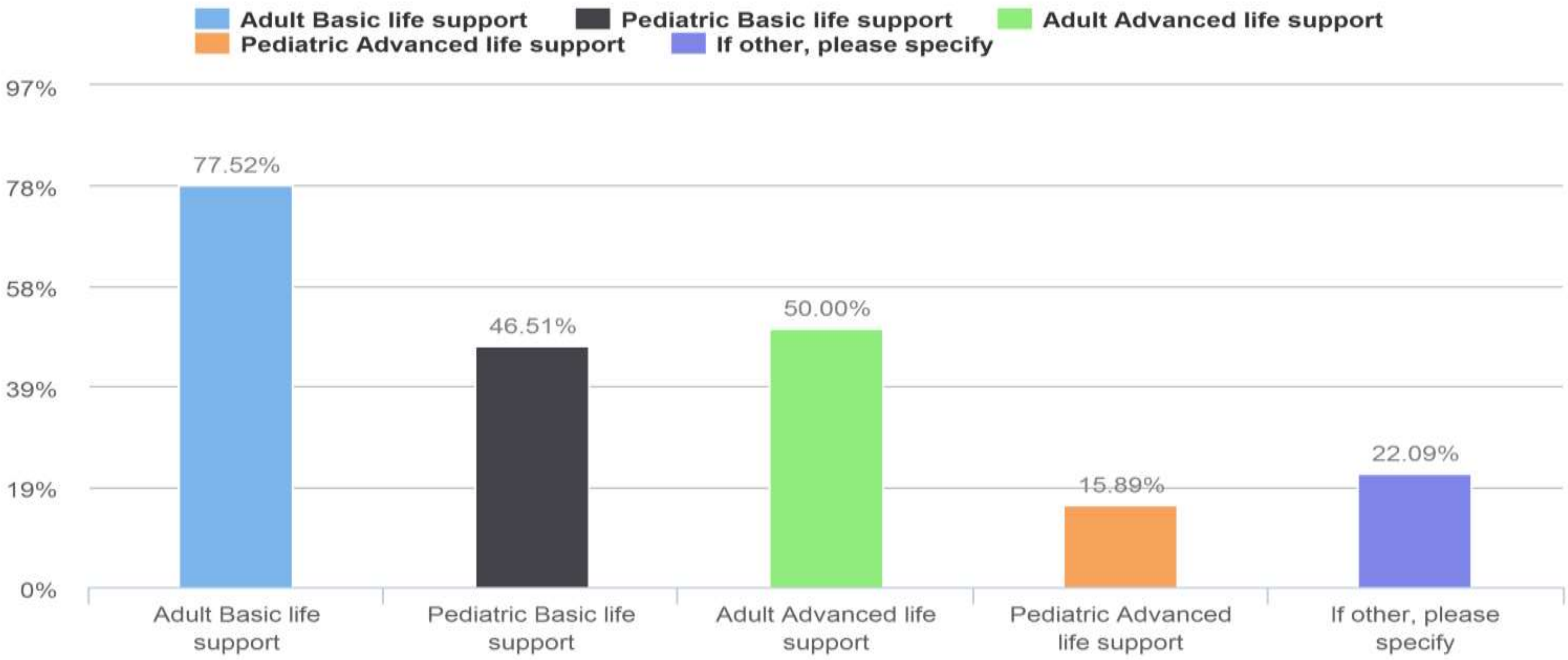
Article in Press

Virtual Reality for CPR training: How cool is that? Dedicated to the "next generation"

Federico Semeraro
Maggiore Hospital, Bologna, Italy
Andrea Scapigliati
Institute of Anesthesia and Intensive Care, Catholic University of the Sacred Heart, Rome, Italy
Giuseppe Ristagno
Istituto di ricerche farmacologiche "Mario Negri" – IRCCS, Milano, Italy
Anita Luciani, Stefano Gandolfi
Italian Resuscitation Council Foundation, Bologna, Italy
Andrew Lockey
Calderdale Royal Hospital, Halifax, UK
Michael P. Müller
Department of Anaesthesiology and Intensive Care Medicine, University Hospital, Technische Universität Dresden, Dresden, Germany
Sabine Wingen, Bernd W. Böttiger
University Hospital of Cologne, Kerpener Straße 62, 50937 Köln, Germany

We received 258 responses from 18 countries. The background of participants was: key person in national resuscitation council, educator, instructor and members of the ERC Research NET

Virtual Reality for CPR training: How cool is that? Dedicated to the "next generation"



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Virtual Reality for CPR training: How cool is that? Dedicated to the "next generation"

