LAVAL VIRTUAL

THE VR/AR SPECIAL EDITION

#4 HEALTH

CLINICAL VR
MEDICINE
WELL BEING

#EDITORIAL

HOW VR IS CHANGING THE WAY WOMEN BREAST CANCER IS DIAGNOSED, TREATED AND MANAGED

LAURENT CHRÉTIEN
DIRECTOR / LAVAL VIRTUAL

Cancer cells live in complex communities. Just like houses in a city, each cell in a tumour is different from its neighbour, and relies on infrastructure to support its existence. And we know that there are different neighbourhoods, some worse than others. Where we have roads, tumours contain blood vessels that deliver nutrients, and act as highways for different cell types to move around. And when a tumour spreads, the cancer cells themselves use these blood 'roads' to migrate.

What the healthcare experts need is a Google Earth-like view of a tumour. If they could make a 3D map, they would find new targets for treatment and, eventually, could use this view to track what's going on in real time, such as in response to treatment. At Cancer Research UK, Professor Greg Hannon's IMAXT team is building 3D tumours containing every cell in them, which can be studied using virtual reality.

THE RESEARCH

Combining established techniques, including DNA sequencing and imaging, with new technology they will invent and develop, the team is studying high-quality breast cancer samples available to them which were collected from women involved in this study.

They aim to gather thousands of bits of information about every single cell in a tumour – from cancer cells to immune cells – to find out what cells are next to each other, how they interact with and influence each other, and how they all work together to help tumours survive and grow.

They will then take all the information they collect about the cells in a tumour and use it to construct a 3D version that can be studied using virtual reality.

Using virtual reality will allow scientists to immerse themselves in a tumour, meaning they can study patterns and other characteristics within it, in entirely new ways that aren't possible in 2D. It will also allow multiple doctors and scientists to look at a tumour at the same time, meaning people at opposite ends of a country, and with different areas of expertise, can work together to help diagnose and treat patients better. And with the Covid19 crisis, the use of virtual reality to cooperate remotely is even more obvious!

THE IMPACT

By developing an entirely new way to study breast cancer, this team hope to change how the disease is diagnosed, treated and managed. Ultimately, it could improve how women with breast and other types of cancer are classified, which would improve their treatment and help more people survive the disease.

THE HEALTHCARE FUTURE IS HERE

Laval Virtual's missions are to gather, inspire and valorize all VR/AR players: reconsidering how to fight against breast cancer thanks to VR is not science fiction, it's one of the use cases that can inspire you, health professionals to put immersive technologies into practice: thank you to all the renowned contributors who joined us in this magazine so that you in your turn can be inspired.

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Publishing Director: Laurent Chrétien
Scientific Director: Simon Richir
Managing Editor: Marie Leblanc
Editor in chief: Nicolas Ribeyre
Editors: Alpha Diallo & Léa Paule
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CONTRIBUTIONS

NICOLAS RIBEYRE
EDITOR IN CHIEF
LAVAL VIRTUAL

This edition is dedicated to the use of immersive technologies, virtual or augmented reality in the field of health, but also in the fields of well-being, handicap or medicine. Who else could we invite to join our columns and write this preface than Robert Fine, VR/AR and Health expert and founder of VRVoice.co?

Robert is the Executive Director and Founder of IVRHA (International Virtual Reality and Healthcare Association).

In 2009, Robert started Cool Blue Media by organizing the first social media conference on the east coast of the United States, leading to the publication of the text book, "The Big Book of Social Media Case Studies, Stories and Perspectives" and shortly thereafter the only printed magazine covering social media, The Social Media Monthly. In May 2016, he launched VRVoice.co, a content vertical exploring virtual reality in the enterprise. In 2017, Robert started the largest annual conference on virtual reality and healthcare with events taking place both in the US and Europe.
Prior to 2009, Robert was the Senior Director of Global Strategy and Development of IT at Conservation International (CI). Robert joined CI in 2000 to take responsibility for connecting all of CI's forty field offices to the Internet with broadband connectivity. During his 10 year tenure, he built an international staff of 25 IT professionals.
Robert has over ten years of additional work experience as a systems and sales engineer with various companies including CMGI, Hughes Network Systems, ioWave and Raytheon. Robert has a bachelor's degree in mechanical engineering from Villanova University, a master's degree in environmental science and public policy from Johns Hopkins University, and is ABD at George Mason University.

Enjoy your reading!

THEY CONTRIBUTED TO THIS SPECIAL EDITION

Robert FINE (IVRHA) - **Sébastien SERLET** (Université libre de Bruxelles), **Paula SÁNCHEZ MARTÍNEZ ALFONSO & Soriano BALLESTER** (Innoarea Projects), **Christophe GOUET** (Middle VR), **David PIQUET** (TMS Studio), **James MARKEY** (HRV Simulation), **Marie POUX-BERTHE** (Tutkii - Ouest Médias agency), **Chloé BIDET** (Oséos), **Nicolas AOUIZERATE** (Feelity), **Marco SACCO** (CNR Stiima), **Rebecca GILL** (VR Therapies), **Christophe MALLET** (Bodyswaps), **Inna KHMELNITSKAYA & Alexandre SITNIK** (ArtoMed), **Patrice BOUVIER** (SYKO), **Alexandre BÉGUÉ** (Relaxmind), **Jérôme LELEU** (Sim for Health), **Albert (Skip) RIZZO, Arno HARTHOLT, Andew LEEDS, David KWOK, Sharon MOZGAI** (University of California - Institute for Creative Technologies), **Guillaume FACCHI** (Biovalley), **Nora YENNEK** (IfisLab), **Corentin DUBOC** (Segula Technologies), **Gregory MAUBON** (HCS Pharma), **Grace MANGIALARDI** (Ex Molecular Devices, now working for SCIEX), **Victor HERRERA & HELENA ORTIZ GIL** (Techer Team), **Xavier RUYRA BALIARDA** (Heart Institute Quiransalud Teknon), **Christopher LAFAYETTE** (Holopratice), **Valentin JOUET & Lauriane CAUCHON** (HRV), **Amina MOHAMED-SOILIHI & Dan BENHAMOU** (LabforSim 2), **Renaud LAMORT** (VR Connection), **Aimen MAKI & Slim KHMISSI** (Holograms), **Carine De POTTER, Umut ELESTEKIN, Ufuk AYDINLI, Tolgar GUNGOR & Sinan VURAL** (Noya Enterprise), **Abdelmajid KADRI** (ARTS et MÉTIERS - Institut de Laval), **Robert STONE** (University of Birmingham), **Mélanie PÉRON** (BLISS - L'effet Papillon), **Alexandre JACQUES** (Bais-Hambers Medical Centre), **Benjamin COSSE** (Cottos Medical), **Jean-François ZAREMBA** (Synthes3D), **Johnny DUERINCK & Frederick VAN GESTEL** (Uz Brussels), **Valérie RIFFAUD-CANGELOSI** (Epson Europe), **Corentin METGY** (Lumeen), **Loïc FLAMENG** (OpenScript VR), **Claire PATOUILLET** (Independent Consultant), **Vincent Rieuf** (Iceberg), **Amaury Solignac** (Iceberg), **Paul Monnier** (Défis d'Hommes), **Lionel MÉTIVIER** (Conserto Labs), **Marguerite BRAC DE LA PERRIÈRE** (Lexing - ALain Bensoussan Avocats)

#PREFACE

THE NEXT TEN YEARS

ROBERT FINE
EXECUTIVE DIRECTOR / IVRHA

THIS INTRODUCTION TITLED "THE NEXT TEN YEARS" HOLDS A FEW DIFFERENT MEANINGS FOR ME WHEN I THINK ABOUT THE IMPACT THAT IMMERSIVE TECHNOLOGIES (LIKE VIRTUAL, AUGMENTED AND MIXED REALITY) WILL HAVE UPON HEALTHCARE AND OUR GREATER SOCIETY.

First, let's just talk about technology in general and the impact it is going to have on all of us over the coming decade. We're seeing the convergence on a number of new technologies that will come into maturity all at about the same time from 2020-2030. Besides immersive, there's the advent of 5G, the Internet of Things, and autonomous vehicles. All of these platforms will be dependent on each other both for effective performance, but also for ubiquity. It's going to a decade of rapid change and impact, and I think when we look back at the year 2020 from 2030, much of our everyday life will look radically different. It's likely to be 2025 at the earliest before we really see the impact of this convergence on daily living as the deployment and usage of 5G is going to take longer than some expect.

The next ten years for healthcare and virtual reality contain a few important points that I believe both the startup and investor community need to take carefully to heart. The healthcare industry is notoriously slow to change and adapt to new technology, no matter how shiny or innovative the technology may be. We've seen this time and time again for the last thirty years. Telemedicine has been a buzzword for decades, and it's still a buzzword as it has yet to be fully embraced and deployed as an efficient way to receive healthcare. We're only now finally seeing the very early dissemination of healthcare through our smartphones, but we're still in the infancy stage.

And virtual and augmented reality applications are no different. Honestly, ten years is probably being too generous. This is going to be a ten, fifteen, even twenty year journey for many. Both investors and founders alike need to manage their own and each other's expectations carefully.

2019 has already seen a plethora of hardware downfalls from Meta, Daqri and ODG. Others are on the horizon, and for those that do survive, it will be because they didn't grow themselves too fast, and managed in lockstep with their funding, or have bootstrapped it altogether like hardware startup Realmax in Bellingham, Washington. Where? Exactly. It's much more affordable to build a startup out of Bellingham than Seattle or Redmond.

But it's not really all doom and gloom. The operations and deployment side of the business will have its challenges, and those will need to be overcome, but the application side is coming along fast and furious. The easiest way to think about the impact that virtual reality will have upon healthcare is to consider any healthcare issue or problem you can think of right now...Alzheimer's, Parkinson's, depression, addiction, etc. Be it mental health or physical in nature, someone is trying to apply virtual reality as an application to it.

THE EARLY SUCCESSES ARE OCCURRING IN MEDICAL TRAINING, WHETHER FOR NEW MEDICAL STUDENTS, OR PROFESSIONALS THAT NEED TO FULFILL THEIR CONTINUING EDUCATION

The early successes are occurring in medical training, whether for new medical students, or professionals that need to fulfill their continuing education. Pioneers in the space such as OssoVR, FundamentalVR and PrecisionOS are having successful pilots and lots of interest from both teaching hospitals and universities.

Elderly care is an area that has been receiving a great deal of attention over the last few years as well. In the United States, AARP the (American Association of Retired Persons) is one of the largest non-profits on the planet with over fifty million members. They've been investing in both startups and developing their own technology to meet a rapidly growing and aging population. Other companies in this area to consider are Embodied Labs, MyndVR, Healium and Viva Vita, just to name a few.

There are also a handful of companies building for the healthcare sector from the infrastructure side. Besides the two largest hardware headset vendors, Oculus and HTC Vive, there are also software companies to consider. XR Health, which had originally focused on providing a platform to the end customer, is now providing the tools and the APIs for other developers to build on top of. And when you need to outsource that development, companies like Paracosma can offer competitive rates, because their entire development team resides in Katmandu, Nepal offering the same quality of production that can be found in any leading tech center.

In this special edition of Laval's focus on virtual reality and healthcare, you'll learn about leading companies working in this space, not just in France, but globally throughout.

DEFINITIONS

VIRTUAL REALITY

Virtual Reality (VR) headsets immerse users in a 3D computer generated environment where spatial data, such as the data that produces a rendering of a building or a house, becomes more real and more actionable. While VR is often associated with gaming and entertainment, VR applications for business hold great promise.

AUGMENTED REALITY

Augmented reality puts computer-generated elements into the real world. That's the technology used in the world-renowned mobile game Pokemon Go and to generate Snapchat filters. AR is different from VR because users can still perceive and sense the real world. To see these digital elements, users need to put on AR headsets or smart glasses, or even use everyday tools such as smartphones or tablets.

MIXED REALITY

Mixed reality is a more recent concept. It combines the two previous technologies by mixing the real world and a virtual environment. Mixed reality is closed to augmented reality because digital objects are overlaid on the real world. But with MR, virtual objects can interact with physical elements around users who then can perceive both in the same space.

EXTENDED REALITY

The term "extended reality" is used to talk about all immersive techniques, that is to say VR, AR and MR. It gathers all current and future technologies related to real and virtual environments and human-machine interactions.

TRAINING

THEORY, TRAINING, EVALUATION

The training market is booming for all medical disciplines. VR and AR are used for training in gestures, tools, procedures, and emergencies. This can be achieved in individual or collaborative modes. Haptics can be coupled with VR for gestures learning solutions. This is aimed at healthcare professionals, interns, and experienced physicians.

PREDICTIVE MEDICINE

MOLECULAR MANIPULATION, RESEARCH

The key to designing a drug is to find the right shape for the molecule to fit inside the targeted protein pocket. The RV saves time in the spatial design of the targeted molecule, which could reduce the time required for creation from 4/5 years to 12 months. In the future, we could see a predictive, preventive and personalized medicine, in particular with the design of drug dosages adapted to individual profiles.

OPERATOR'S ASSISTANCE

SURGERY, MEDICAL IMAGERY (AR)

The advantage is to make information more accessible to the surgeon during the operation. For AR: this is relevant when it takes into account the real environment. For instance, for the symbolic decomposition of environments or for collaborative experiences. In this case, we will see the use of scans of the doctor's environment and more occlusion, with the eventual integration of lighting and sounds. VR is preferable for presence, engagement. The uses still lack depth of field and the precision of the superimposition is difficult to achieve because the patient has to remain motionless. The size of the field of vision and the coherence of the lighting and materials remain points of improvement.

WELL-BEING

ANALGESIA, ANXIETY, BOREDOM (VR)

Immersive technologies are used in geriatrics, operating rooms, dentists, and so on...

THERAPY

TREATMENT OF MENTAL ILLNESSES, RAISING AWARENESS OF RELATIVES (VR/AR)

Immersive technologies are used for phobias, anorexia, schizophrenia, addictology and autism, but also to raise awareness among the patient's relatives or caregivers.

HARDWARE VR, AR AND OTHER DEVICES ON THE MARKET

Every week, Laval Virtual's "Intelligence services" pole publishes a "Hardware" news feed. Here is a non-exhaustive list of recent hardware if you want to go further in terms of immersive technologies. Some of these equipments can be tested in our show-room.

THE MAIN AUGMENTED REALITY HEADSETS ON THE MARKET

Manufacturer: Ximmerse
Graphic resolution: 1440 x 2560
Field of view: 57° (VFOV), 50° (HFOV)
Weight: 590g
Year: 2019
Country: China

RHINO X

The Rhino X is a MR headset manufactured by Ximmerse, a Chinese company, which was previously offered by Lenovo, in part through its Lenovo Mirage AR.

This headset, not yet on the market, has major advantages. First of all, it is a stand-alone headset that relies on an integrated screen that reflects on its display.

Secondly, it's a headset equipped with several technologies that allow it to distinguish itself from other headsets in the same category, especially in terms of rendering. Its X-Anchor allows for example, to have an interactive positioning of large spaces and allows it to instantly enter a shared space for several people. It also has an X-Render that provides it with a distortion-free rendering.

The headset is intended for different sectors such as Health. Indeed, the interactive system allows to make an analysis of lesions but also to preview operating procedures before surgery for example.

Manufacturer: North
Graphic resolution: 200 x 200 (based on the image)
Field of view: 15°
Weight: 82g
Year: 2019
Country: Canada

FOCALS BY NORTH

In the field of HUD, after google glass, Focals glasses from the Canadian company North represent a real revolution.

Indeed, these glasses equipped with AR technology have a design very similar to ordinary glasses. At first glance, it is difficult to realize that these are glasses with AR, unlike Google Glass.

The discretion of the AR technology in these glasses is that the glasses are equipped with a small projector placed inward, which projects the contents in front of the wearer's retina.

The glasses can be directly connected to a smartphone via Bluetooth. This allows you to receive all the notifications in front of you without having to bend your head to look at the smartphone. They are also accompanied by a "ring" that acts as a controller.

However, if these glasses represent a major advance in design and technology, particularly in the field of HUD, Focal Glasses are still intended for people who are interested in AR technology. Due to its relatively high price, today they are not widely deployed among the general public.

THE MAIN AUGMENTED REALITY HEADSETS ON THE MARKET

Manufacturer: Kura Technologies
Graphic resolution: 8K 75Hz / 6K 100Hz
Field of view: 150°
Weight: 80g
Year: 2019
Country: USA

KURA GALLIUM

The Gallium is an augmented reality eyeglass manufactured by the Californian company Kura.

These glasses are equipped with a wide field of vision and should be available to the general public. It is a high-resolution eyewear with high opacity and brightness.

These glasses are not yet available but should be on the market in 2020.

Manufacturer: Magic Leap
Graphic resolution: 1280 x 960
Field of view: 50°
Weight: 345g
Year: 2018
Country: USA

MAGIC LEAP ONE

After significant fundraising and years of development surrounded by mystery, Magic Leap unveiled its Magic Leap One, augmented reality and/or mixed reality goggles. The headset is only available in the United States, for the moment, and is mainly designed for developers and other image professionals in particular.

The entire equipment consists of three elements: the Lightware headset connected by a cable to the Lightpack, which is a circular box and in which the heart of the equipment is located. Lastly, there is a wireless controller that is able to detect 6DoF and provides haptic effects synchronized to the actions. Its autonomy remains within the norm of other existing headsets, i.e. more or less 3 hours.

Manufacturer: Huawei
Graphic resolution: 3200 x 1600
Field of view: 90°
Weight: 166g
Year: 2019
Country: China

HUAWEI VR GLASS

After a first experiment in 2016, and a second one during CES 2018 with a VR headset, the Chinese giant Huawei has just launched a new virtual reality device, the Huawei VR Glass.

Unlike the first two attempts through headsets, this one Huawei surprises everyone by introducing virtual reality glasses to the market.

In terms of design, the glasses are only 26.6 mm wide and weight approximately 166g.

Technically, the glasses are equipped with two 2.1 inch LCD screens. They are also equipped with a 3D sound system.

THE MAIN AUGMENTED REALITY HEADSETS ON THE MARKET

Manufacturer: Vuzix
Graphic resolution: 640 x 360
Field of view: 16,8°
Weight: N/A
Year: 2019
Country: USA

VUZIX M400

The Smart Glasses Vuzix M400 were presented at the 2019 MWC in Barcelona. They are the latest in the Smart Glasses category from Vuzix. They will most likely be released during the year. This new generation of Smart Glasses from Vuzix is one of the first to use the XR1 platform. The glasses were designed in partnership with Qualcomm, and are equipped with an XR1 snapdragon chip. The M400 offers a multi-touch pad, integrated GPS and, above all, better noise suppression compared to previous versions. Equipped with an XR1 processor, these glasses are considered to be the fastest on the solutions currently available on the market. Like previous generations, the M400 is designed for professionals.

Manufacturer: Microsoft
Graphic resolution: 2048 x 1080
Field of view: 52°
Weight: 566g
Year: 2019
Country: USA

HOLOLENS 2

This new version is exclusively designed for professionals. Thus, unlike the first Hololens version, the Hololens 2 has been designed so as to ensure that the weight is balanced between the front and the rear. Which enables it to be worn for a longer period of time on a construction site, for example. One of the new features of this new version is the possibility of lifting the visor, which did not exist in the previous version. From a technical point of view, the Hololens 2 is equipped with two eye-facing cameras, which allows it to do eye-tracking. It also features iris scanning via Windows hello, which allows users to launch their personal account or preserve their personal preferences on the headset. Its larger field of view than the first version increases immersion.

Manufacturer: Lynx
Graphic Resolution: 1600 x 1600 / eye
Field of view: 90°
Weight: NC
Year: 2020
Country: France

LYNX - R1

Lynx R1 is a mixed-reality headset designed by the French start up LYNX. Unveiled earlier in 2020, this 6 DoF headset is one of the very first MR headsets to integrate the Snapdragon Qualcomm XR2 processor. In the display section, the headset integrates two 1600 x 1600 pixel LCD screens. Its also features video-see-through technology, as do other MR headsets such as the HoloLens 2. In addition, the headset integrates hand-tracking technology. So the headset does not require the use of physical controllers. In terms of connectivity, the headset is equipped with Bluetooth, wifi and Usb-C connection The headset has various other technologies such as positional tracking, room scale, etc. In terms of its characteristics, the R1 is one of the most advanced headsets on the market.

THE MAIN VIRTUAL REALITY HEADSETS ON THE MARKET

Manutacturer: HTC
Graphic resolution: 1440 x 1600
Field of view: 110°
Weight: 550g
Year: 2018
Country: Taiwan

HTC VIVE PRO EYE

Specially designed for professionals and presented at CES 2018, the HTC Vive Pro is the new HTC Classic version. It is an improved version with the particularity of being intended only for B2B. But also with increased comfort and boosted resolution.

From a technical point of view, the HTC Vive is equipped with high-resolution AMOLED displays. This provides ultra rich colours and contrast.

It is also important to note that the Headset is equipped with different sensors such as: SteamVR tracking, G-sensor, gyroscope, and IPD sensors.

The headset is designed in such a way that it is also possible to free yourself from wires using a wireless Vive adapter. This increases the space available for movement.

In order to deliver a more immersive sound, the Vive Pro has integrated headphones with high-resolution 3D spatial sound with Hi-Res certification.

Manufacturer: VRGineers
Graphic resolution: 5120 x 1440
Field of view: 170°
Weight: 770g
Year: 2018
Country: Czech

XTAL

Like the HTC Vive Pro, the Pimax 8K, the VRGineers XTAL is also considered a top-of-the-range VR headset.

With a 5K resolution, it is unique in its kind and is undeniably one of the high-resolution virtual reality headsets.

From a technical point of view, the headset itself is largely a rework of VRHero but with many improvements. The XTAL is indeed equipped with 2 high-density Quad, but also with two OLED type displays with lenses already patented by the company especially clear and which are custom designed.

THE MAIN VIRTUAL REALITY HEADSETS ON THE MARKET

Manufacturer: Oculus
Graphic resolution: 2560 x 1440
Field of view: 110°
Weight: 467g

OCULUS GO

Oculus Go is an autonomous virtual reality Headset. So it doesn't need a smartphone as a screen, nor a computer next to it to calculate renditions.

Accompanied by its controller, the equipment is complete.

Manufacturer: Pimax
Graphic resolution: (2*)3840 x 2160
Field of view: 200°
Weight: 400g
Year: 2018
Country: China

PIMAX

The PIMAX 8K is a Chinese VR headset that offers 4K definition. Its characteristics, in particular, its field of vision and its graphic resolution with more than 16 million pixels make it the most advanced device on the market ahead of its predecessor Pimax 5K Plus, but also ahead of the Czech XTAL.

Even if we can't compare its images with those of an 8K television for example, its 200° field of view still has the advantage of offering a greater immersion than other headsets on the market and which probably have a smaller field of view.

Manufacturer: Varjo
Graphic resolution: 1920 x 1080 OLED
1440 x 1600 AMOLED
Field of view: 87°
Weight: 605g
Year: 2019
Country: Finland

VARJO VR-1

The VR-1 is the first VR headset launched by the Finnish Start-up Varjo, founded by former Nokia engineers.

The headset uses an innovative display system that gives it an unparalleled resolution at the center of its screens.

The headset is exclusively designed for the business world, particularly for industrial design, simulation and architecture.

It has a dual display system with a clearer central area.

Thus, the headset has two types of screens. First of all, small OLED screens of the Microdisplays type which constitute the central area. These small screens are overlaid on larger AMOLED type screens.

THE MAIN VIRTUAL REALITY HEADSETS ON THE MARKET

Manufacturer: HP
Graphic resolution: 2160 x 2160
Field of view: 114°
Weight: 498,95g
Year: 2019
Country: USA

HP REVERB

The HP Reverb headset is the new VR headset from HP. It is considered from the beginning as the great rival of the HTC Vive Pro headset.

It stands out from other headsets on the market, particularly the HTC Vive Pro, for its light weight. This is an ultra-lightweight helmet compared to the headset in its category.

Like the HTC Vive Pro, the HP Reverb headset is designed for professionals.

In terms of optical clarity, the HP Reverb has a much higher clarity of view than the HTC Vive Pro, due in particular to its Field of View and graphic resolution that is almost twice as high as its rival.

Manufacturer: Oculus
Graphic resolution: 1280 x 1440
Field of view: 110°
Weight: 563g
Year: 2019
Country: USA

OCULUS RIFT S

The Oculus Rift S is part of Oculus' VR project. Indeed it was released following the launch of the Oculus Quest. But also in the continuation of the Oculus Rift series.

Unlike the Oculus Quest, the Rift S is a wired headset. It is therefore not autonomous.

The Rift S can be seen as the successor of the Rift in that the new headset (Rift S) shows several changes both in the number of integrated sensors and the resolution. But also, even if the details are less detailed, the Rift S attachment system has also been modified.

If we continue to compare it to the Rift, the notable difference is the use of the Oculus insight positioning system, which uses cameras integrated into the headset instead of using external sensors.

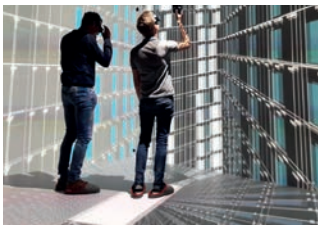
Through the feature called Passthrough+ you can see through the helmet to better locate yourself in the room. This feature is automatically activated when you leave the game area. But it can also be activated manually through the joysticks.

The kit remains almost the same compared to the Oculus Quest except that in the Rift S we have a cable for the headphones and a video output.

OTHER DEVICES ON THE MARKET

TOUCH HAPTIC DEVICE

Touch is a motorized device that applies force feedback to the user's hand, allowing the user to feel virtual objects and producing truer-than-life tactile sensations as the user manipulates 3D objects on the screen. The device is made by 3D Systems, a company based in South Carolina (USA). It is well used in the medical field for various purposes, but is also intended for various other applications such as simulation, training, skill evaluation, rehearsal, virtual assembly, robotic control, collision detection, machine interface design, rehabilitation, cartography, etc. The product is currently commercialised and is used, in particular , by FundamentalVR, a UK surgical training company



CAVE

In terms of virtual reality immersion, the Cave is undoubtedly the tool which provides the most complete immersion.

Despite this fact, the Cave or the 3D Immersive Cube remains unfamiliar to the general public, probably because the difficulty of transporting it but also and especially to deploy it unlike headsets and other virtual or augmented reality devices.

Even if its price remains high, there is a real advantage to using the Cave because of the total immersion it offers. Indeed, in a Cave there is no restriction in the field of view.

ULTRAHAPTICS - STRATOS

The haptic effect feedback technology, is an innovative technology because it allows you to feel what you touch on a screen.
For a long time, techniques have consisted in setting up systems that involve contact with the screen or using equipment such as gloves.
Ultrahaptics has developed a technology that allows you to feel what you touch without direct contact with the screen. The Stratos in particular.
Technology makes it possible to know the shape of the object you are touching. With the Stratos-Ultrahaptics, the return of the haptic effect is optimally perceived at a distance of between 5 and 35 cm.
It should also be noted that even without a display, the Stratos can work.

OTHER DEVICES ON THE MARKET

SENSGLOVE

The SenseGlove is a tool that allows you to feel and control virtual environments, using your hands only. Thus, it has three main elements:
• Motion tracking: with these 24DoF, the SenseGlove accurately tracks the fingers, hand and wrist through any possible gesture.
• Feedback Force: SenseGlove's patent-pending haptic drives can put up to 1.8kg of force on each finger, creating the sensation of both hard and soft materials.
• Tactile Feedback: With a buzz motor in each individual finger, the SenseGlove can produce vibrations for interactive cues, and textual replication.

These three elements put SenseGlove at the heart of virtual reality training, but also augmented simulation processes and design verification.

MANUS VR

The Manus VR Glove is a data glove that provides intuitive interaction with virtual reality. Developed by a Dutch Start Up of the same name, Manus VR's gloves tend to reinforce immersive experiences by tracking hands in real time.
Therefore they offer unlimited possibilities. They are an essential device for a successful training simulation, as they allow us to have a haptic feedback and thus have a feeling of touching the objects.
Designed for the professional sector at first, the gloves are equipped with a high-performance battery. They integrate different sensors, such as a gyroscope, an accelerometer and a magnetometer, which facilitates tracking.
What's new about these gloves is that they incorporate a vibrating motor on each finger, which provides better information feedback when grabbing an object in the virtual environment.
Manus VR gloves are compatible with the main VR and Capture motion systems.

OTHER DEVICES ON THE MARKET

TESLASUIT

Beyond the haptic devices that already exist such as gloves, collars and other sensors, TeslaSuit is the most advanced device in this field. Indeed, TeslaSuit is a haptic suit that allows you to feel the elements you see through your VR headset. The particularity of TeslaSuit is that as a combination, it offers a haptic feedback over the whole body. To achieve this result, the combination uses an electro-tactile feedback system. Thus it integrates about 92 electric beacons from the chest to the legs, capable of transmitting all types of sensations. The Combination integrates two types of electrostimulation, one of which stimulates the muscle and the other activates electrical discharges on the skin. It is important to emphasize that discharges are normally harmless to the body. Through this suit, the immersion using the VR is quite total. Because you can feel the cold on your body, just like the feeling of heat. It is also possible to simulate a collision without physical damage.

SPOTTED BY LAVAL VIRTUAL

Every week we read nearly 4,000 articles on virtual reality, augmented reality and related technologies (robotics, 3D printing, artificial intelligence etc) in the international press, here are some of the topics we have spotted for you...

SPOTTED BY LAVAL VIRTUAL

MARIE LEBLANC
NICOLAS RIBEYRE
LÉA PAULE
ALPHA DIALLO
VR/AR INTELLIGENCE

DISCOVER THE LATEST WEEKLY VR/AR USE CASE
IN YOUR BUSINESS WITH THE LAVAL VIRTUAL'S VR/AR NEWS FEEDS

FREE REGISTRATION

EYESIGHT

TESTING GLAUCOMA WITH VR

ORIGINALLY DESIGNED FOR GAMING – INTO MEDTECH DEVICES THAT CAN MONITOR EYE AND NEUROLOGICAL HEALTH

Like vignetting on an old photograph, the first signs of glaucoma appear as dark fringes around the periphery of your vision. With time, the blackness creeps inward, narrowing your field of view to smaller and smaller circles—as if you were looking at the world through a rolled-up piece of paper. Often referred to as the 'sneak thief of sight' because of its slow and stealthy progression, glaucoma is the second leading cause of blindness worldwide after cataracts, and is estimated to affect some 66 million people by 2020. In Singapore, the disease affects about three percent of the population aged over 40. While vision lost to glaucoma cannot be restored, there are treatments that can slow its progression, provided the disease is detected early. By taking advantage of VR headsets with eye-tracking technology, BetaSight wants to give decades-old medical tests like the Humphrey a significant upgrade—with the aim of improving the diagnosis of glaucoma and other eye and neurological diseases. A new look at vision tests BetaSight got its start in 2017 at Entrepreneur First (EF) Singapore, a company builder programme that brings together individuals with deep tech expertise. A visual effects and computer graphics expert, Mr Sawtell applied to the programme after a four-year stint at Lucasfilm—you've probably seen his work on the big screen in movies like Ready Player One, Thor: Ragnarok and Star Wars Episode VII: The Force Awakens. "I'd been looking for a way to combine my interest in VR with some kind of business outside of the content realm," he explains. At EF, he met Dr Manders, an image processing researcher who trained with Canadian AR pioneer Steve Mann, whom many regard as the father of wearable computing. Keen to be a part of Singapore's increasingly vibrant startup community, Dr Manders joined EF after a decade as a research scientist at the Agency for Science, Technology and Research's Institute for Infocomm Research, where he worked on projects such as VR environments and user interfaces. Through conversations with researchers at the Singapore Eye Research Institute, the pair realised that glaucoma testing badly needed a rethink. To take the Humphrey test, patients must sit immobile with their heads in a visual field analyser—an unwieldy machine that needs to be housed in a lighting-controlled room. They are then asked to stare at a dot of light in the centre of their visual field, and to click a button whenever they see a blinking light in their peripheral vision. But because staring at a fixed point for ten minutes is mentally and physically exhausting, data from the test is often unreliable, BetaSight's founders learned from the eye doctors. "By the time you're done with both eyes, you're psychologically drained," explains Dr Manders. "On top of that, 50 to 70 percent of the results may be thrown out."

THE EYES AS WINDOWS TO HEALTH

With VR headsets with eye-tracking capabilities becoming more commonplace, Dr Manders and Mr Sawtell hit on the idea of building a new visual field test using off-the-shelf technology. To take BetaSight's test, patients simply don a headset and follow points of light with their eyes. "Instead of forcing yourself to stare at a dot, you can just be natural and look around. It makes the test much more accessible," says Mr Sawtell.