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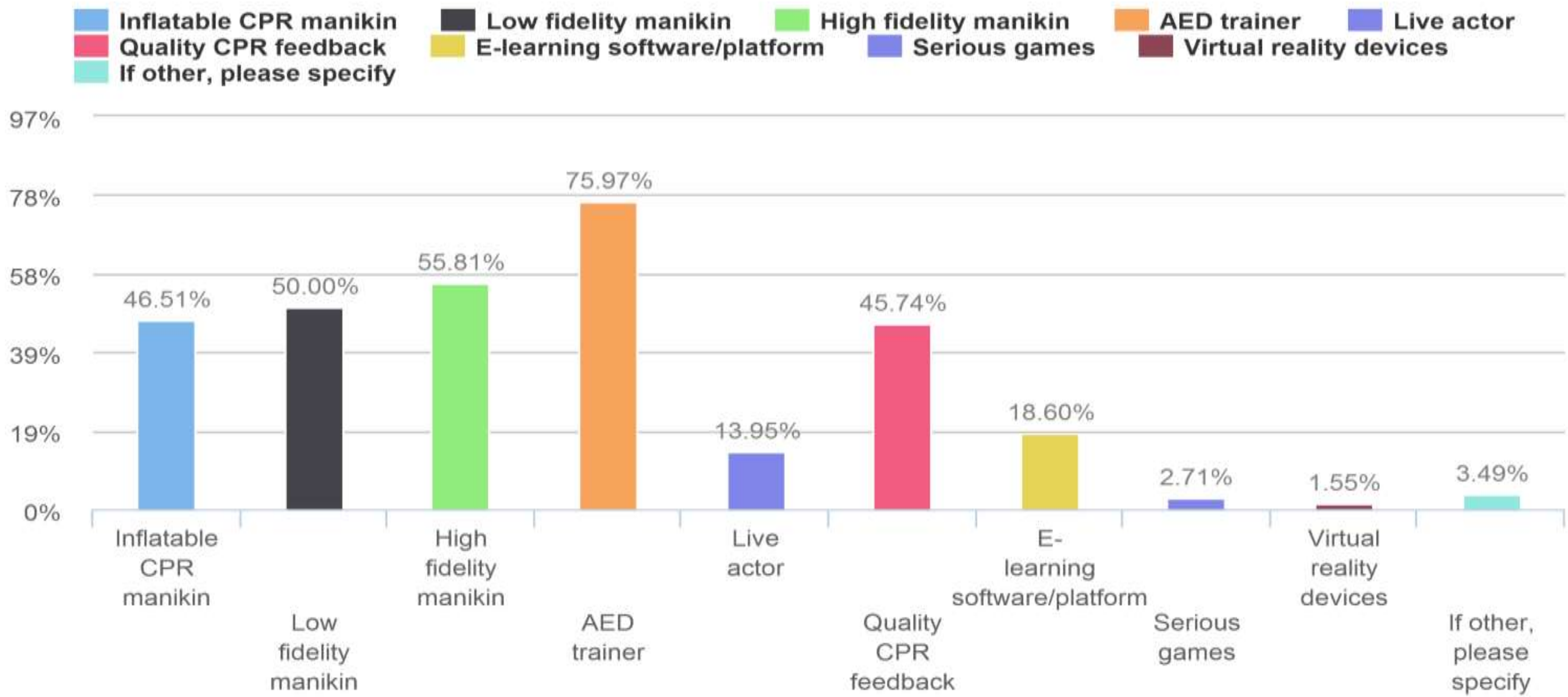
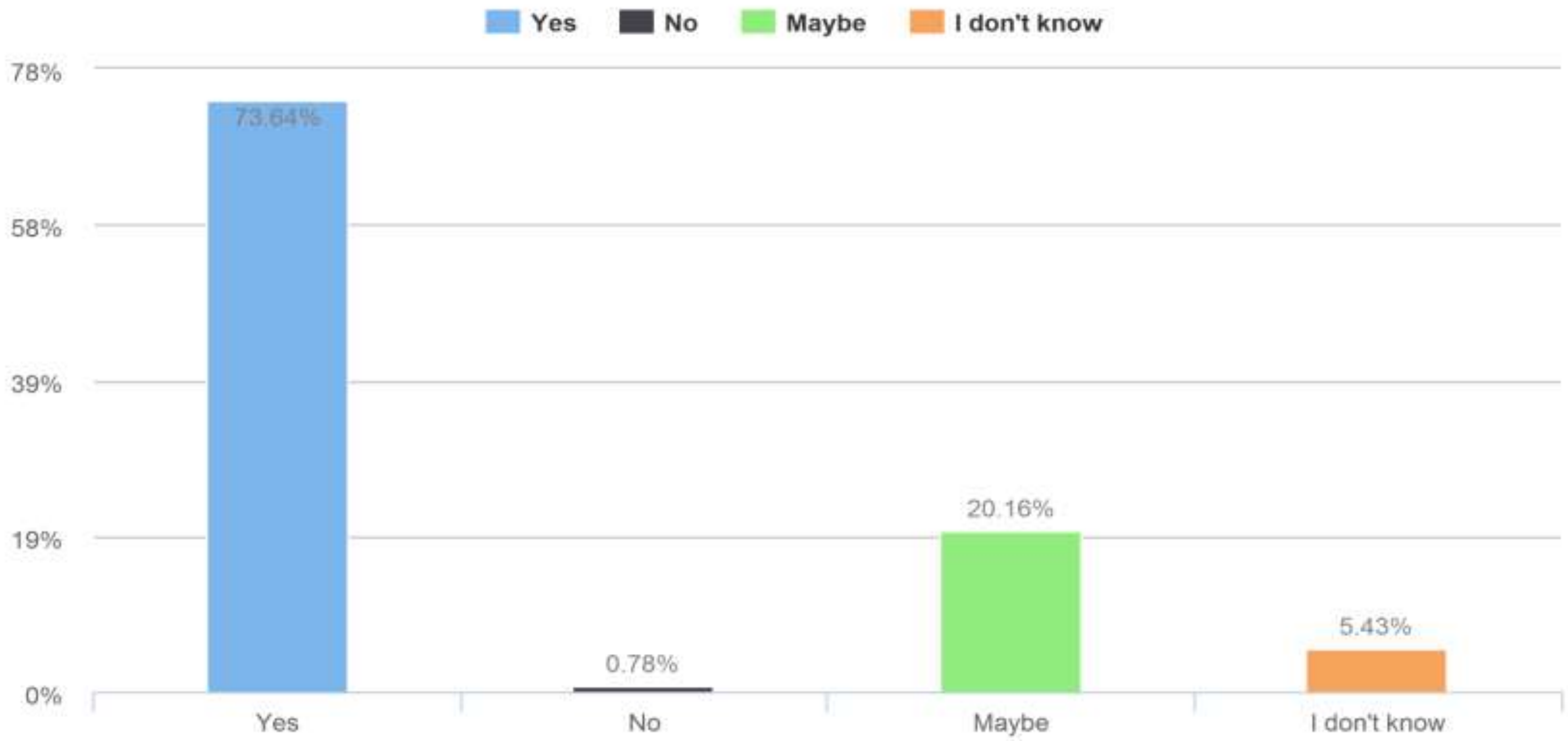
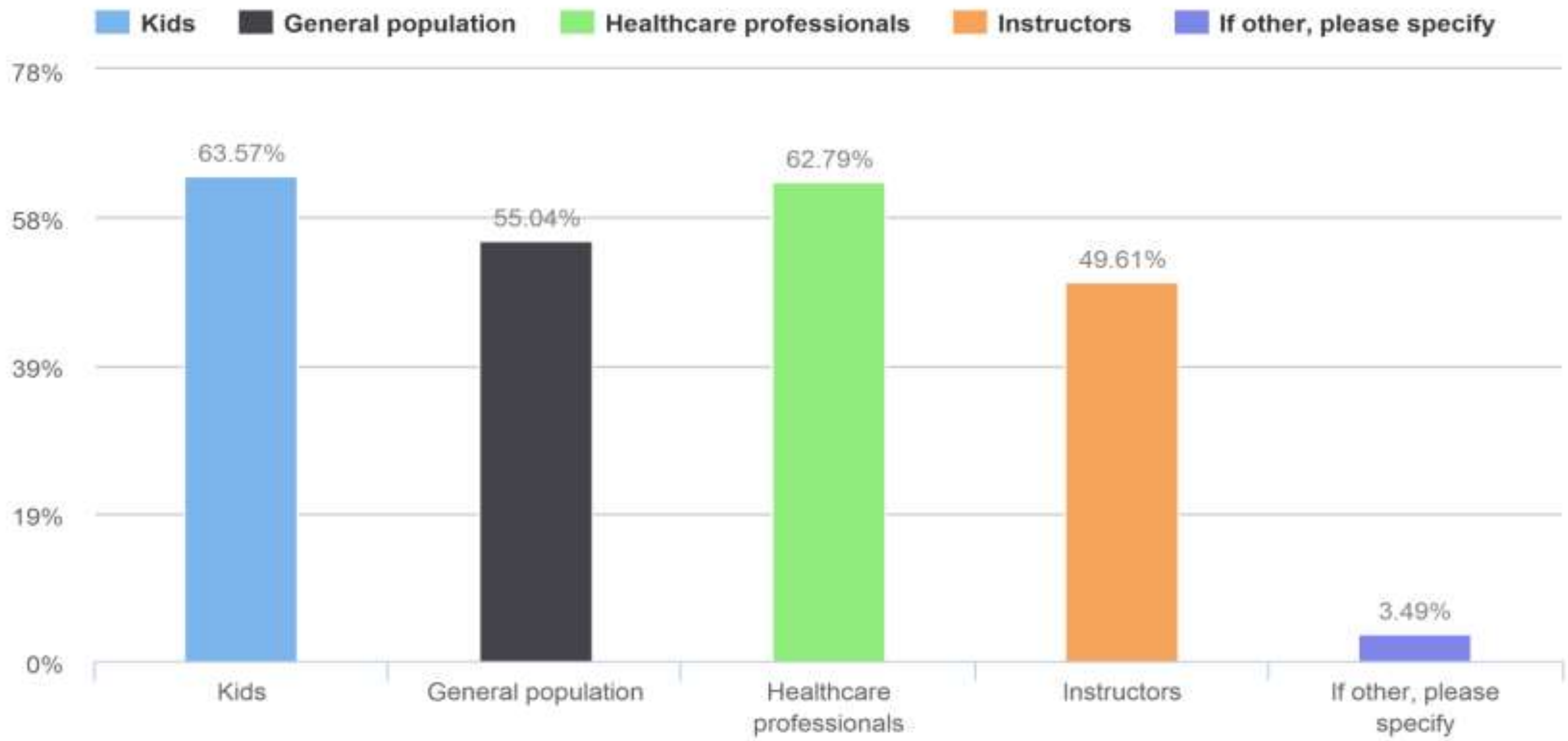