The pair even coded in a taste of old-school arcade games: when points are correctly tracked, they explode in a tiny burst of light and a satisfying 'ping'. In addition to the direct results of the test, BetaSight also uses the eye-tracking data collected to train neural networks. Eventually, the goal is for these to be able to predict—based on a person's eye movements—the probability that he or she has glaucoma, age-related macular degeneration, diabetic retinopathy or other eye diseases, say the co-founders. For a start, the company is planning clinical trials to evaluate its eye-tracking-based glaucoma test against existing methods of diagnosis. But the eyes give away much more than information about eye health. "They reveal so much about what a person is thinking, both on a reflexive level and on a higher-order cognitive level as well," said Mr Sawtell. "They reveal intent—if you ask somebody to carry out a simple task, you can almost see their mental process unfold when you watch what their eyes are doing." In the longer term, these insights will allow the company to expand beyond ophthalmology to diagnose other ailments, including neurological conditions such as attention deficit hyperactivity disorder, Parkinson's disease and dementia, the founders hope. With VR and eye-tracking set to go into widespread use in the near future, BetaSight's technology may eventually weave its way into daily life, think the duo. "With VR and eye-tracking, it's going to be similar to wearing a smartwatch with a heart rate monitor—there's all this information about you that will be available from a background service or an always-on service. Imagine if you were just playing a game or doing something in VR, and we could get all this extra information about your health," said Mr Sawtell. "It seems logical that this will happen in the future, and we aim to be in the best position when it does."

Sources: AsianScientist.com, sginnovate.com, Betasight

MORE INFO ABOUT BETASIGHT

BetaSight Technologies uses VR and Eye-Tracking to understand a user's health. Their mission is to make diagnostics intuitive, engaging and ubiquitous by understanding what your eyes are doing. By focusing on the problem of Glaucoma first, their growing platform should grow to be able to diagnose neurological as well as physiological conditions. According to them, eye-tracking will be the new blood test, enabled by the coming wave of mixed reality technology.

BetaSight has raised 2 rounds. Their latest funding was raised on Feb 1, 2018 from a Convertible Note round. BetaSight is funded by 2 investors. SGInnovate and Entrepreneur First are the most recent investors.

Mr. Sawtell looking at data from BetaSight's test © SGinnovate

HUMAN HEART TISSUE

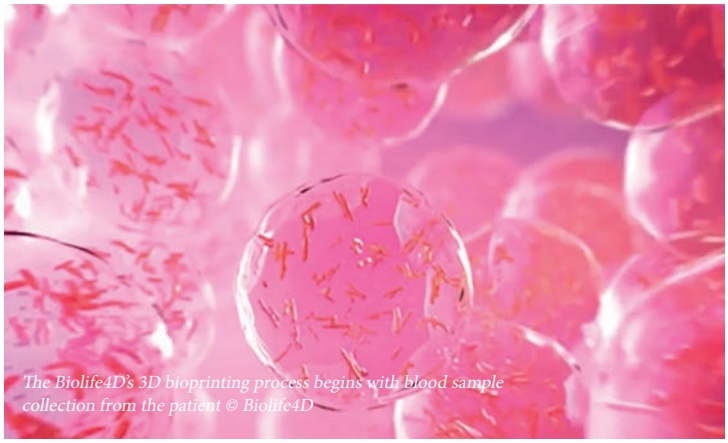
BIOLIFE4D "3D BIOPRINTS" HUMAN HEART TISSUE

Biolife4D, a Chicago-based medical tech firm specializing in 3D bioprinting and tissue engineering, has successfully demonstrated its ability to 3D bioprint human cardiac tissue – specifically, a human cardiac patch. The successfully 3D printed cardiac patch contains multiple cell types of which the human heart is made of, rather than just cardiomyocytes, and includes preliminary vascularization. Bioprinted 3D cardiac patches can be used in patients with acute heart failure to restore lost myocardial contractility.

The whole process was completed in just a few days and much sooner than anticipated. Biolife4D will now turn its focus to other constructs like valves, blood vessels and a mini-heart as it seeks to progress to 3D bioprinting a full human heart.

«The speed at which we bioprinted 3D human cardiac patches, within days, is unheard of within the scientific community,» said Dr. Ravi Birla, Chief Science Officer (CSO) at Biolife4D. «These efforts clearly demonstrate our ability to bioprint human tissue and provide a clear and rapid pathway towards bioprinting human hearts."

The Biolife4D's 3D bioprinting process begins with blood sample collection from the patient. Because every cell in a human body has the same number of genes and the same DNA, every cell has the potential to be converted to essentially any other cell. In the second step of the process, the blood cells from the sample is converted to unspecialized adult induced pluripotent stem cells (iPS) – cells that can ultimately be changed back into specialized cells of our choice.



The Biolife4D's 3D bioprinting process begins with blood sample collection from the patient © Biolife4D

Through a process called differentiation, iPS cells would be converted to almost any type of specialized cell in the human body, in this case cardiomyocytes (heart cells). These cells would then be combined with nutrients and other necessary factors in a liquid environment (hydrogel) to keep the cells alive and viable throughout the process. This bio-ink would then be loaded into a bioprinter, a highly specialized 3D printer designed to protect the viable living cells during the printing process.

Biolife4D's 3D bioprinting process provides the ability to reprogram a patient's own (white) blood cells to iPS cells, and then to differentiate those iPS cells into different types of cardiac cells needed to 3D bioprint not only a cardiac patch but ultimately, a human heart viable for transplant.

"This is a tremendous time for Biolife4D and we could not be prouder to have accomplished this scientific landmark in such a short period of time," said Steven Morris, CEO, Biolife4D. "From the beginning, our mission has been to utilize our technology to save lives. Today, we believe we are one step closer to ultimately achieving that goal."

This ability is crucial as Biolife4D seeks to disrupt how heart disease and other cardiac impairments are treated, particularly by improving the transplant process by eliminating the need for donor organs.

Sources: 3ders.org, Biolife4D

MORE INFO ABOUT BIOLIFE4D

Biolife4D is committed to perfecting the technology to make viable organ replacement a safe, accessible and affordable reality. With Biolife4D, a patient-specific, fully functioning heart will be created through 3D bioprinting and the patient's own cells, eliminating the challenges of organ rejection and long donor waiting lists that plague existing organ transplant methods.

VIRTUAL REALITY

TRAINING SURGEONS

HOW VIRTUAL REALITY CAN HELP TRAIN SURGEONS
OSSOVR AT UCLA'S DAVID GEFFEN SCHOOL OF MEDICINE

Advancements in medical devices and surgical techniques hold promise for saving and improving lives. But our current system of training and assessing surgeons has lagged behind the pace of innovation — leaving some doctors unprepared to perform complex surgeries and putting some patients at risk. Using virtual reality technology in training may play an important role in addressing these deficiencies and improving skills.

While the skills-deficiency problem takes many forms, we see a particular disparity in surgeon preparedness between their residencies and fellowships. This leads us to the questions: Are some residents innately better surgeons? Or do these differences point toward discrepancies in the clinical scenarios and the level of autonomy that each surgeon experienced in training? For example, while one surgeon might have performed dozens of hip arthroscopies during their training, another might have done it once or never at all.

More to the point, how can we deliver the right kind of training in a standardized way? Furthermore, how can we objectively assess whether surgeons can perform proficiently prior to entering independent practice?
Indeed, accurate and objective assessment is an Achilles heel among many surgical residency programs. These programs don't traditionally provide standardized assessments with quantitative benchmarks or "scores" for surgical skill, which can leave them subject to bias when it comes to gauging residents' performance. When defining a "good surgeon," it can be difficult to separate bedside manner and work ethic from technical ability and surgical mastery.

In addition to challenges with assessment, surgeons often lack adequate opportunities to consistently practice skills they're learning — especially skills related to new medical technologies. When training on a new device, surgeons often travel to a one to two-day training workshop with the medical device company. This one-time

Training Surgeons in VR © Osso VR

training generally doesn't offer avenues for surgeons to continue reinforcing their skills. It could be four to six months from the time surgeons train on a procedure to when they perform it on a patient, forcing them to refresh their knowledge "on the fly" in the operating room.

These shortfalls in training and assessment are creating increasing levels of risk, with serious consequences for patients and the surgeons that care for them. Consider these statistics:
A recent University of Michigan (1) study found that 30% of surgeons couldn't operate independently after residency.
Lower-skilled bariatric surgeons had mortality rates five times higher than their high-skilled counterparts, according to research (2) published in the New England Journal of Medicine.
An estimated 7 million patients around the world experience surgical complications each year (3).
VR-based training systems offer a solution to several aspects of these challenges. These platforms directly address the skills gap by providing immersive, hands-on training that closely simulates an operating room environment. VR platforms offer portable, on-demand training that can be used anytime, anywhere.

What is more, VR-based tools incorporate "checklist-style" assessment measures to objectively gauge surgical proficiency, taking the process outside the realm of human subjectivity. These tools offer a highly granular picture of what surgeons are doing correctly and identify areas for improvement.

Hospitals and universities around the world have successfully embraced VR-based training for years, but until now, we've had limited research on VR's effectiveness. We set out to fill that gap through our recent clinical validation study at UCLA's David Geffen School of Medicine. The key finding:

"VR training on the Osso VR platform improved participants' overall surgical performance by 230% compared with traditional training methods."

In the study, which was performed end of september 2019, 20 participants were randomized between a traditionally trained group and a group that underwent VR training on the Osso VR platform to a specified level of proficiency. Then, each participant performed a tibial intramedullary nailing, a procedure to repair a fractured tibia, one of the bones running between the knee and ankle. They operated on an artificial "sawbones" model, graded by a blinded observer.

As measured by the Global Assessment Five-Point Rating Scale, participants in the VR group received significantly higher ratings in all categories compared to the traditionally-trained group, with an overall improvement of 230% in the total score. VR-trained participants completed the procedure an average of 20% faster than the traditionally-trained group. They also completed 38% more steps correctly in the procedure-specific checklist. Both findings were statistically significant.
The results of the yet-unpublished study, "Randomized, Controlled Trial of a Virtual Reality Tool to Teach Surgical Technique for Tibial Shaft Fracture Intramedullary Nailing" were presented at the 2019 Annual Meeting of the Western Orthopedic Association. Long-term longitudinal studies are needed to further explore how VR impacts patient outcomes and decreases costs by improving surgical efficiency.
Today's rapidly evolving surgical landscape requires new ways to provide access to experiential surgical education. In addition, we must formalize our approach to technical assessment in order to more objectively measure surgeons' capabilities to ensure a consistent level of quality and standardized skill set of our surgical workforce. With a strained surgical-education system, rapid medical innovation and a pending surgeon shortage (4), VR may offer an important educational tool to augment surgeon training and continue to offer patients the very best care.

Sources: Harvard Business Review © Gideon Blumstein, MD, orthopaedic surgery resident at UCLA'S David Geffen School of Medicine, OssoVR

MORE INFO ABOUT OSSOVR

Osso VR is an award-winning, clinically-validated surgical training platform designed for surgeons, sales teams, and hospital staff of all skill levels. Their product offers realistic hand-based interactions in an immersive training environment containing cutting edge procedures and devices.

RELATED TECHNOLOGIES

3D PRINTING BLOOD VESSELS

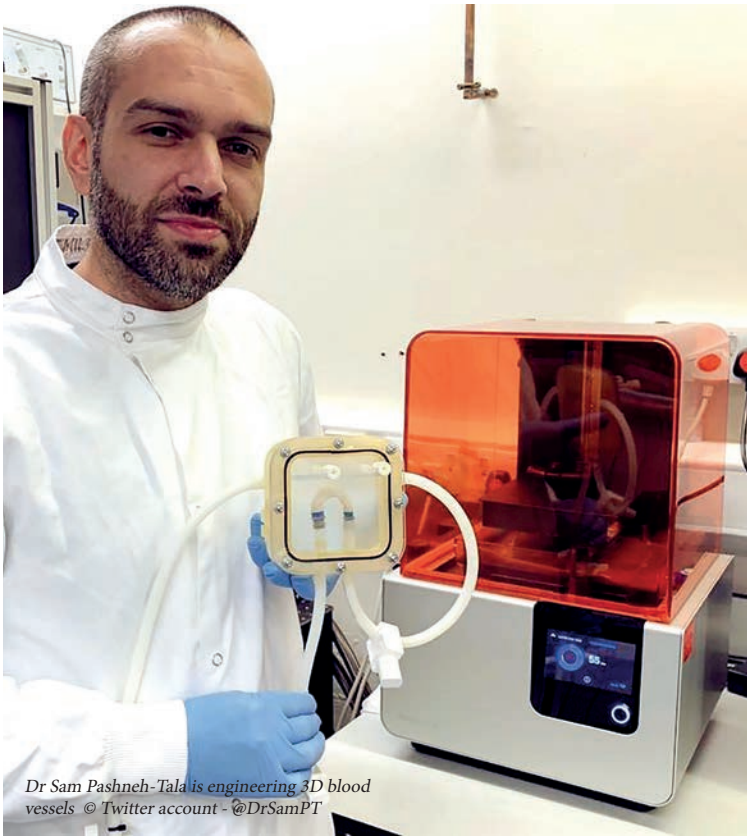
3D PRINTING ACCELERATES RESEARCH INTO CARDIOVASCULAR DISEASE AT UNIVERSITY OF SHEFFIELD

Dr Sam Pashneh-Tala, a research fellow at the U.K.'s University of Sheffield, is pioneering tissue engineering techniques for creating complex, lab-grown, blood vessels with patient-specific shapes, powered by high-precision desktop stereolithography (SLA) 3D printers.

The tissue-engineered blood vessels could be used in the development of new medical devices, heart surgery, drug treatment testing and studying cardiovascular disease. Conventional surgical treatments for cardiovascular disease rely on autografts, which involve harvesting a blood vessel from a less vital part of the patient's body and using this to repair or bypass a more important damaged or blocked vessel.

The availability of autografts is limited and obtaining them requires invasive surgery. Synthetic vascular grafts made from polymer materials are also available, although these are prone to infection and blood clotting. This is where tissue engineering comes in, enabling new blood vessels to be grown in the lab and then used for implantation.

Dr. Pashneh-Tala uses SLA 3D printing to enable the production of tissue-engineered blood vessels with a variety of geometries. **"Regenerative medicine and bioprinting functional tissue substitutes have numerous benefits, from minimizing immune rejection to reducing the need for animal and even human samples,"** says Gaurav Manchanda, Director of Healthcare at Formlabs, the maker of the SLA 3D printers used in Dr. Pashneh-Tala's experiments. **"However, the cost of development for such intricate and technically challenging devices is not always aligned with the budgets available to researchers and teaching hospitals. By using Formlabs printers and scaffold-based engineering techniques Dr. Pashneh-Tala has proven that 3D printing can be an accessible and revolutionary technology in the creation of tissue constructs with precise biomimetic properties."**



Dr Sam Pashneh-Tala is engineering 3D blood vessels © Twitter account - @DrSamPT

Sources: University of Sheffield, The Innovator, Les Echos, news-medical.net, formlabs.com

VIRTUAL REALITY

LEARNING CPR

FRENCH STARTUP D'UN SEUL GESTE LAUNCHES NEW VR TOOL TO TRAIN PUBLIC SERVICE EMPLOYEES IN FIRST AID BY 2021

During an accident or a terrorist attack, people who try to help the wounded can lose their ability when they see blood. The French startup called D'un seul geste imagined a first aid training course in virtual reality. VR is used to provoke emotions to trainees that will contribute in memorizing life-saving techniques. The startup gives first aid training course to company employees. In parallel it will launch an offer dedicated to local authorities. The idea is to train 80% of public service employees to first aid techniques in the street by December 31st 2021.

CONNECTED MANNEQUIN AND VR HEADSET

Public service employees must be able to react to an external bleeding and a cardiac arrest but also use an automatic defibrillator. The training course provided by the French startup meets these requirements. The immersive first aid training course is conducted with a first-aid mannequin connected to a VR headset worn by the user. The trainee is immersed in a room where he will learn different reflex gestures to perform. This sensorial experience will encourage memorization and action in emergency situation. Each lesson lasts one hour - 40 minutes of immersion in virtual reality and 20 minutes of discussion with the trainer. The training course comes with quizzes, badges to win and individualized scores that facilitate the involvement of learners. Virtual reality provides a real simulation but also a supervision. A trainer remains present with the learner. Moreover, virtual characters give advice in the VR simulation. Immersion in a virtual environment during the training course gives more confidence to learners. Then they can more easily react to emergency situation in the real world. It is already proven that virtual reality improves and increases gesture memorization.

Sources: infoprotection.fr, franceinter.fr

RELATED TECHNOLOGIES

WILL ROBOTS REPLACE SURGEONS?

ROBOTS ARE THE FUTURE OF SURGERY. US STARTUP VICARIOUS SURGICAL CONCEIVED A VR SOLUTION TO DO REMOTE SURGICAL OPERATIONS

Vicarious is a startup specialized in medical robotics based in Cambridge. It developed a VR surgery platform with a robot assistance. This device combines virtual reality with a patented surgical robotic technology that can be compared to a human being. It should allow surgeons to perform minimally invasive surgery with a single microincision.

Two former MIT students created the startup with the idea to develop robots that could be able to perform minor operations on patients in a completely autonomous manner. With the recent development of immersive technologies, the colleague duo added virtual reality to their project. The robots will be remotely controlled by surgeons wearing VR headset.

A SOLUTION TO EXPORT THE EXPERTISE OF SURGEONS

The robots have got a head and two arms. A camera is placed on the robot's shoulder and allows images to be transmitted to the surgeon. With a VR headset, he can then replace the machine. The surgeon has the possibility to control the robot's arms. It will reproduce the gestures of the surgeon with high fidelity.

The device could be the long-term solution to medical deserts, allowing isolated hospitals to benefit from more advanced care. It can also be a way to be treated by the best surgeons wherever the patient is in the world. Surgeons can control the robot from thousands of kilometres. According to the startup the solution could also decrease the cost of surgical operations. The idea is to democratise surgical robotic which is still too expensive for some hospitals. By providing a solution with mini-robots, costs will be less important than using real-size robots.

Source : RT Flash

MARKET & RESEARCH HEALTH

With 991 experts involved in VR/AR research in healthcare, this sector is particularly active and encouraging, especially in training.

MARKET & RESEARCH HEALTH

MARIE LEBLANC
NICOLAS RIBEYRE
LÉA PAULE
ALPHA DIALLO
VR/AR INTELLIGENCE

THE GLOBAL VR/AR MARKET WORLDWIDE BETWEEN US$200 BILLION AND US$570 BILLION IN 2025

Laval Virtual's VR/AR Intelligence Dpt. is a human-sized team: it is always complex to position oneself on the issue of markets and figures. We note in our surveillance all the public figures published (1), most of which come from American sources or are integrated into analyses conducted by Indian firms.We also keep an eye on any sources relating to the Chinese market which have a strong global influence. However, the firms list partial data which at best gives us a partial view of the market today.

Since we have been observing these markets, analysts put its importance between USD 200 billion in 2025 (for studies initiated between 2015 and 2017) and USD 570 billion for firms that conducted studies between 2018 and the end of 2019. This, by adding up the categories hardware, software and services at the global level. It is therefore within this range that we estimate the global VR/AR market size.

(1) These figures include public data published by Allied Market Research, Goldman Sachs, IDC, Zion Market Research, Gartner, Transparency Market Research, Citi Financial, IDC, CB Insight, Statista, SGDSN.

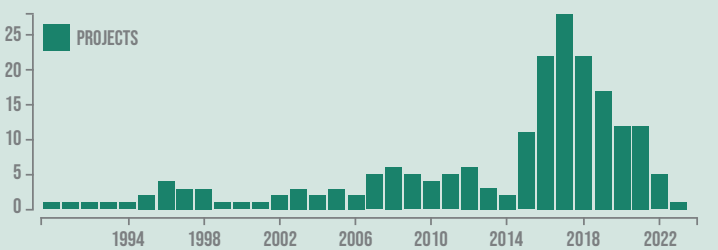
78 RESEARCH PROJECTS ARE CURRENTLY BEING CONDUCTED AS WELL AS 18 CLINICAL CASES USING IMMERSIVE TECHNOLOGIES

6277 EXPERTS ACTIVE ON THIS SUBJECT

2091 PUBLICATIONS OR SCIENTIFIC DOCUMENTS PUBLISHED

4873 ORGANIZATIONS INVOLVED IN THESE RESEARCH FIELDS

1263 LISTED PATENT FAMILIES



Listed research projects on virtual reality AND augmented reality from 1990 to 2023 (as of April 2020) © Laval Virtual

VR/AR IN HEALTHCARE

Training ahead of other areas

In the field of healthcare, it is the training that prevails in the number of use cases encountered for immersive technologies. Health care professionals must not only have knowledge, but also be able to organise, synthesise and apply this knowledge in such a way that it promotes the development of clinical reasoning.

VR is especially well-suited to acquiring behavioral and social skills by immersing the learner in an environment and simulating critical scenarios. This is invaluable for preparing residents for stressful or hazardous circumstances, all in a secure context where the clinician can restart the exercises in progress in continuous mode.

AR, in contrast, is better suited to building technical skills on the job. The combination of physical and digital visual information will allow a surgeon, for example, to perform a procedure while receiving complementary information, without having to look away. The fields of vision currently generated by headsets are quite restricted and require a certain distance between users and patients. This is a point for improvement in AR to be taken into account, but since 2017 and particularly in orthopedics, the first operations have been carried out successfully.

A FEW RECENT EXAMPLES IN THE TRAINING FIELD

VR Clinical skills from ECS (USA), developed a solution intended for medical staff. It allows the learner to dive into a care room where they can perform a physical examination on a virtual patient with whom they can interact. The solution allows the user to learn how to check all of the patient's vital signs, including blood pressure, heart rate and temperature, in order to make a diagnosis.

THE COLORADO STATE UNIVERSITY HAS ROLLED OUT A NEW VR LAB

The lab houses 100 headsets, in groups of four, allowing students and instructors to simultaneously view complex 3D anatomical images in a shared virtual space. The lab and its immersive visualizations are part of a more comprehensive anatomy education program where students also study in a traditional lab, explore medical imaging data and perform evaluations on iPads. They complement a cadaver-based curriculum.

Plain Concepts developed an AR application to assist surgeons in the Spanish Basque Country in planning biopsies for lung lesions. This initiative was done in collaboration with Osakidetza, the institution in charge of the public health system in the region.

Lung biopsies are medical examinations that can be heavy to bear because they take a long time. Indeed, if the patient is not opened, he sometimes undergoes several interventions. Before the biopsy, a CT scan is carried out to get a global vision because no direct vision is possible during the sampling phase. Once the sample has been taken, the surgeon is not sure if it is good, and must check it by doing a second CT scan. If the sample is not good, the biopsy must be repeated. In addition to this repeat biopsy, the patient must hold his or her breath during the doctor's procedure. This can therefore be a long phase of discomfort for the patient. The purpose of the application is also to reduce this discomfort.

25 RESEARCH PROJECTS ARE CURRENTLY BEING CONDUCTED AS WELL AS 43 CLINICAL TRIALS IN HEALTHCARE AND EITHER VR OR AR

991 EXPERTS ACTIVE ON THIS SUBJECT

352 PUBLICATIONS OR SCIENTIFIC DOCUMENTS PUBLISHED

4708 ORGANIZATIONS INVOLVED IN THESE RESEARCH FIELDS

30 LISTED PATENT FAMILIES

TOP 25 R&D CENTERS INVOLVED IN RESEARCH IN HEALTHCARE AND VR/AR

1. Élisabeth Bruyère Research Institute, Bruyère Continuing Care, uOttawa
Ottawa, Canada
2. Fundación Tekniker, Eibar, Gipuzkoa
Spain
3. Karlsruhe Institute of Technology Helmholtz-Gemeinschaft
Karlsruhe, Germany
4. CEReSS - Centre d'Etudes et de Recherche sur les Services de Santé et la Qualité de Vie
AMU, APHM, Marseille, France
5. Faculté de Médecine, AMU
Marseille, France
6. NTT Medical Center, Nippon Telegraph & Telephone East Corp.
Tokyo , Japan
7. Faculty of Medicine, UofT
Toronto, Canada
8. LETI - Laboratoire d'Electronique et des Technologies de l'Information, CEA
Grenoble, France
9. IETR - Institut d'Electronique et de Télécommunications de Rennes CNRS, CNRS Bretagne et Pays de la Loire, Université de Rennes 1, SUPELEC, INSA RENNES
Rennes, France
10. ENAC - Ecole Nationale de l'Aviation Civile
Toulouse, France
11. Duke University School of Medicine, Duke University Hospital, Duke University Health System
Durham, United States
12. Department of Computing Science, UmU
Umeå, Sweden
13. Faculty of Health and Medical Sciences, KU
Copenhagen, Denmark
14. IRCAM - Institut de recherche et coordination acoustique/musique
Paris, France
15. LIS - Laboratoire d'Informatique et Systèmes
AMU, UTLN, CNRS Provence et Corse, EC
Marseille, France
16. LTCI - Laboratoire Traitement et Communication de l'Information CNRS Paris A, ENST
Paris, France
17. LPL - Laboratoire Parole et Langage, AMU, CNRS Provence et Corse, CNRS
Aix-en-Provence, France
18. CRI - Centre de Recherche en Informatique, ENSMP
Fontainebleau, France
19. IFC - Institute of Clinical Physiology, CNR Pisa, Italy
20. Warwick Medical School, The University of Warwick
Coventry , United Kingdom
21. CS - Subdepartment of Clinical and Social Psychology, LiU
Linköping, Sweden
22. NIA - National Institute on Aging, NIH Bethesda, United States
23.Department Of Surgery, Mount Sinai Hospital
Toronto, Canada
24. Weill Cornell Medical College, Cornell University
New York, United States
25. Robarts Research Institute, Western University
London, Canada

TOP 25 ACTIVE PEOPLE IN R&D FOR HEALTHCARE AND VR/AR

1. Nathaniel Patrick Andrew QUAIL
University of Glasgow, U.K
2. Byeong DOO CHOI
Samsung Electronics ,South Korea
3. Eric YIP
Samsung Electronics, South Korea
4. Lisette jewc VAN GEMERT PIJNEN
Faculty of Medical Sciences Universitair Medisch Centrum Groningem, Netherlands
5. Hanneke KIP
Department of Research Stichting Transfore
Deventer, Netherlands
6. Saskia M KELDERS
Optentia Research Focus Area North-West University Vanderbijlpark, South Africa
7. Yvonne H. A. BOUMAN
Department of Research Stichting Transfore
Deventer Netherlands
8. Marilena DO NASCIMENTO
Beehive integrated medical therapeutic area
colmeia, Brazil
9. Lisa SHEEHY
Élisabeth Bruyère Research Institute , Bruyère Continuing Care, uOttawa, Canada
10. Giuseppe RIVA
Department of Psychology, Catholic University of Milan, Italy
11. Jun HYUNG KIM
Samsung Electronics, South Korea
12. Du SAN BAE
Samsung Electronics, South Korea
13. Bon-Hyun KOO
Samsung Electronics, South Korea
14. Junhyung KIM
Samsung Electronics, South Korea
15. Young-Kyu KIM
Samsung Electronics, South Korea
16. Dusan BAEK
Samsung Electronics, South Korea
17. Taewon AHN
Samsung Electronics, South Korea
18. Youngkyu KIM
Samsung Electronics, South Korea
19. Bonhyun KOO
Samsung Electronics, South Korea
20. Tae-Won AHN
Samsung Electronics, South Korea
21. Gilda APARECIDA DE ASSIS
Department of Informatics , Federal University of Technology – Parana (UTFPR), Pato Branco, Brazil
22. Roseli DE DEUS LOPES
Universidade de São Paulo, Brazil
23. Ana Grasielle DIONÍSIO CORRÊA
Universidade de São Paulo, Brazil
24. Wolfgang STAUBMANN
University of Applied Sciences, Austria
25. Xiaoguang LI
Samsung Electronics, South Korea

TOP 25 COMPANIES INVOLVED IN R&D FOR HEALTHCARE AND VR/AR

1. Samsung Electronics
Seoul, South Korea
2. Bright Cloud International Corporation
HIGHLAND PAKR, United States
3. Nippon Telegraph and Telephone Corporation
Tokyo, Japan
4. The Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD)
Rockville, United States
5. YANTRIC, INC.
WEST NEWTON, United States
6. Virtually Better
Decatur, United States
7. Engie
Paris, France
8. Hudson Simulation Service, LLC
Delmar, United States
9. Microsoft
Redmond, United States
10. U.S. Department of Veteran Affairs
Washington, United States
11. Kimberly-Clark Corporation
Dallas, United States
12. Clinical Tools, Inc.
Chapel Hill, United States
13. BioSensics
Watertown, United States
14. Society of Family Planning
Denver, United States
15. Bioindustry Park Silvano Fumero
Colleretto Giacosa (to), Italy
16. Air Liquide International
Paris, France
17. STMicroelectronics
Geneva, Switzerland
18. Orange
Paris, France
19. Conversion Energy Enterprises
SPRING VALLEY, United States
20. Axway
La Défense, France
21. Koninklijke Philips
Amsterdam, Netherlands
Netherlands
22. Daum
Schwerin, Germany
23. 3d Web Technologies
Carrington, United Kingdom
24. Pera
Melton Mowbray, United Kingdom
25. People Pulse Media LLC
Dubai, United Arab Emirates

CONTRIBUTIONS BY EXPERTS

VR/AR projects in healthcare are often born out of difficult periods of life where technologists strive to improve the well-being of their patients, family and friends, all of whom are keen to measure progress thanks to immersive technologies.

R.O.G.E.R offers the possibility to progress safely in a everyday life environment. // © Vladimir Mokry, Unsplash

SÉBASTIEN SERLET
UNIVERSITÉ LIBRE DE BRUXELLES

R.O.G.E.R : CREATE YOUR OWN VIRTUAL SCENARIO FOR COGNITIVE EVALUATION OR REHABILITATION

Currently, the professionals of cognition dispose of tools to create virtual environments (Unity, Engine Unreal ...). However, these tools require specific knowledge in order to obtain convincing results. There is a real demand of tools and softwares by cognitive professionals to create their personalized evaluation tasks. These new methods will have a key role in the processes of evaluation and rehabilitation of the cognitive functions.

Numerous studies demonstrated that the virtual reality is an effective tool in clinical neuropsychology as well as in neuroscience research (Camara Lopez, Cleeremans, Seron, & Van der Linden, 2016 ; Jollivet, Fortier, Besnard, Le Gall & Allain 2018 ; Allain & Joubert 2019). Current virtual tools allow to evaluate and improve cognitive functioning, but very few of them leave the possibility to personalize the material and the situation according the needs of the patients. Indeed, many of these tools offer pre-established situations that are effective in the lab but that offer no degree of freedom for users to make the care more ecological. Cipresso et al., 2014 have shown the effects of the virtual reality on the cognitive functions re-educated. They advocate the use of ecological situations to facilitate the transfer of knowledge (learning, technics, use of aids ...).

REALITY SOFTWARE TO HELP IN COGNITIVE REHABILITATION

R.O.G.E.R (Realistic Observation in Game and Experiences in Rehabilitation) is a virtual reality software. It was developed by a video game compagy, by researchers and neuropsychologists and offers the possibility to create cognitive evaluation scales and game scenarios as a help in cognitive rehabilitation. This is a Belgian creation subsidized by the public authorities mainly. Many prototypes led to a final version in 2016.

This software can be used in research laboratories or neurological rehabilitation unities. It can be employed by many therapists (neuropsychologists, physiotherapists, speech therapists, occupational therapists...) and different research profiles (researchers, engineers, developers...). It is also possible to add physiological measurements that can be recorded and analyzed during reeducation sessions (eye-tracker, electrodermal activity, cardiac ...). The software can be coupled with different measures and facilitates the diagnosis during the evaluation of cognitive functions. For example, it is possible to couple behavioral data with an eye-tracker to evaluate a neglect syndrome.
Virtual reality is accepted as a medical tool and offers a better transfer in daily life activities (Cipresso et al., 2014). It becomes obvious to suggest exercises or situations that are very close to everyday life situations (cooking, managing one's daily life, shopping, etc.). Today, any software in virtual reality propose everyday situations to encourage immersion and a recording of behavioral and cognitive data as they occurred in the patient's daily life. For instance, Rizzo et al., in 2000, proposed to use a virtual classroom for the assessment and rehabilitation of children with attentional deficit disorders.

R.O.G.E.R offers the possibility to progress safely in a everyday life environment. The environment includes a virtual house (bedroom, kitchen, living room, bathroom, toilet, gardens...) accessible on a computer (the graphic quality and the design parameters for a complete immersion). The software also disposes of a system of movement in the environment facilitated by an interaction with a manual joystick (with one hand). This joystick makes learning easier and more accessible. The software includes an ergonomic scenario editor for configuring and designing your own scenarios.