Do you believe virtual reality could play a role in the future of training?



Do you believe virtual reality could works better with some target groups?



VR & AR CPR: example

Resuscitation Council (UK)

Lifesaver VR

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https://www.resus.org.uk/apps/lifesaver-vr/

Resuscitation Council (UK)

Lifesaver VR

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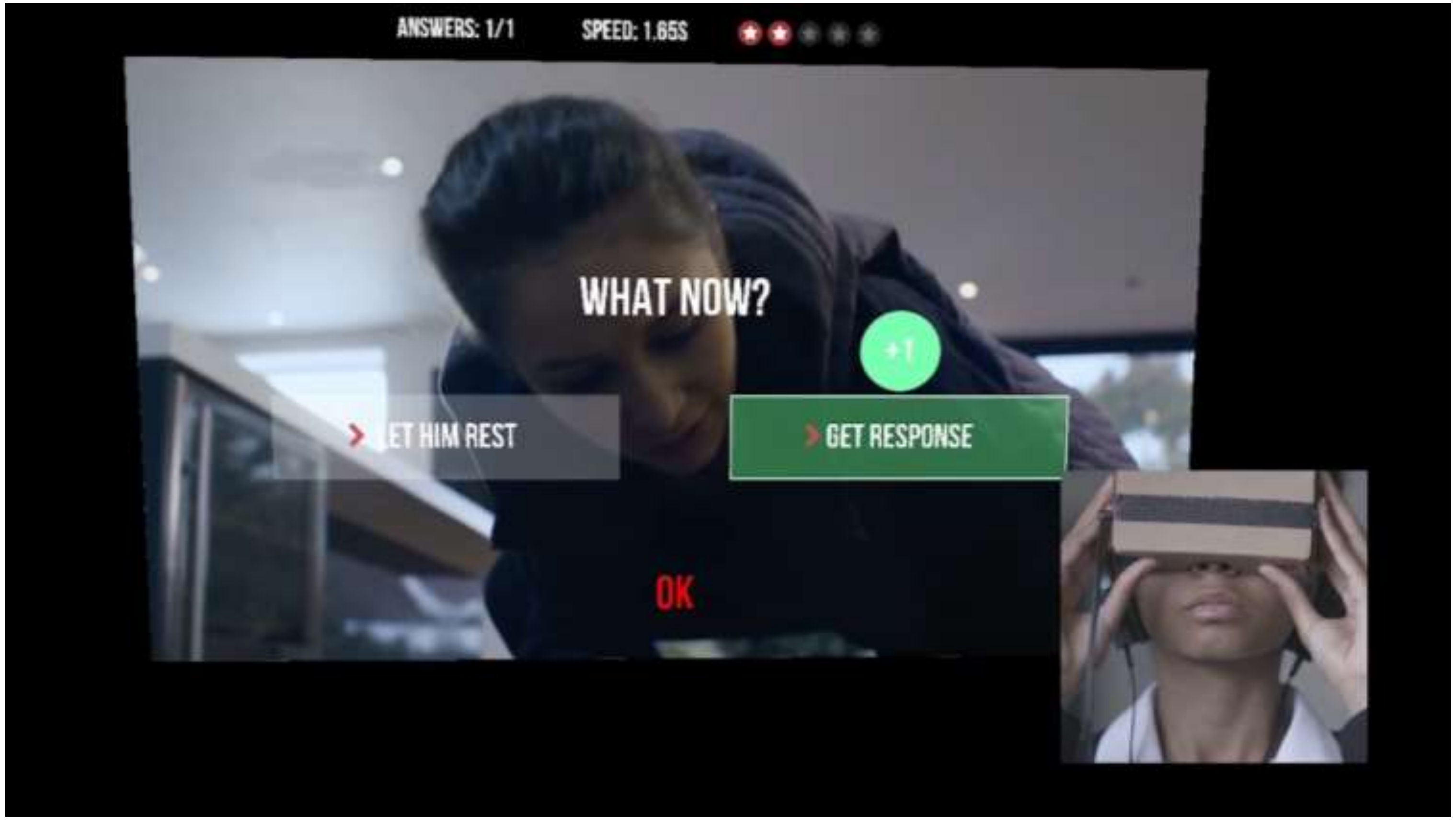

https://www.resus.org.uk/apps/lifesaver-vr/

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Virtual Reality Enhanced Mannequin (VREM)

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Short communication

Virtual reality enhanced mannequin (VREM) that is well received by resuscitation experts☆

Federico Semeraro[a,*], Antonio Frisoli[b], Massimo Bergamasco[b], Erga L. Cerchiari[a]

[a] *Department of Anaesthesia and Intensive Care, Ospedale Maggiore, Bologna, Italy*
[b] *Percro, Scuola Superiore Sant'Anna, Pisa, Italy*

Summary: The objective of this study was to test acceptance of, and interest in, a newly developed prototype of virtual reality enhanced mannequin (VREM) on a sample of congress attendees who volunteered to participate in the evaluation session and to respond to a specifically designed questionnaire.
Methods: A commercial Laerdal HeartSim 4000 mannequin was developed to integrate virtual reality (VR) technologies with specially developed virtual reality software to increase the immersive perception of emergency scenarios. To evaluate the acceptance of a virtual reality enhanced mannequin (VREM), we presented it to a sample of 39 possible users. Each evaluation session involved one trainee and two instructors with a standardized procedure and scenario: the operator was invited by the instructor to wear the data-gloves and the head mounted display and was briefly introduced to the scope of the simulation. The instructor helped the operator familiarize himself with the environment. After the patient's collapse, the operator was asked to check the patient's clinical conditions and start CPR. Finally, the patient started to recover signs of circulation and the evaluation session was concluded. Each participant was then asked to respond to a questionnaire designed to explore the trainee's perception in the areas of user-friendliness, realism, and interaction/immersion.
Results: Overall, the evaluation of the system was very positive, as was the feeling of immersion and realism of the environment and simulation. Overall, 84.6% of the participants judged the virtual reality experience as interesting and believed that its development could be very useful for healthcare training.
Conclusions: The prototype of the virtual reality enhanced mannequin was well-liked, without interfence by interaction devices, and deserves full technological development and validation in emergency medical training.