The scenario editor (ergonomic, without prior knowledge of codings) allows you to add objects, avatars or to write a text, a help. Thus, it becomes possible for a therapist to create daily situations by incorporating cues, such as objects helpers. The therapist can also modulate levels of difficulty depending on the performances of the patient. It is also possible to set up the types of reminders and modify them from one session to another to keep the patient motivated. Indeed, the therapist can set up the sequences of actions to play as well as the order of appearance of the objects or helpers. He can reveal distractive tasks at a defined time or randomly. It is also possible to set up other options such as the appearance times or responses of certain situations.
Subsequently, we will create a library for share yours creations. This platform can be used for buying and selling scenarios (created by other professionals and made available to all). Each new creation will enrich the catalog of the software. Every scenario in the library will be evaluate by an expert committee.

REAL-TIME SCENARII

The software also disposes of a system of movement in the environment facilitated by an interaction with a manual joystick

Finally, it is also possible to obtain specific data necessary for the evaluation. The therapist can easily design an exercise (a baseline, a stimulation, a situation...) and extract the important data (response time, reaction time, correct answer rate, answer order...) in order to measure effects (links between an answer and a behavior). Then, the data can be extracted to proceed to a statistical analysis. With the collect of the data, there is also the possibility of real-time data realignment for each scenario with evaluation goals as well as rating scales for re-education scenarios (baseline for example). For example, we can recreate a daily life situation such as preparing a meal. Considering a patient with memory impairment, we can ask him to memorize a list of ingredients and then pick them up (in the fridge, closets...). The first steps can be done with few ingredients and we can increase the number of ingredients to improve the difficulty. We can also provide more distractors or add delays (for immediate or delayed recall). This exercices can be done according to the current goals of the patient (prepare a suitcase, prepare a do-it-yourself moment...). Then, we can adapt this situation to many requests (make a cake, an egg, a breakfast ...). We have the possibility to record the time for the passation, the order (organization), the delay between an order and the behavior... All the situations can be evaluated and played again identically. R.O.G.E.R promises a graphic quality, a grip accessible to everyone and will allow a constant update (adding features, objects). It can be used in a huge range of cognitive functions (memory, executive functions, inhibition...), pathologies (degeneratives disorders, ADHD...), ages (from childhood to the elderly) and bring new approaches and new data for the clinic and research fields. All data collected during the sessions can be grouped together and can serve as standardization data for assessment or re-education scenarios. Thus, researchers can make available their protocols and collect data from each user. The method and the scenario will be present in the library. A therapist will be able to download this protocol and will obtain data for the researcher. We hope to create a software by therapists with the help of therapists (researchers, experts and clinical therapists).

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PAULA SÁNCHEZ MARTÍNEZ
ALFONSO SORIANO BALLESTER
INNOAREA PROJECTS
#TRAINING

HOW VIRTUAL REALITY TECHNOLOGY CAN HELP TO TRAIN FUTURE HEALTH PROFESSIONALS

Virtual Reality is a technology that has spread in recent years to different fields: from marketing, through construction, sports or health. This last is one of the sectors that is benefiting most from the advances produced in the industry of Virtual and Augmented Reality. In addition, it seems these immersive technologies have arrived to stay in the world of health

TRAINING OF FUTURE HEALTH PROFESSIONALS THROUGH VIRTUAL REALITY

In the sanitary field, as in many others, Virtual Reality is a very effective tool for training medical and nursing students. The Catholic University of Valencia is making the jump to training their students using glasses and Virtual Reality controllers. In this way, their students learn in the virtual environment to develop tasks they will have to carry out in their workplace. Specifically, when the user get into the immersive experience, is virtually placed in an surgery. Thus, according to the level of difficulty they choose, they have to unite different bones to form a complete skeleton.
This training system has countless advantages for the students. Thanks to this technology, they can practice, take risks and make mistakes without causing harm to any patient. It will be very useful to prevent future failures.

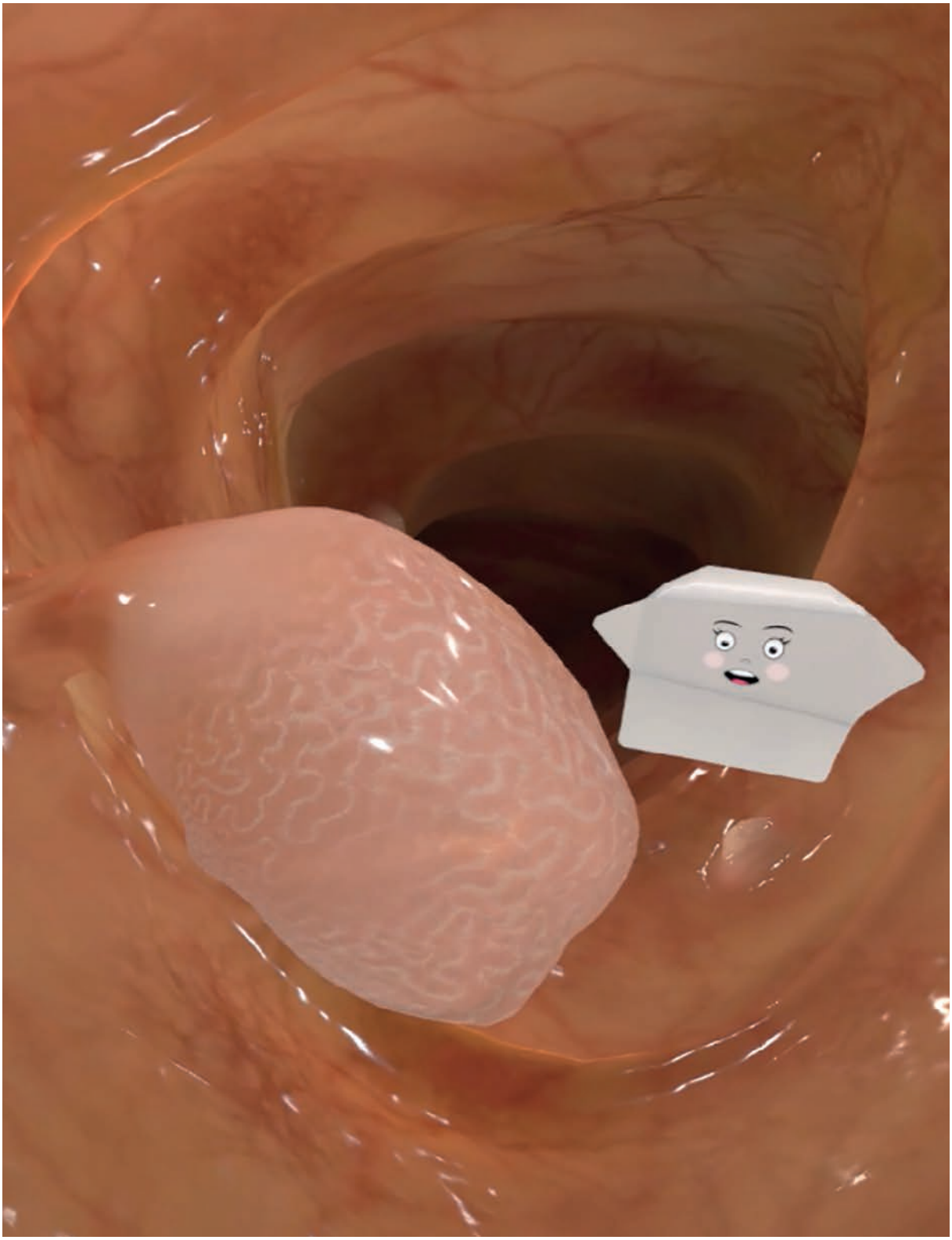
VIRTUAL REALITY TO DECREASE CHILDREN'S FEAR OF INJECTIONS

Also, Virtual Reality is a tool that can help children to overcome certain situations without incidents. We refer, for example, to the panic that youngest patients tend to have towards needles. The Public University of Navarra detected this problem and thought in Virtual Reality as a method to entertain children and bring them to an immersive world where they aren't altered by the presence of needles or doctors around them. The experience lies in series of fun mini-games in which the children have to complete puzzles and interact with animals.

VIRTUAL REALITY TO IMPROVE THE QUALITY OF LIFE OF PEOPLE IN SITUATIONS OF DEPENDENCY

Another application of Virtual Reality is its ability to improve the quality of life of people in situations of dependency. VITAVR, a Madrid-based company dedicated to the care and rehabilitation of dependent persons, has implemented 360º video and Virtual Reality in the therapies they offer to their patients. Thanks to this technology, the responsible therapist can manage the session from a PC, making decisions such as,

for example, the speed of the videos, the music and the images that are reproduced. Through this technology, this specialized professional can offer group therapy, supporting on the visual and auditory stimulus he or she wishes.
Thanks to these projects, it has been able to see how Virtual Reality technology is playing an increasingly important role in the field of health.



COLOVISIO® projects the visitor inside the colon to observe lesions // © MiddleVR studio

USING VR TO PREVENT THE COLORECTAL CANCER

43 000 new cases of colorectal cancer are identified each year in France, causing more than 17 000 deaths. Though it can save lives, the national prevention program participation rate is still very low, reaching only 32.1% of the French population. Among the main causes are the misconception and taboos persisting around the disease and the testing modalities, consisting in the detection of blood in the feces. To raise awareness about the disease danger and prevention modalities, the French League Against Cancer called on MiddleVR Studio to develop the pedagogical VR application COLOVISIO.

A PUBLIC HEALTH EMERGENCY

The colorectal cancer is, by its frequency, the second biggest death cause for French men and the third biggest one for women. The populations the most at risk are the elderly persons aged from 50 to 74 and people having a family background. Raising awareness amongst those populations about the disease danger is crucial, yet it is not an easy task.

One of the major issues of the colorectal cancer prevention is the breaking of taboos persisting around the detection test modalities. "Today, a particularly simple and effective free screening test kit exists to help people collect a feces sample before sending it to the medical center for an analysis. However, a lot of barriers remain despite the prevention efforts : lack of sensitization, misconception of the diagnostic procedures, fear of the colonoscopy, embarrassment about this cancer location or about the fact of having to manipulate their feces..." explains Dominique RONDU, French League Against Cancer Calvados Committee President.

Yet, promoting the prevention program is a challenge that, once taken up, can save lives. Indeed, if the colorectal cancer is detected at an early stage, the disease can be cured in 9 out of 10 cases.

MAKING THE INFORMATION ACCESSIBLE

The French League Against Cancer Calvados and Seine-Maritime committees searched for new ways of preventing populations and called on MiddleVR Studio to develop the virtual reality application COLOVISIO.
The objective was simple and ambitious: using the pedagogical power and realism of VR to overtake taboos by making the information accessible and ludic to the general public, despite the anxiety that can be generated by the discussions about the disease.

Via VR, the experts can show the evolution of the colorectal cancer to help people better understand how a simple screening test can help detect the disease as early as possible to greatly raise the chances of recovery.

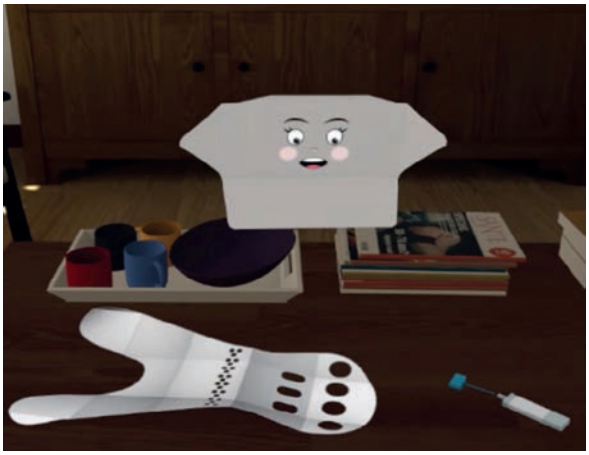
"When the Calvados Committee contacted us, we quickly understood the major issues of COLOVISIO in terms of prevention. We needed to make people discover the colon from the inside so that they can visualize how our body is made to better understand the different phases of the lesions. After the demystification of the disease itself, a major point was to explain and demonstrate the simplicity of the screening test and to sensitize people on the chances of recovery to, finally, contribute to the breaking of taboos crystallized around the disease to actually save lives" relates Christophe Gouet, Director of MiddleVR Studio.

IMMERSION SERVES A LUDIC, INTERACTIVE AND PEDAGOGICAL APPROACH

COLOVISIO was elaborated by both French League Against Cancer committees, gastroenterologists from the Rouen university hospital and VR experts from MiddleVR Studio to explore all the possibilities virtual reality could offer the colorectal cancer prevention.

VR is a powerful pedagogical tool helping experts explain complex concepts more easily as it allows people to see what they cannot access in reality. Here, COLOVISIO projects the visitor inside the colon so he can observe closely the lesions and the cancer evolution in a time-lapse mode.

"The immersion allowed by virtual reality makes the understanding and the appropriation of complex concepts easier and dedramatize the subject by the very attractiveness of the experience." explains Dominique RONDU, the French League Against Cancer Calvados Committee president.
May we not, indeed, forget the ludic and attractive aspect of the VR experience, which is still an innovating and new experience to live for non-specialists. Attracted by the opportunity to live a virtual reality experience, some of them may be more inclined to discover the colorectal cancer



Appropriation of complex concepts with VR // © MiddleVR Studio

screening test modalities. VR then acts as a mediator.

COLOVISIO, AN INVITATION TO THE DIAGNOSTIC TEST

The VR application COLOVISIO proposes to the visitors a prevention scenario of the colorectal cancer detection test. The audience is guided by a little character shaped as an envelope. This envelope represents the invitation mail emanating from the local screening antenna. It grumbles tenderly and ironically against the visitor who neglected the diagnostic test invitation. After this short introduction, the envelope leads the visitor through an exploration inside the colon so he can understand everything about its function and the disease without over-dramatizing it. In the end, the scenario brings the visitor back to reality by explaining how the detection test works.

The envelope is reassuring, and addresses the disease differently, with pedagogy. Understanding the colorectal cancer evolution to learn more about the simplicity of the screening test is a crucial element in the prevention of the disease. The message has thus to be delivered with empathy, and no moralization, because the final aim of COLOVISIO is to encourage the audience to respond positively to the French League Against Cancer invitation. COLOVISIO is a tool to help experts inform in new ways the general public about the disease, removing doubts, fears and prejudices subsisting around the colorectal cancer, in order to promote the detection test. To do so, the French League Against Cancer showcased COLOVISIO during the "prevention days" (Journées "Côlon allez-vous?") organized in partnership with ADRÉA Mutual in the context of Blue March, the month dedicated, in France, to the colorectal cancer disease. The French League Against Cancer already obtained good feedbacks from the populations when they used the VR application during their prevention tour in March 2019. Virtual reality opens new possibilities to inform the widest audience possible. "The immersion contributes to the removal of geographical limitations: the application is practical and movable and will allow the French League Against Cancer committees to broadcast the information to a wider public. It's particularly interesting to communicate to sectors less inclined to answer to the prevention campaigns and to target isolated locations, distant from prevention and medical cares" explains Dominique RONDU, the French League Against Cancer Calvados Committee president.

NOTES :

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A NEW SOLUTION TO DIAGNOSE MUSCULOSKELETAL DISORDER RISKS

The direct cost of musculoskeletal disorders is 900 million € along with 10 millions lost workdays every year in France. In the USA, the cost is 213 billion $ along with 291 million lost workdays every year.

TMS Studio helps to answer this problem. The solution is a new concept of bio-mechanical measurement to diagnose musculoskeletal disorder risks. TMS Studio analyses and quantifies the movements in real time, based on a plug & play software and hardware solution. In a few easy steps, you can realize a global ergonomic study of all your workstations thanks to clear and fully automatic reports, then perform the changes to be made and validate them instantly with the real-time rating of musculoskeletal disorder risks.

THE SUIT

The use of TMS Studio is made of a comfortable and cordless suit, equipped with 17 wireless sensors measuring the angles of all the limbs, head, wrist and ankles. It allows a complete mobility and a total freedom of movements. The operator being behind a machine, under an engine, or spinning on him/herself won't be an issue. Each sensor is composed of a gyroscope, an accelerometer as well as a magnetometer, our data crossing algorithms reproduce each movement on the 3D avatar. TMS Studio technology records data 60 times per second.

THE TRAVEL-CASE

TMS Studio solution is plug & play. On any workstation, they deliver a ready to use system in a travel-case, containing everything you need to capture the movements of the operators.
Mobile and autonomous, the travel-case can be delivered in your production environment (Sites, factories, offices...), it contains: 4 connected suits, 17 WiFi sensors, 1 Android tablet, 1 computer.

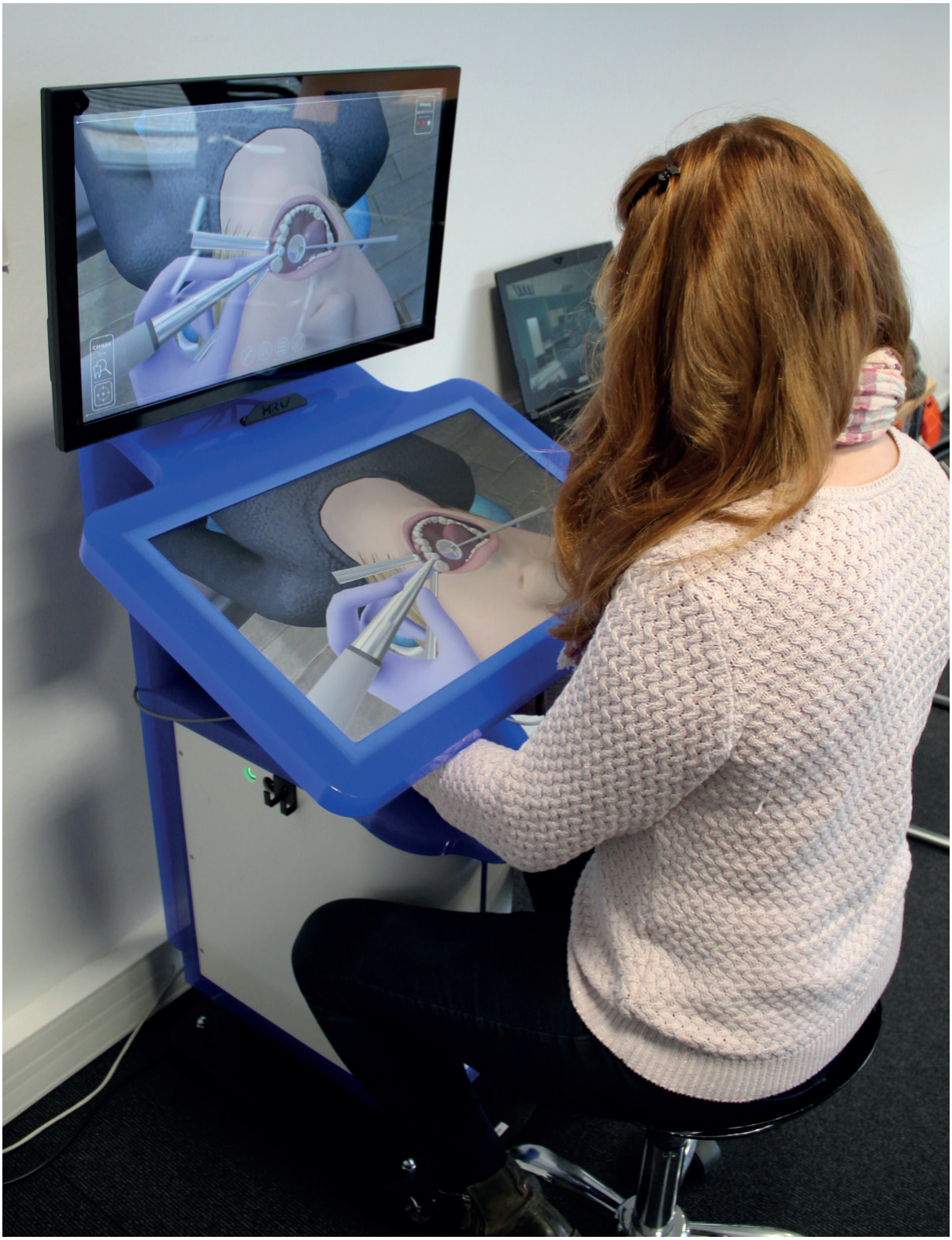
ANALYSIS SOFTWARE

TMS Studio analysis software can be installed in any computer. You can retrieve the data captured by the travel case from your private web access. The software will produce a summary of the arduous and tedious tasks and help identify possible improvements. You can easily enrich your reports with several elements as add profile (name, gender, weight, age of the employee...); carried weights; cut, arrange and label scenes to focus on parts of the captures; add video footage; focus on parts of the body (for example export data to track back or neck pain); export raw data as excel sheets; produce ready to use personalized PDFs. Use the software to instantly export a complete summary of captured data, gain accuracy and considerable time in the ergonomic analysis of workstations. Easy to understand reports thanks to the complete coloring based on the multiple ergonomics rules included.

BENEFITS FROM USING TMS STUDIO

- Saves time and precision in order to significantly reduce occupational risks.
- Improve your trainings upstream and validate the right gesture, in real time.
- Create a new, optimized, ergonomic workstation the first time.
- Adapt your human resources to the position (rotation, recovery time) and prevent work stoppages.
- Regularly evaluate your production environment (monthly, annually) thanks to the speed of implementation.

© TMS Studio



Virteasy Dental allows students to train on virtual teeth // © HRV Simulation

THE DENTIST IS READY FOR YOU NOW

Your first-time practicing dentist would have most likely trained on plastic teeth inside of a mannequin head. If you're lucky, maybe they got to practice on a pig's head for implants. If they went to a prestigious university, they might have had access to a haptic simulator, like Virteasy Dental, which permitted them to train on virtual teeth which felt like the real thing. Virtual reality headsets are making this cheaper and more immersive than ever before.

How dentists have trained hasn't changed much over the last few decades. Whereas surgery has been an obvious application for VR, for dentistry, plastic teeth have worked well enough for so long and the offer of free treatment to real patients means that they can be used as practice for students with real world experience. In the 21st century, should we really be accepting that patients, many of whom can't afford to pay for their treatments, are being used as human guinea pigs for student practice, knowing that we could prepare them better?

The potential for change on an international scale is already massive. Enhanced graphics already allow the 3D recreation of patients. Haptic arms (force feedback devices which replicate real life feelings) already permit the recreation of life-like sensations. Virtual reality headsets are already creating new immersive worlds to learn in. Yet, how the majority of dental students learn their skills is still waiting to be improved, yet alone revolutionised.

TECHNICAL AND SOFT SKILLS

The problems are very real: students need to learn both the technical and people skills required to deal with their (very real) patients. Plastic teeth help teach technique of handling a dental tool but do not feel the same as real teeth (which are made up of multiple densities including enamel and dentine) during drilling. Furthermore, they also negate the people skills required in diagnosis, treatment and post treatment stages when interacting with real people - whom often have fears and real anxiety about dental treatments. The best solutions to these problems require a considerable investment which only the most prestigious universities can afford.

The current solutions are a very good start. Virteasy Dental's standalone simulator already trains more than 3,000 students around the world every year for restorative, endodontics (root canal), prosthodontics (crown preparation) and implantology for example. Whilst a simulator from Forsslund Systems, called Kobra, does a very good job allowing students to learn the skills needed for oral surgery and the extraction of teeth. This is where virtual reality comes in and we are starting to solve a huge part of the problem by being able to cut the cost of investment in half, if not more, by a lower fidelity desktop simulator equipped with a virtual reality headset and a commercially available haptic arm.

This progress is in part thanks to Epic Games, the creators of the Unreal Engine and the popular game Fortnite, who are helping to tackle this challenge through their Mega Grants investment and faith in HRV Simulation and Virteasy Dental. The challenge is to make a dental trainer which offers photo-realistic graphics to replicate the dental clinic, an integration with dental scanners to recreate the teeth of real patients virtually and the use of VR headsets for a completely immersive experience eventually with Dr - patient interaction.

A LARGE MARKET

The upside is gigantic. With more than 700 pre-clinical and dental schools and universities around the world, there's a lot of students to train. The first benefit is the cost. VR enables a desktop simulator to be possible which will have half the investment cost of a fully integrated simulator. To only focus on the more accessible cost is to miss all the other parts of the puzzle that VR helps fit together. Technical skills can be learnt without putting real patients at a student's mercy. Furthermore, the software can analyse the student's performance, technique and decision making and go on to advise them on where they need to hone their skills. The current conventional way of training requires a teacher to be standing over the student's shoulder, with the added pressure that gives, to understand how the student arrives at the final product. With the strain on the teacher's time and the increase in student class sizes, it's easy to see how quickly this ideal becomes impossible.
The teaching of softer skills, like the interaction between the Dr and patient will also be revolutionised. Student's will be able to analyse the CT scans of a real patient to decide how to proceed with the treatment before virtually sitting in the cabinet with a virtual patient and telling the patient what their diagnosis is, how they would like to proceed and what this means for the patient. Post treatment they will be able to explain to the virtual how the procedure went and advise them on how to look after their teeth in the future. All of this

can be recorded and the student can then relive the experience through the patient's eyes to understand the procedure from the other side. In real life, perhaps a few days later, the student will be welcoming the real patient who's scan was used and who's treatment they performed virtually into the student clinic and explaining to them what they diagnosed and how they would like to proceed.

Integration with other equipment, like intraoral and CT scanners also helps bridge the gap between the pre-clinical and clinical divide. A student's first real patient can have a scan at the first drop-in appointment and visual their scan on their virtual avatar. Between their drop-in session and their scheduled treatment date the student will visualise the patient's scan in VR, they'll be able to decide on the treatment and then, with the help of haptics recreating the real sense of touch, they'll be able to perform the treatment.

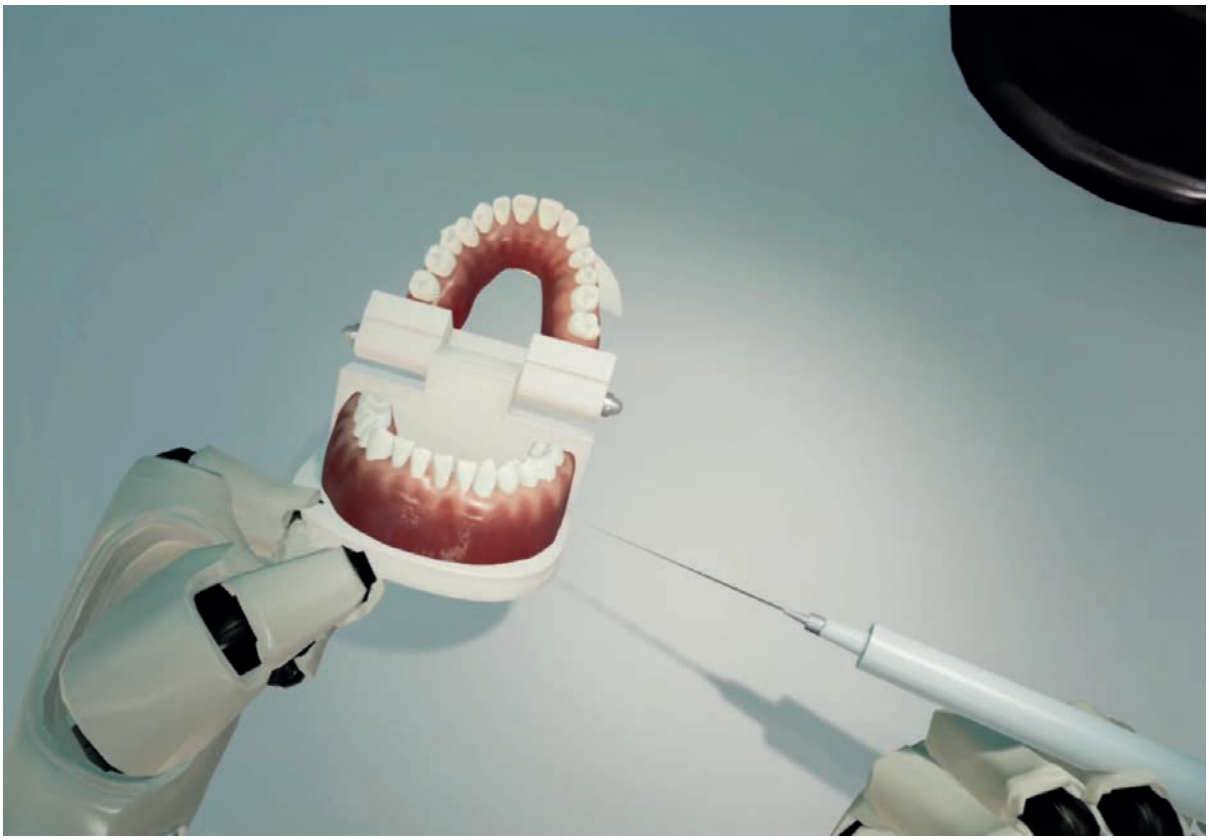
PATIENTS, STUDENTS & BUDGETS

This is the holy grail of mixing virtual reality with real life implementations. Improving patient care, improving student's training experience and ultimately reducing costs. None of this is an unrealistic dream but, in fact, a lot of this is already a use case in more than 125 universities around the world.

Beyond this, one of the most exciting next-steps in this field is using these advancements in training for remote-surgery once they have been tested and validated. Using the same haptic technology that is used to train students could also be used for treating patients. Imagine how useful this could be in hard to reach areas, towns without enough trained dentists or older people with limited mobility. By sitting in a dental chair, with only a dental assistant loading up the dental burrs, tools and materials, it could be possible for a trained dentist to control the haptic arm from far away and perform the treatment remotely. Rare or high risk cases could be recorded and then used across the world to train dentists as they replay and experience the situation through virtual reality and haptic feedback.

CREATING NEW CURRICULUMS WITH VR

All in all, the technology is already here and working well. We are only just starting to truly apply it into the domain of dentistry and as the hardware and software improves the markets will become more accepting and create new curriculums which integrate these new technologies, and with it, the scale will bring down the cost in general. Virtual reality headsets are becoming an exciting example of how we can radically reduce the upfront cost for universities whilst also adding extra value at the same time. It's really an exciting time to be getting into dentistry as a student learning in VR, and as a patient, your doctor is becoming more and more ready to see you now.



How VR can improve dentists' training with VR // © HRV Simulation

MARIE POUX-BERTHE TUTKII - OUEST MÉDIAS AGENCY
CHLOÉ BIDET OSÉOS
#WELLBEING #HANDICAP

VISITING A FARM IN VR: A COLLABORATIVE AND EMPOWERING PROJECT

Immersive experiences can help to break both physical and mental borders in order to enhance well-being. In collaboration with a group of disabled people, a virtual farm visit has been produced to explore how the creative process itself can benefit the users. The project was led and designed both by Chloë Bidet from Oséos, a VR start-up based in Nantes which offers immersive experiences designed to combat loneliness and Marie Poux-Berthe from Tutkii, Ouest Médias agency's exploratory laboratory.

Enhancing well-being with disabled people thanks to VR // © Tutkii

The use of VR to foster a sense of well-being and improve people's health is slowly developing. Retirement homes have begun implementing VR animations to entertain and relax the elderly and stimulate cognitive activity: especially that regarding memories. Therapists also use VR experiences as a tool to overcome a phobia: desensitising the patient to the source of fear whilst keeping him or her within a safe environment. Indeed, the immersive characteristic of virtual reality offers opportunities to use this medium to help shatter both physical and mental boundaries. A growing number of studies demonstrate that VR can disprove traditional stereotypes and stimulate empathy towards social or environmental causes. Equally, it can facilitate the educational process because it helps with visualising concepts, ideas or knowledge models (cf. bibliography).

We meant to use VR for all the aforementioned advantages, but we also wanted to transform the immersive experience into a collaborative and empowering project for disabled people. The project had two objectives. Firstly, offering an immersive experience to disabled people where they participate both in its conception and consumption and secondly, analysing the impact of the experience on the participants regarding the degree of pleasure they felt\did not feel. Additionally, we observed their ability to make autonomous choices and their potential desire to go beyond the virtual experience to live it in the real world. This analytical portion was managed by Julie Chaffangeon from CENTICH, an institute based in Angers and specialising in TIC for autonomy. We opted for the 360° video medium and chose to explore a farm theme. Indeed,

via previous VR workshops, Chloë had identified that visiting a farm was an experience that people wanted to have.

This project can be described in five consecutive phases. The first step consisted of engaging all project stakeholders: those residents and workers from APF (Association des paralysés de France) willing to participate and the owner and volunteers of « La Ferme des biquettes au poil » (The Goats' Farm), a non-profit educational farm based in Vertou near Nantes. It was important for Oséos' founder Chloë Bidet to choose a farm which doesn't maltreat animals and which pursues a sustainable agricultural model. Julie Chaffangeon, the occupational therapist, agreed with Chloë Bidet on how she could take part as an analyst of the collective immersive experience. There was an inevitable exploratory dimension to the project as CENTICH's expertise had never before been requested regarding VR use with disabled people.