Semeraro et al. Resuscitation 80 (2009) 489–492

Virtual Reality
Enhanced Mannequin (VREM)

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Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

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Simulation and education paper

Virtual reality enhanced mannequin (VREM) that is well received by resuscitation experts☆

Federico Semeraro[a,*], Antonio Frisoli[b], Massimo Bergamasco[b], Erga L. Cerchiari[a]

Italian Resuscitation Council
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Mini-Virtual Reality Enhanced Mannequin (VREM)

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Resuscitation
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Simulation and education

Motion detection technology as a tool for cardiopulmonary resuscitation (CPR) quality training: A randomised crossover mannequin pilot study

Federico Semeraro[a,*], Antonio Frisoli[b], Claudio Loconsole[b], Filippo Bannò[b], Gaetano Tammaro[a], Guglielmo Imbriaco[a], Luca Marchetti[c], Erga L. Cerchiari[a]

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Feedback device

ABSTRACT

Introduction: Outcome after cardiac arrest is dependent on the quality of chest compressions (CC). A great number of devices have been developed to provide guidance during CPR. The present study evaluates a new CPR feedback system (Mini-VREM: Mini-Virtual Reality Enhanced Mannequin) designed to improve CC during training.
Methods: Mini-VREM system consists of a Kinect® (Microsoft, Redmond, WA, USA) motion sensing device and specifically developed software to provide audio–visual feedback. Mini-VREM was connected to a commercially available mannequin (Laerdal Medical, Stavanger, Norway). Eighty trainees (healthcare professionals and lay people) volunteered in this randomised crossover pilot study. All subjects performed a 2 min CC trial, 1 h pause and a second 2 min CC trial. The first group (FB/NFB, $n = 40$) performed CC with Mini-VREM feedback (FB) followed by CC without feedback (NFB). The second group (NFB/FB, $n = 40$) performed vice versa. Primary endpoints: adequate compression (compression rate between 100 and 120 min^{-1} and compression depth between 50 and 60 mm); compressions rate within 100–120 min^{-1}; compressions depth within 50–60 mm.
Results: When compared to the performance without feedback, with Mini-VREM feedback compressions were more adequate (FB 35.78% vs. NFB 7.27%, $p < 0.001$) and more compressions achieved target rate (FB 72.04% vs. 31.42%, $p < 0.001$) and target depth (FB 47.34% vs. 24.87%, $p = 0.002$). The participants perceived the system to be easy to use with effective feedback.
Conclusions: The Mini-VREM system was able to improve significantly the CC performance by healthcare professionals and by lay people in a simulated CA scenario, in terms of compression rate and depth.

Relive Tracking

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EUROPEAN RESUSCITATION COUNCIL

Letter to the Editor

RELIVE Tracking for quality cardiopulmonary resuscitation training: An experimental comparison with a standard CPR training mannequin

Sir,

The most widely used and recognized approach to train high quality basic life support (BLS) manoeuvres and automated external defibrillation (AED) remains the classic instructor-led training course. A recent review, however, introduced new evidence in support to alternative methods of training, including the use of self-directed learning and CPR feedback/prompt devices.[1] For the Viva! Campaign 2014, the Italian Resuscitation Council developed a new and more ambitious project called "Relive" game.[2] In this article, we propose a new markerless solution[3,4] called RELIVE Tracking still developed within the Mini-VREM project,[5] which is able to accurately estimate chest compressions depth and rate during chest compression. In addition, RELIVE Tracking has been tested with two different RGB-D (Red Green Blue-Depth) sensors based on different technologies featuring different prizes (Kinect® v1, Microsoft, Redmond, WA, USA and Creative Senz3D®, Creative Technology, Singapore, Republic of Singapore) and has been provided of a game-like realistic interface used for conveying a 3D visual feedback to the user/rescuer.

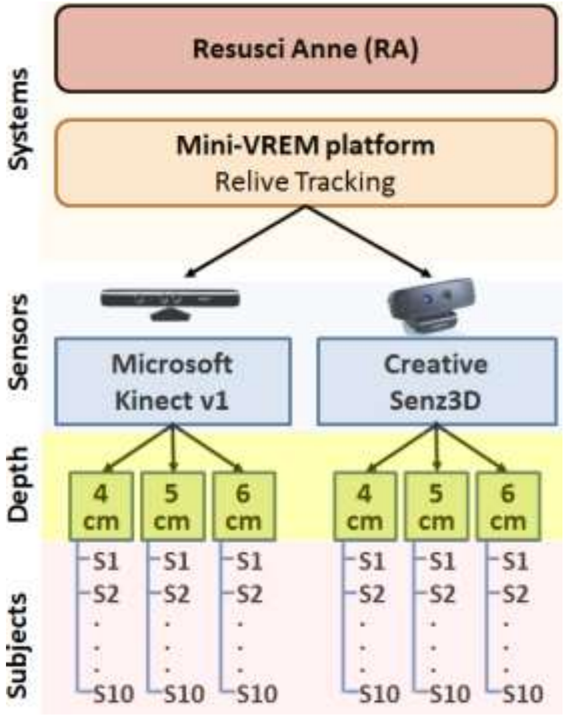
The RELIVE Tracking software (the engineer's heart of Relive Game) was specifically developed, to guide the training and to improve the quality of chest compression (CC) by tracking the hands of the user, without the need of any marker. RELIVE Tracking features a game-like Graphical User Interface (GUI) (Fig. 1) that allows non-experts to intuitively access all the application. RELIVE Tracking was tested with both RGB-D sensors, on a sample of ten healthy subjects to evaluate the effect of the proposed software on CC performance. This study was carried out at the PERCRO Laboratory in Pisa in August 2014. Ten male participants were recruited from students and researchers (non-CPR experts) at the PERCRO Laboratory. For each participant, the experiment consisted of a group of three trials of CC each lasting 30 s and characterized by a different depth CC (4–6 cm). Each group of trials was repeated for each of the two RGB-D sensors, 60 trials in total. For each of the 60 trials, the data were simultaneously acquired with RELIVE Tracking and with a traditional training mannequin (Resusci Anne – RA, Laerdal Medical, Stavanger, Norway) that was used for a quantitative evaluation of the accuracy of CC depth measured with RELIVE Tracking. The best RELIVE Tracking performance was obtained with RELIVE Tracking using Microsoft Kinect® v1, with an average square quadratic error equal to 4.3 ± 0.3 mm, whereas the worst was with the Creative Senz3d® with a mean square quadratic error equal to 6.5 ± 0.3 mm. Considering RELIVE Tracking as a low-cost training

Fig. 1. The RELIVE Tracking user interface.