BRAINSTORMING

Once all stakeholders of the project were gathered and ready, a two-hour brainstorming session was organized at the APF residency « les Magnolias » in Nantes. There were six residents and one APF worker, Oséo's two-person team and two people from Tutkii. To understand more about the type of farm visit the participants would like to experience, we asked open-ended questions during the session such as "What does thinking about a farm evoke in your mind? What kind of farm-related memories do you have?" and recorded their thoughts.

VIRTUAL SCRIPT

The next stage consisted of writing the virtual visit script. The script had to weave together the content both from the creative session and the farm's volunteers' presentation into a story that would capture the user's attention. Céline, who directs mediation sessions using the farm animals, is the primary storyteller and leads the visitor through seven scenes. Her profession aside, the fact that she is visually impaired strengthened the project's coherence between the message and the medium. During the creative session, a lot of participants' memories were linked to their childhood. Furthermore, their idea of a farm was mostly traditional and meant farming cows, pigs and goats. Therefore, we created a scenario where Céline talks to the "visitor" as if he/she were a child and invites him/her on a tour of a special farm where animals have unexpected rôles!

After shooting the 360° video at the farm and its subsequent editing by the Tutkii team during Summer 2019, the eight-minute immersive experience was ready to be experienced and criticised. The collective VR session took place once again at the " Les Magnolias " residency. Six participants, including one APF worker who had participated in the initial creative session, were present. Two additional APF workers came as well as four other disabled people living at "Les Magnolias". Chloë launched the virtual farm visit simultaneously on six Oculus Go headsets whilst the occupational therapist Julie Chaffangeon observed everything. After it was over, she asked the participants' questions to discover more about the emotions and sensations they had felt and received any other type of feedback that she could. Since the experience was short (eight minutes long) and two hours were dedicated to the session, Chloë offered other VR experiences to the participants - snowboarding, water-skiing, space exploration - to provide more time for the occupational therapist to observe reactions and collect data to analyse later.

SUCCESSFUL RESULTS

The results of this experience were very rich. From a communication and media professional point of view, the participants' degree of engagement was really profound. After living the experience, the participants constructively criticised scenes they liked, the farm world elements they recognised or thought were missing or the sensations they wished to feel more of. This sensory importance in relation to the story being told by the mediator is good feedback for VR experience designers to favour sensory elements – prompts to see, hear, touch or even to smell - over words in communicating a message. Furthermore, the minor frustration participants had from not being close enough to the animals "as if they could touch them" serves Chloë Bidet's mission of fostering support for disabled people to continue "living" the experiences they think they cannot have anymore because of self-imposed restraints and\or accessibility constraints. Julie Chaffangeon's observations are still being analysed and her results will be shared as soon as they are released by Oséos and Tutkii at the beginning of 2020.

As a communication campaign is about to be launched to promote this project, the project's team hopes to change attitudes towards the disabled and raise awareness about the use of VR to fight stereotypes.

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DETECTING AND RELIEVING EYE DISORDERS WITH VIRTUAL REALITY

Innovation is progressing very rapidly in the visual industry, yet one profession remains out of step with these technical advances: orthoptics. Increasingly solicited since the emergence of screens, this practice of ocular rehabilitation has not evolve for decades. With the help of the HTC Vive Pro Eye headset, the Eyesoft and Feelity teams are digitalizing the practice of these professionals through virtual reality.

How VR can help your eyes // © Feelity

HUGE INCREASE IN CHRONIC HEADACHES

Originally nomadic, Man has developed a visual system particularly adapted to distance vision. His genetic heritage was thus adapted to the hunter-gatherer lifestyle and his near vision was less used. Over the last few centuries and decades, fundamental evolutions in our societies have changed the situation. The use of technology has thus became more prevalent in our lives and screens have multiplied. From childhood to the end of our professional lives, we are now exposed to screens of all kinds on a daily basis : computers, tablets, smartphones, advertising screens. And these new supports stimulate our near vision in an unusual way, putting more and more strain on our eye muscles. Eye care professionals are noticing a rapid increase of visual fatigue in our society and the generalization of associated functional signs such as headaches, dizziness, blurred vision, or difficulties adapting to glasses. The chronic aspect of these symptoms obviously seems to be accentuated by the intensity of screen use. Today, it is estimated that one in two French people suffers from regular headaches and in most of cases the origin of these headaches is ocular.

ORTHOPTICS, AN EFFECTIVE BUT UNKNOWN SOLUTION

When suffering from chronic headaches, our first reflex is often to use medication (usually painkillers, ibuprofen).
This crisis treatment, although effective at the time, does not address the real reasons for these disorders: visual fatigue, and by extension, eye muscles. However, there are vision professionals who specialize in ocular rehabilitation : orthoptists. Unfortunately, professionals in this discipline, which has existed for more than fifty years, are often excluded from the care pathway. It is estimated that less that one in two patients with chronic headache visits an orthoptist. The causes of this medical wandering are multiple: general practitioners who are too often not aware of the specialty and who prefer complementary examinations (blood tests, scans, MRIs, etc.), or consultations with other specialists who are not always vision experts (neurologists, ENT specialists, etc.). Although there are more than four thousands orthoptists in France, their practice has not evolved for decades and the equipment they use is still quite rudimentary. Prism, synoptophore and other fixing rods are hand tools whose effectiveness is often linked to the practitioner's skill and, for some measurements, to his subjectivity. As a result, orthoptic sessions are often monotonous and the measurements performed are not always reliable. For the patient, it is the assurance that he or she will become discouraged in the long term, will not attend regularly or will even abandon treatment before the symptoms have completely disappeared. On the other hand, the current equipment does not allow home sessions, limiting autonomy in the rehabilitation process. Composed of orthoptists, software engineers and creative people, our team wondered how to disrupt this discipline?

THE EYE-TRACKING SYSTEM: THE KEYSTONE OF THE EXPERIENCE

The first response track came with the release of the HTC Vive Pro Eye virtual reality headset in May 2019. Until now, the eye-tracking systems on the market did not provide sufficient accuracy to consider any medical application. HTC hit a major milestone with the release of the first mass-produced virtual reality headset with integrated eye-tracking. It allows you to navigate in a menu simply by looking at the element, but also and above all allows you to take measurements of physiological data fundamental to the orthoptist with millimeter accuracy. No more manual measurements required with the HTC Vive Pro Eye ; the practitioner can now calculate the patient's inter-pupil distance and detect possible convergence disorders.

SAAS SESSION MANAGEMENT SOFTWARE

Our team has developed an eye diagnosis and training tool that is revolutionizing the practice of vision professionals. Based on a patented algorithm for the interpretation of eye data collected by the HTC Vive Pro, this software simplifies the disorder detection, training and follow-up of patients suffering from ocular disorders in their rehabilitation process. No more obsolete equipment and approximate measurements, the Eyesoft tool ensures reliable measurements that are unrivalled on the market. The various visual universes offered in virtual reality immerse the user in a spatial or underwater environment that is worthy of a video game. Distributed as an annual software license along with an HTC headset, it can provide both spot screening for convergence deficiencies as well as longer-term rehabilitation of the eye muscles of diagnosed patients. Different types of training are thus proposed (convergence, pursuit, saccades and fixation) gathered in a single dashboard accessible only by the practitioner. An API allows the interoperability of the tool with the other business software used by the practitioner. Eyesoft therefore makes it possible to effectively monitor each patient's sessions based in particular on the progress curves automatically generated by the software. Anonymized, the data collected will eventually provide a valuable database of eye disorders based on various established physiological criteria.

WIDE RANGE OF APPLICATIONS

While it is particularly suitable for orthoptists, the tool is also perfectly suited for opticians. Indeed, the latter are regularly confronted with cases of unsuitability to glasses and in particular progressive lenses. With a detection performed in less than a minute, they can determine if the cause may be a lack of convergence or divergence. In these same optical stores, the physiological measurements necessary for the manufacture of glass can be quickly taken by the tool.
Marketing through pharmacy and health houses networks can also be considered, to improve access to healthcare for everyone. Finally, a mobile application combined with a VR Cardboard headset can be added to the in-office sessions to allow autonomous work at home.

FEELITY

Feelity is a French digital company with a team of computer engineers and creative technologists. Holder of the Innovation Tax Credit (ITC) accreditation, the agency focuses on innovative topics such as virtual reality, augmented reality, connected objects on behalf of large corporations and young strartups in the growth phase. In the field of e-Health, we previously worked on issues related to the AR data visualization of clinical trial results, digitalized health record booklet, diabetes daily management, or asthma therapeutic education.

MARCO SACCO
CNR-STIIMA

CNR-STIIMA SMART AND HUMAN-CENTERED LIVING ENVIRONMENTS LAB

The use of VR/AR technologies has grown in many fields; one of the most important is the healthcare sector, in which the technologies are employed to support the rehabilitation process by making the interventions more engaging, controllable and ecological [1]. VR/AR applications can help people with motor or cognitive disabilities to continue their rehabilitation path at home, also after de-hospitalization, following a "continity of care" paradigm.

Figure 1. The immersive Virtual Supermarket.

Figure 2. A screenshot of SocialBike application. Two users are collaborating in the performance of the cognitive task.

Lecco premises of CNR-STIIMA deployed the Smart and Human-Centered Living Environments laboratory in which many living environments can be simulated (e.g., home, workplace and spaces for leisure activities) and all the developed technologies can be integrated and validated. All the solutions that exploits AR/VR technologies, robotics and artificial intelligence are currently used within the Living Lab to provide customized and adaptive services to different users. Indeed, all the developed solutions are designed considering users' characteristics and needs, e.g., their health status, specific requirements deriving from chronic conditions, or specific pathologies, their preferences. Among others, the Living Lab encompasses solutions dedicated to the fields of healthy and active aging, ambient-assisted living, return to work, cognitive and neuro-motor rehabilitation.

The first VR applications dedicated to the cognitive training of elderly with Mild Cognitive Impairments is represented by a supermarket environment in which the user is required to do the shopping searching for products on the shelves, thus training his/her visuo-spatial abilities. The first version was a 2D virtual environment that can be interacted via a touch-screen [2] while the second has been deployed to be used with the HTC Vive headset [3] (Figure 1). The feasibility and the acceptability of immersive VR in the elderly population is now being investigated.

REHABILITATING ELDERY WITH PULMONARY DISEASE

A second solution is dedicated to the rehabilitation of elderly with Chronic Obstructive Pulmonary Disease [4]. The first application allows users to perform aerobic exercise, in particular cycling, in a virtual park. The system, including a cycle-ergometer and a monitor, can be integrated with physiological sensors e.g., heart rate monitor or pulse-oximeter, to monitor the user's performance and to assure safety conditions. A second solution, based on a motion tracking device, provides the users the possibility to perform upper and lower limbs strength exercises at home in a motivating scenario. The usability, acceptability and feasibility of the applications are currently being evaluated in ongoing pilot studies involving COPD patients.

In line with the idea of providing personalized solutions, the VR cycling system functionalities have been extended enabling dual-task training for active ageing. In this case, the users not only have to perform physical exercise, but they have also to complete a cognitive task – such as identifying objects with specific characteristics appearing along the pathway. The dual-task VR application can be experienced as a "social" multiplayer environment, allowing the elderly to communicate with peers, to schedule meetings and to train together either competing or collaborating in the achievement of the cognitive tasks [5] (Figure 2).

HOLOHOME : A MR FRAMEWORK

As mentioned, the Living Lab comprises also AAL solutions. One of these is HoloHome [6], a Mixed Reality framework which aims to provide new means of interaction with the Smart Home and its components. HoloHome integrates multiple technological paradigms encompassing Internet of Things, Ambient Assisted Living, and Augmented Reality to offer the ultimate tailored comfort experience for the Smart Home's inhabitants including frail elderlies and people with mild cognitive disabilities. The main purpose of the HoloHome is to provide a Mixed Reality environment implemented on the Microsoft HoloLens, to allow the user interaction with the Smart Home devices and appliances through the Augmented objects. It also defines the modality of the interconnection between the Mixed Reality application and the distributed network of smart devices through the communication channel of WiFi-enabled microcontrollers; allowing the users to regulate domestic devices via HoloHome Mixed Reality application such as turning on/off light. The Smart Home Simulator [7] is a mixed-reality application able to support the configuration and customization of domestic environments in AAL systems; it combines the inhabitants' characterization (formalized into semantic knowledge bases) and environments' characteristics with VR-based simulations to provide a realistic simulation of a home, where the designer can set up the appliances according to the changes occurring to the dwellers and their environment.

Dealing with the return to work of wheelchair users, the Institute is developing a simulator to train novice injured people in maneuvering the wheelchair, in order to regain autonomy in the activities of daily living, both at home and at the workplace [8]. Such a simulator encompasses immersive VR environments, their related interaction technologies (e.g., trackers and data-gloves), and a parallel-kinematic platform equipped with sensors and actuators to return appropriate vestibular and haptic feedback to the user.

For the at-home rehabilitation of post-stroke patients, CNR-STIIMA has developed VR-based applications to support the active or passive mobilization of the hemiplegic upper limb with a low-cost robotic device. The aim of these applications is making at-home rehabilitation sessions more engaging, and providing the patient with real-time feedback about the current performance [9]. In one of the examples, signals coming from different sensors integrated in the robotic device are elaborated to make the patient proceed in a virtual tour in different European cities; when the performance does not respect boundaries that the therapist decided for the specific patient, he/she will see fog appearing or the tour deviating from the right path.

All the presented solutions have been designed, tested and validated thanks to the collaboration of clinical and vocational partners whose competencies have contributed to the deployment of usable, acceptable and effective solutions. These collaborations include National (IRCCS E. Medea – La nostra famiglia, Ospedale Valduce - Villa Beretta, IRCCS Istituto Nazionale Riposo e Cura per Anziani, IRCCS Fondazione Santa Lucia, Istituto Auxologico Italiano, Centro Clinico Nemo) and International (Sint Maartenskliniek, East Tallinn Central Hospital) hospitals, the Italian Institute for Insurance against Accidents at Work (INAIL).

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VIRTUAL REALITY THERAPIES ACROSS THE WORLD

From reducing recovery time in rehabilitation to supporting children with chemotherapy, immersive technology is transforming healthcare. Virtual Reality (VR) in particular is changing everything from pain management by offering an alternative to addictive pain-killers, to helping communicational and behavioural difficulties for those with autism. Rebecca Gill, Nurse and Founder of VR therapies, will be discussing these latest advances in immersive healthcare and how they are improving lives around the world.

Rebecca Gill's ambition is to improve patients' lives with VR // © VR Therapies

VR is an interactive experience taking place within a simulated environment, that incorporates mainly auditory and visual, but also other types of sensory feedback like haptic. This immersive environment can be similar to the real world or it can be fantasy, creating an experience that is not possible in ordinary physical reality. The environment could be anything from the middle of the ocean to different galaxies or worlds – it is only limited by our imagination. Although research for VR within healthcare and education dates back to the 70's, the average person still associates VR only with zombies and entertainment.

VR draws on all of our sensory, motor and cognitive capabilities, which creates an effective person-centred therapy available to support a variety of healthcare professionals. Current VR technology most commonly uses VR headsets or multi-projected environments, sometimes in combination with physical environments or props, to generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual or imaginary environment. A person using VR equipment is able to «look around» the artificial world, move around in it, and interact with virtual features or items.

Technology also can range from a simple PC and keyboard setup, to a modern VR headset with accessories. Whilst someone with a hearing impairment may not benefit from the musical sessions, you do not need hearing to enjoy art or travelling the world. Physical disabilities need not limit their access either, for example some experiences are purely controlled by the direction the individual looks. Individuals may require support to set up the initial experience without need for further assistance, or prefer experiences where they can just sit back and relax.

These benefits are happening right now because of VR – the mind-bending technology that offers immersive, multisensory environments that nudge our brains into thinking we are somewhere else. Sharing these experiences with them as a Nurse has been amazing. The benefits are immediately apparent as people forget their pain, breathe easier and smile more.

VR THERAPIES AROUND THE WORLD

PTSD AND PAIN REDUCTION

Dr. Difede, is a Professor of Psychology in Psychiatry at Weill Medicine, an Attending Psychologist at the New York Presbyterian Hospital, and Director of the Program for Anxiety and Traumatic Stress Studies. She is internationally recognized for her pioneering work using VR technology in the treatment of PTSD consequent to the WTC attack of September 11, 2001, and more recently in the treatment of combat-related PTSD. Dr. Difede also uses VR during a study for people undergoing treatment for burning wounds.