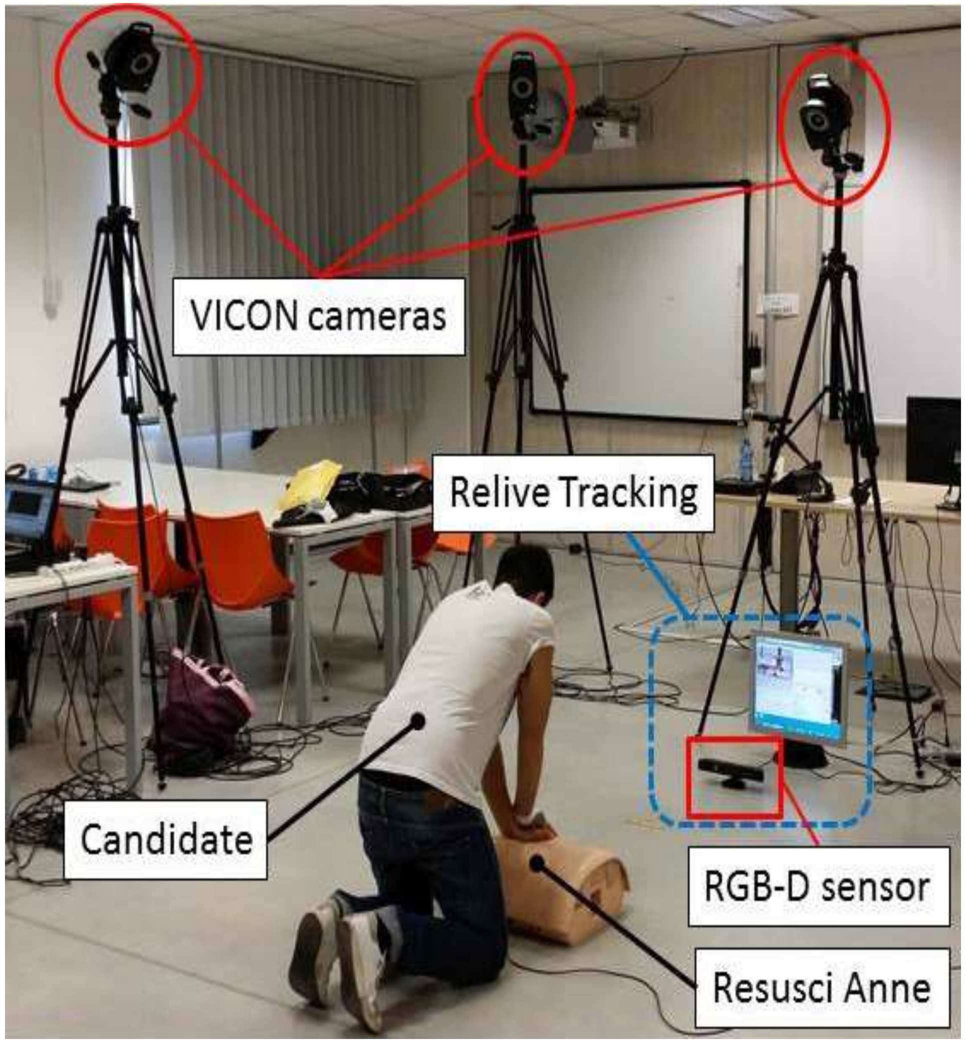
platform, not for clinical use, the error committed by RELIVE Tracking is acceptable to anticipate its potential future implementation in training programs for general population with a gamification approach.

Conflict of interest statement

Italian Resuscitation Council, PERCRO Laboratory and Studio Evil received a no-profit grant to build a no profit serious game from CZ Health Insurance Netherlands. Mini-VREM team is the winner of the Future of Health Award 2012. The award is a joint initiative of CZ healthcare insurance and Games for Health Europe.



Ten male participants were recruited from students and researchers (non-CPR experts) at the PERCRO Laboratory.
For each participant, the experiment consisted of a group of three trials of CC each lasting **30 s** and characterized by a different depth CC (4–6 cm). Each group of trials was repeated for each of the two RGB-D sensors, **60 trials in total**. For each of the 60 trials, the data were simultaneously acquired with **RELIVE Tracking and with a traditional training mannequin**.



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Relive Tracking

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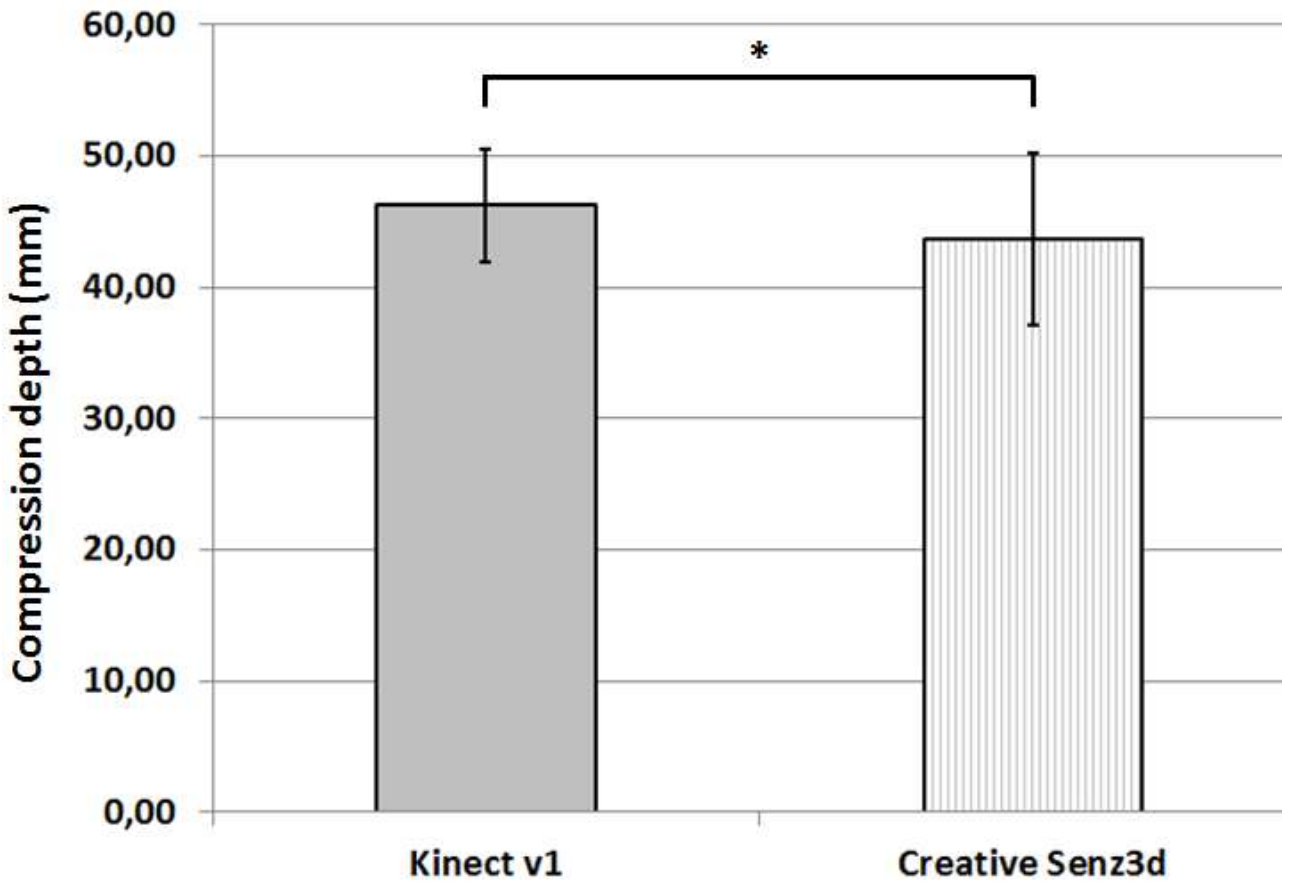
The best RELIVE Tracking performance was obtained with RELIVE Tracking using Microsoft Kinect® v1, with an average square quadratic error equal to **4.3 ± 0.3 mm**, whereas the worst was with the Creative Senz3d® with a mean square quadratic error equal to 6.5 ± 0.3 mm.



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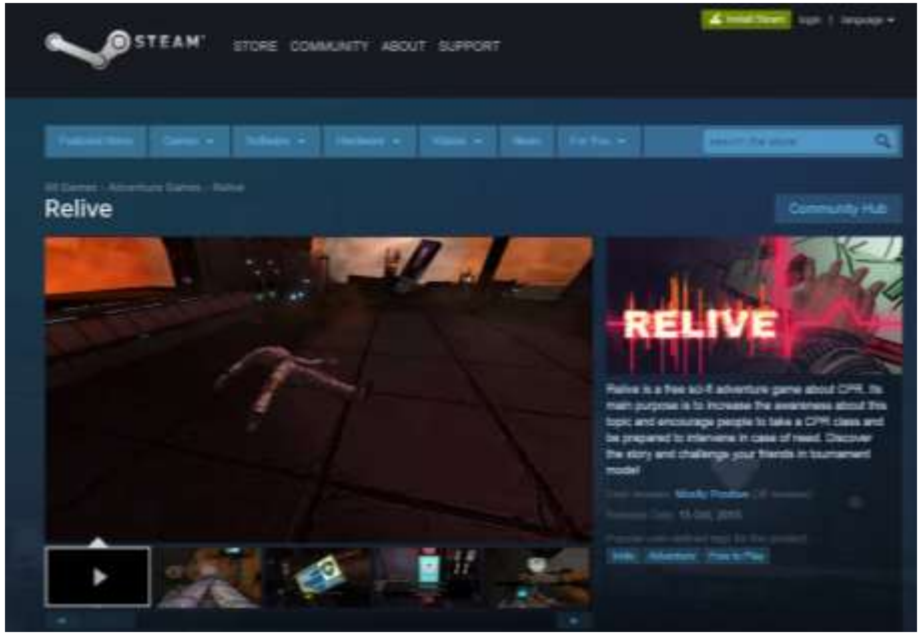
Relive is a free sci-fi adventure game about CPR. Its main purpose is to increase the awareness about this topic and encourage people to take a CPR class and be prepared to intervene in case of need. Discover the story and challenge your friends in tournament mode!



relivegame.org

Kids (learn how to) save lives in the school with the serious game Relive

Month 1-2	65 students	Baseline
Month 3-4	65 students	Competition
Month 8	50 students	Retention

15 students dropped out

Semeraro et el. Resuscitation 116 (2017) 27–32

Kids (learn how to) save lives in the school with the serious game Relive

Baseline Participants

Sixty-five students were enrolled in the study: 75% male and 25% female.
The median age was 16 ± 1 years old; BMI was 21 ± 3.

Table 1
CC depth and rate during the three study phases.

CC	Baseline (B) n = 65	Competition (C) n = 65	Retention (R) n = 50	P value C vs B	P value R vs B	P value R vs C
Depth, mm	31.2 ± 12.2	45.5 ± 8.2	46.6 ± 15.3	p < 0.01	p < 0.01	NS
Rate, cpm	94.8 ± 32.0	111.4 ± 9.6	131.3 ± 37.9	p < 0.01	p < 0.01	NS

Endpoints

The primary endpoint was the overall improvement in schoolchildren CPR awareness in terms of knowledge (MCQ results) and skills (CC rate and depth).
The secondary endpoints included the usability test of Relive as a tool to learn CPR and the differences in performance according to sex and BMI class.

Semeraro et el. Resuscitation 116 (2017) 27–32

Kids (learn how to) save lives in the school with the serious game Relive

Table 2
CC depth and rate in relationship to gender and BMI.

	Baseline n = 65		Competition n = 65		Retention n = 50	
	Depth, mm	Rate, cpm	Depth, mm	Rate, cpm	Depth, mm	Rate, cpm
Male	33 ± 11	92 ± 31	48 ± 7	111 ± 9	51 ± 15*	133 ± 41
Female	27 ± 14	102 ± 36	38 ± 7*	112 ± 11	33 ± 10	124 ± 22
BMI ≤ 18	31 ± 6	95 ± 29	38 ± 7	112 ± 9	31 ± 9	127 ± 35
BMI 19–24	32 ± 11	97 ± 32	46 ± 8	112 ± 11	49 ± 15	123 ± 33
BMI 25–29	39 ± 15	90 ± 37	49 ± 5	108 ± 4	54 ± 12	171 ± 45
BMI ≥ 30	22 ± 0	49 ± 0	51 ± 0	109 ± 0	67 ± 0	134 ± 0

* $p < 0.001$ vs. female. Relation between gender and BMI (see Supplementary data).

Table 3
Players' perception of Relive (n = 65).

Q1. It was difficult to use Relive in the competition mode	3 ± 2
Q2. The feedback that you received from Relive game on your chest compressions performance during 2 min of CPR were clear	6 ± 1
Q3. Relive helped you to perform a chest compression rate between 100 and 120 compressions per minute	6 ± 1
Q4. Relive helped you to perform a chest compression depth between 50 and 60 millimetres	5 ± 1

Participants rated the following statements using a seven-point Likert scale (1 = completely disagree, 7 = completely agree).

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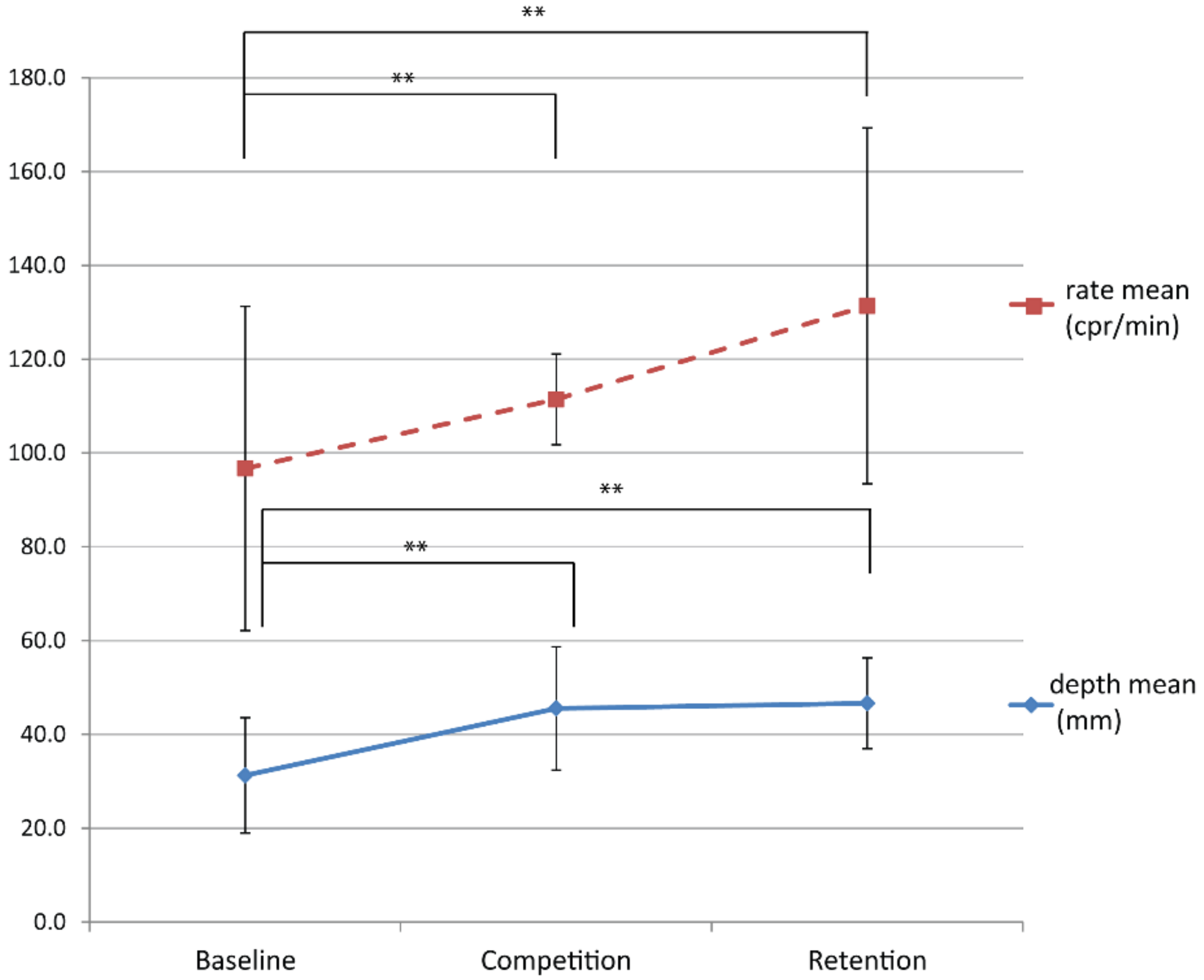
Kids (learn how to) save lives in the school with the serious game Relive



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Kids (learn how to) save lives in the school with the serious game Relive

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Conclusions

Relive Tournament Mode was able to improve significantly awareness in terms of knowledge of CA and CC skills in a group of schoolchildren without any previous experience in CPR. Relive was able to improve retention of knowledge and was able to ensure retention of CC depth skill at 3 months after only one session of competition. The RTM was perceived as easy to use and providing an effective feedback. Relive could be useful as a tool to spread CPR knowledge and skills in the schools.

Semeraro et el. Resuscitation 116 (2017) 27–32


STAR TREK
THE NEXT GENERATION™

Virtual Reality CPR AED
Italian Resuscitation Council

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The aim of VR CPR AED project would be to **develop a self-directed learning station BLS and AED**.

VR CPR AED is an assisted learning mode for CPR procedures.

In this mode **the learner will follow the tutorial to learn how to correctly perform CPR and use AED**.

The **tutorial takes place in a special environment**, where an overlay will show the steps for the procedure.

All the tutorial sessions are tracked and the learner receives a feedback about the quality of the CPR procedure.

A WINNING SOLUTION BOTH FOR GENERAL POPULATION/KIDS AND HEALTHCARE PROFESSIONALS

GENERAL POPULATION & KIDS	HEALTHCARE PROFESSIONALS
Opportunity to spread knowledge about the CPR in a ludic way Very immersive and engaging experience	Every training center use the technology Possibility to train and retraining healthcare professionals very quickly

TIMING VR PROJECT

Fund raising: End 2016, first quarter 2017

VR project development 2017

Official presentation ERC Congress 2018, Bologna

Final version available in December 2018

FUND RAISING

PHILIPS — Gold Sponsor

ZOLL — Silver Sponsor

FONDAZIONE DEL MONTE, stryker PHYSIO CONTROL — Bronze Sponsor

IRC Italian Resuscitation Council

Italian Resuscitation Council Scientific Supervision

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The Lord of the Rings: The Fellowship of the ERC

Giuseppe (Frodo) Ristagno, Andrea (Aragorn) Scapigliati & Federico (Legolas) Semeraro

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**Out Of Hospital Adult
Cardiac Arrest Scenario**

**Chest compression only
and defibrillation scenario**

Location: Santo Stefano Square

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In Hospital Adulto
Cardiac Arrest Scenario

Adult Basic Life Support
Defibrillation Scenario

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Out Of Hospital Pediatric Cardiac Arrest Scenario

Pediatric Basic Life Support Defibrillation Scenario

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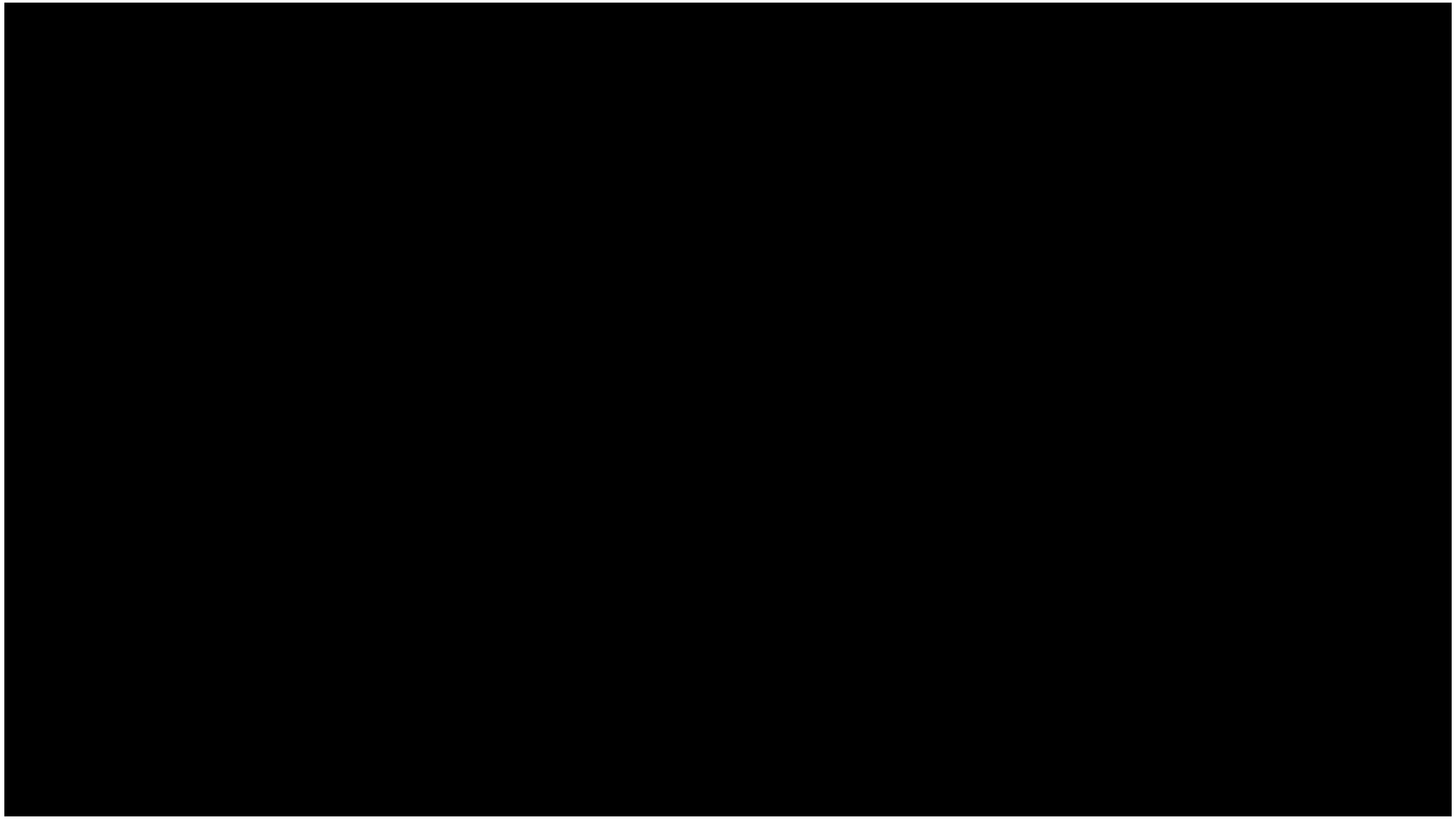

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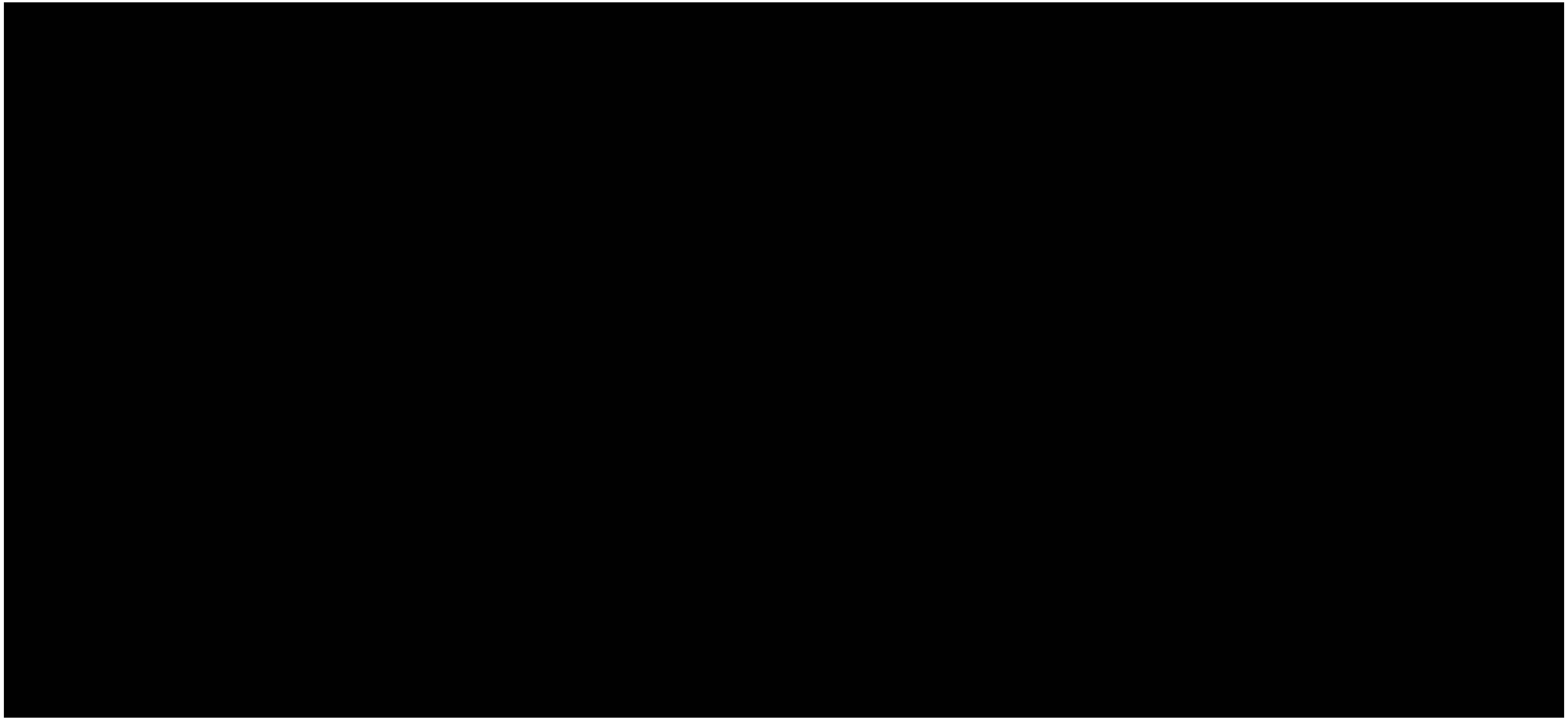

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Virtual Reality CPR AED
Stay Tuned & Save the date

RESUSCITATION 2018
New technologies in resuscitation
20 - 22 September • Bologna • Italy


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#LLAP

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CATCH THE BEAT WITH THE "LIVE LONG AND PROSPER" VIRAL SLOGAN!

Help to spread cardiac arrest awareness in the medical literature

"A life is like a garden. Perfect moments can be had, but not preserved, except in memory. LLAP (Live Long and Prosper)" by Leonard Nimoy.

Leonard Nimoy, who played Mr. Spock on the original Star Trek series, died on February 27th, 2015 at the age of 83. Nimoy signed all his tweets with "**LLAP**" or "**Live Long and Prosper**", his peculiar catchphrase from the Star Trek series and films. Nimoy had announced via Twitter last year that he had been diagnosed with COPD, a chronic respiratory disease caused by smoking that has no cure (Figure 1). He then encouraged his followers to stop smoking[1].

www.ircouncil.it/LLAP

IRC Italian Resuscitation Council

Teach & Learn CPR
as soon as possible

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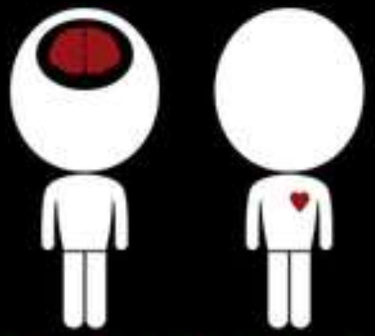
Peter Safar’s Laws

If you can't win,
change the rules

If you can't change the rules,
then ignore them

When in doubt, think!

http://www.ccm.pitt.edu/peters-laws



think different


THINK OUTSIDE THE BOX


DO NOT CONFORM.

Italian Resuscitation Council

MAY THE 4TH
BE WITH YOU.

CPR SAVES
LIVES!