BURN WOUNDS

Hunter Hoffman and his University of Washington colleague David Patterson have been working on clinical health applications of VR for more than twenty years. The programs they have developed and tested, including "Snow World" and "Snow Canyon," have been shown to reduce the need for pain medication in burn patients during painful wound care procedures. Their work has been shown to reduce recovery time and pain through fun and engaging VR, which is ideal for this new generation of tech-savvy children.

CANCER

Thanks to the Norwegian Cancer Society cancer treatment for young Norwegians in need of a bone marrow transplant is a little less harsh. Post-operative recovery entails isolation in a sterile tent for up to six weeks. Since late 2016 a set of VR Goggles and the 360° VR movie of the Dolphin Swim Club helps them to cope throughout their hospitalisation and treatment.

LEARNING DISABILITIES

Clients of Dutch healthcare facility Heeren Loo (10,000 residents) enjoy VR in specially developed relaxation rooms. A study took place with a group of 55 residents with learning disabilities who were also suffering from very high-stress levels. 82% showed and reported a considerable improvement after experiencing therapeutic VR on a regular base. Other benefits included one man no longer experiencing the chronic pains he continuously had in his arm.

CHILDREN WITH HEART DISEASE ND ANXIETY IN HOSPITALS

In March 2017 doctors at Lucile Packard Children's Hospital Stanford started a pilot study called 'Project Braveheart' researching the effect of VR on anxiety and stress levels. 40 patients, youngsters in the age of 8 to 25, with congenital heart diseases took part. Using VR goggles patients followed a tour guiding them along the exact path that will take place on the day of their procedure.

PAIN & ANXIETY – BREAST CANCER

In September 2018, a study completed to assess the effectiveness of immersive VR distraction technology in reducing pain and anxiety among female patients with breast cancer. A randomised control trial design was used with a sample of 80 female patients with breast cancer at a specialized cancer center in Jordan. The study findings showed that one session of the immersive VR plus morphine made a significant reduction in pain and anxiety. Using immersive VR as an adjuvant intervention is more effective than morphine alone in relieving pain and anxiety; furthermore, they found VR is a safer intervention than pharmacological treatment.

SEVERE PAIN RELIEF

To measure how well therapeutic VR reduces pain, researchers studied 120 patients at Cedars-Sinai Medical Center in Los Angeles between 2016 and 2017. 61 people were given a VR headset with access to different immersive experiences, such as a simulated helicopter tour over rugged Iceland or a guided relaxation while looking at soothing ocean or mountain scenery. They then used the headsets during three 10-minute sessions a day over the course of 48 hours. The control group of 59 watched television featuring guided relaxation, like yoga and meditation, along with poetry readings. On a scale of 1 to 10 the self-reported pain scores dropped by 0.46 points in the group that watched the television programming and 1.72 points in the patients who used the VR headsets. Most notably, patients with the most severe pain reported the greatest benefits from the VR headsets, with their pain score dropping roughly three points. While a two or three-point drop may seem minor, they actually indicate quite a notable decrease in pain sensations.

AUTISM

The Blue Room, a unique immersive VR which helps children with autism overcome their fears and phobias is being offered on the NHS. In 2014, the Newcastle University team reported how eight out of nine children treated in the Blue Room were able to tackle the situation they feared and some were found to have completely overcome their phobias, even a year later. Now the immersive reality treatment is available as a NHS service, where there is funding by the children's Clinical Commissioning Group, and each child referred will receive four sessions at the facility in County Durham.

HYDROTHERAPY

VR therapies, a social enterprise based in Northamptonshire, already provide individual and group sessions with the latest immersive technologies to the local community. They are also the first to combine hydrotherapy with VR. This combination supports physiotherapy and mobility, whilst creating the full immersive experience of swimming with dolphins. Designed with the University of Northampton, clinical trials will begin next year into this innovative and new therapy.

CHRISTOPHE MALLET
BODYSWAPS
#RESEARCH

CAN SWAPPING PLACES WITH PATIENTS IN VR HELP NURSES IN PSYCHIATRY DEVELOP BETTER SOFT SKILLS?

In the world of mental healthcare, poor soft skills can have dire consequences, and the current semi-supervised learning on the job approach leaves students terrified and patients not properly cared for. How can we safely prepare mental healthcare students for difficult conversations with patients? BODYSWAPS® has worked with SAGE Publishing to create an immersive learning experience that uses VR, AI and a body-swapping mechanic to let students safely prepare for the real-world.

Immersive learning experience that uses VR to swap your body // © BODYSWAPS

THE CHALLENGE

How well prepared did you feel on Day 1 of your first ever job? How confident were you in your first interactions with clients, colleagues, bosses? The transition between the classroom and the real working world is often abrupt. Higher education as we know it is not designed to let you experience the human interactions which will form, if not the core, at least an important part of your work day. Essentially, there is a gap between knowledge and competence. That gap is called experience.

For psychiatric nurse students, entering the real-world can be utterly terrifying. Before their first hospital placement, the majority won't even have role-played patient-nurse interactions. Some lucky few will have had a few minutes with an actor as part of an assessment. It is too costly and impractical for hospitals to organise constant supervision for every student. And so the students are often left, absolutely inexperienced, to interact with patients suffering from severe mental conditions. There is no room for trial and error there, for experimentation.

You wouldn't let a pilot come anywhere near a plane until they had completed hundreds of hours in a flight simulator. Why should we allow this to happen in the context of critical healthcare?

THE APPROACH & RESULTS TO DATE

Academic researchers have been studying the behavioral effects and performance of Embodied Virtual Reality

learning (EVR) for over a decade. Even at its most basic level, VR is the most immersive learning medium there is besides reality itself. Comparative studies of virtual reality, video-based and text-based learning have hailed VR as the best performing medium in terms of engagement levels, understanding and memorability.

Beyond that, recent academic research led by Stanford University and the University of Barcelona, has shown that VR is a very powerful tool to drive and sustain behavioral change. Fascinating results include reducing implicit racist bias, transforming subconscious attitude towards homeless people or improving mental health through self-counselling in VR.

Working with SAGE Publishing to solve the challenge of preparing psychiatric nurse students for the real-world, we sought inspiration in that body of research whilst bringing in principles of adult learning design. With the help of Dr. Sue Barker from Cardiff University, we designed the Susan Experiment; essentially a flight simulator for patient-nurse interaction training. The Susan Experiment is a 10-minute experience that combines embodied Virtual Reality and conversational AI to create an interactive and realistic patient-nurse scenario. The experience has 4 keysphases: Q&A, Intervention, Body-Swap and Analytics.

- During the Q&A, the learner, now embodied, finds herself face-to-face with Susan, a suicidal patient. The learner can ask a series of pre-set questions to get Susan to describe her current state of mind.
- The learner is then tasked with providing an intervention to Susan, giving her contextual advice on how to cope better with her days. Importantly, they do so using their own voice and body language, saying whatever they want.
- Once done, the learner "body-swaps" with Susan. They takes Susan's place and see and hear themselves back giving the intervention from her perspective. The learner is directly impacted by what they said and how they said it. They can self-reflect and identify ways for improvement, both in content and delivery.
- Finally, the learner accesses an Analytics Dashboard consisting of behavioral and semantic data and gets personalised recommendations on how to improve.

The experience is currently piloted by SAGE Publishing at a few UK and US universities. A small scale study led by Alice Jane from UCL London found that over 90% of participants felt that the experience helped them reflect on their performance and 93% declared wanting to try the experience again to improve.

THE CHALLENGE

Although very promising, the feedback to date also serves to underline the journey left to travel before immersive learning becomes a staple of higher education for human-centered jobs. Firstly, there are a number of technical areas to work on, from a necessary leap in conversational AI capabilities to allow free conversations to improved behavioral analytics via, for example, biofeedback or speech emotion data.

The second main challenge is deployment. Classrooms don't accommodate VR-learning well and individual ownership of headsets seems at least a few years down the line. And so universities must work to integrate immersive behavioral training in their curriculum and provide safe, private physical spaces for students to train when they most need it.

Finally, self-reflection on the job is difficult and soft skills training should benefit from the support of lifelong learning strategies from hospitals.

WHAT WE LEARNED / BEST PRACTICES

We learned a lot developing the Susan Experiment. Designing great content is only the first part of the challenge. Until immersive learning becomes standard in soft skills training, we recommend adopting an agile, iterative approach to deployment.

Firstly, If you are looking to explore immersive learning, you should identify an internal champion. Immersive Learning comes with a number of typical innovation-related challenges: getting buy-in from budget holders more used to traditional approaches, managing procurement-related issues around hardware, dealing with the logistics necessary for on-site deployment, etc.

Successful deployments require the client to be hands-on and a dedicated point-of-contact with the resources and decision-making power to move the project forward.

Secondly, we would advise starting with a big challenge on a small scale. Tempting as it is to justify launching an immersive learning programme by its cost-effectiveness at scale, it is recommended to focus first on a small number of stakeholders for whom the training topic area is mission-critical. This will speed up buy-in, ad-hoc deployment, and greatly help with the collection of feedback.

Finally, you should facilitate the initial deployment. Ultimately, immersive learning through VR lends itself to a self-service solution that will allow learners to practice and learn at the point of need. But an initial facilitation period is highly recommended to get users acquainted with the technology. The first contact (at least) with VR learning should be facilitated in a face-to-face intervention to allow for immediate feedback.

WHAT'S NEXT FOR BODYSWAPS?

The body-swapping format is applicable in multiple training areas. Save the Children, the UN Agency for Refugees and the International Labour Organisation are for example currently piloting Safeguarding VR, a BODYSWAPS® scenario for aid workers to practice conversations with a survivor of a safeguarding incident.

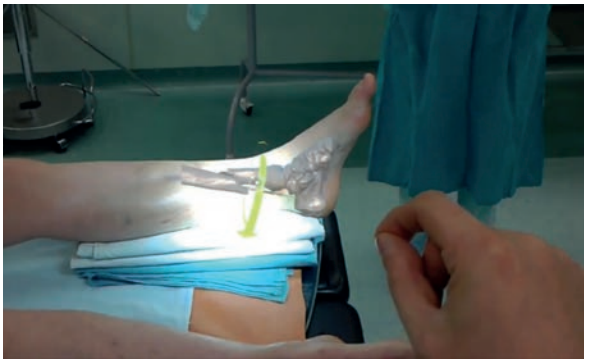
In 2020, we will publish the first public-access iteration of our BODYSWAPS® platform, with a pack of simulations called 'Workplace Communication Essentials'. Think of it as a communication skills bootcamp to bump up every employee's competency around things like active listening, clear communication or gender inclusivity.

We have no doubt that embodied interactive VR is the future of soft skills training. But there's a long road ahead and in 2020 we will be looking for innovative partners to go on that journey with us. You know where to find us!

INNA KHMELNITSKAYA
ALEXANDRE SITNIK
ARTOMED
#SURGERY

ADVANCED SURGERY MIXED REALITY SOLUTION FOR HOSPITALS AND MEDICAL UNIVERSITIES

The idea of a «Smart Surgeon Assistant» project belonged to the famous Traumatologists Dr. Alexander Sitnik. Later it was discovered that the development of such an "assistant" is a very difficult and expensive work requiring a large team.



Position of fracture hologram on the patient body via HoloLens App // © ArtoMed

Planning and conducting surgery with HoloLens App // © ArtoMed

For a time a team had been focusing on a methodology of work with real medical data and patients in the hospital (high-quality 3D models, their stable positioning (a difficult technological problem)) to develop an AR Surgery App for Microsoft VR glasses HoloLens. After the Silver awards on EFFORT (European traumatology and orthopedics congress with around 3500 participants) a development of products line for surgery started. 60+ surgeries with Hololens app have been conducted and now it is being used approximately once a week. The solution was presented in Las Vegas, Berlin, Montreal etc. Also it was presented at the stand of the Ministry of Health (main state IT forum) and at a meeting of innovative IT companies with the President of the Republic of Belarus. The technology was presented with great success at the VR conference and other events in California and London.

Now we are working in dentistry, traumatology and orthopedics, with difficult clinical cases and pathologies. ARtoMED Hololens app has been used many times during a tunique dentistry surgery for a child with Goldenhar syndrome. 3D Models Library and Trainers in neurosurgery and oncology are now being discussed and researched, as those are the first ever steps in these medical fields.

ARtoMED solution is based on creation of a 3D model and a hologram of damaged bones/organs from CT (computed tomography) scan of a patient. This approach helps a lot surgeons to understand the damage's anatomy as well as plan and conduct surgery in the most effective way. The newest technology of sharing 3D models of damaged bones/ organs enables any person located either in the same room or at a distance to see the injury and it's hologram «through the eyes» of the operating surgeon. Doctors wearing VR glasses are able to exchange knowledge and consult each other remotely. The same approach can be used in the Student and Surgeon training. Unique, 3D models and holograms Libraries for difficult clinical cases and pathologies will exalt surgery study to a new, advanced level and provide unlimited time of training on a mannequin, alone or remotely.

A SURGERY SOLUTION

HOW IT WORKS

Creating 3D models of damaged bones/tissues based on CT/ MRI data, managing 3D content and data via the personal user account created within the ARtoMED platform, using Microsoft HoloLens application to position holograms on patient's body in order to plan and conduct surgeries

ADVANTAGES OF SURGERY SOLUTION :

For surgeons: visualisation of damaged bones/tissues directly on patient's body, prompt and accurate understanding of

1.3D MODELS CATALOGUE TRAINING	Studying difficult clinical cases and pathologies, their nature, classification and recognition means based on catalogue of 3D models.
2.MANNEQUIN TRAINING	Working with 3D models and holograms of particular bones fractures, dental and organs pathologies created using real patients data. Applying acquired skills positioning 3D models on a mannequin Advanced studies of traumas and organs pathologies on the basis of a unique 3D models database Surgery plans based on the best practice and comprehensive understanding of injuries anatomy
3. HOLOGRAM SURGERY TRAINING	Studying examples of complex and rarely found bones fractures, dental and organs pathologies on the basis of real cases contained in the 3D models database Advanced approaches to planning/conducting a complex surgery based on the analogous cases Practising selected surgery approach on a mannequin before working with a patient

damage's anatomy; improved accuracy of surgical incisions marking; choosing the most effective plan of a surgery; scaling 3D models to examine organs of small children in great detail;
For patients: surgical injury; shortened period of post-surgery recovery and number post-surgery complications; time of being under anesthesia; no need of making 200-300 X-rays during the surgery; more accurate treatment plan;
For hospitals and insurance companies: medical care costs; shortening of patients waiting lists due to surgeries duration; more efficient management of patients flow; developing new methods of surgeries conducting; creating hybrid operating rooms; replacing open-heart surgeries with a non-invasive approach; amount of insurance payments

TELEMEDICINE & REMOTELY CONSULTATION SOLUTION. HOW IT WORKS :

Sharing a hologram of a damaged bone/organ in the real-time mode for surgeons located in the same surgery room. Surgeons are able to consult both colleagues and patients on the treatment and surgery plan at the distance. Sharing 3D models of damaged bones/organs for educational purposes. It is ideal for training surgeons in the operating room and students in the study room. Advantages of telemedicine & remotely consultation solution: For surgeons: working simultaneously with the same 3D model in real time, improving understanding, interaction and knowledge exchange,
For patients: receiving consultations from highly-qualified medical specialists/surgeons remotely without travelling long distances; patients expenses,
For training purposes: participating in a large number of surgeries remotely; viewing surgeries flow "through the eyes" of the operating surgeon; study cases amount; extending students hands-on experience; training costs.

MIXED REALITY TRAINER AND A UNIQUE 3D MODELS AND HOLOGRAMS LIBRARIES FOR DIFFICULT CLINICAL CASES AND PATHOLOGIES

ADVANTAGES :

For surgeons: working simultaneously with the same 3D model in real time; improving understanding, interaction and knowledge exchange;
For patients: receiving consultations from highly-qualified medical specialists remotely without travelling long distances; patients expenses;
For training purposes: participating in a large number of surgeries remotely; viewing surgeries flow "through the eyes" of the operating surgeon; study cases amount; students hands-on experience; training costs.
ARtoMED Holograms can be used by any of users and on any of distance that allows surgeons works in an advanced level. ARtoMED also perfect tool allows students and young surgeons to explore real fractures and damaged organs with the surgeon's eye via HoloLens. ARtoMED is the future that has come by expanding the borders of the conventional surgery and education.

TRANSFUSION SAFETY TRAINING IN VIRTUAL REALITY

Focus on the development of a transfusion safety training in virtual reality. Indeed, virtual reality is the ideal media to learn a procedure and to allow an analysis of professional practices.

SYKO studio designs and creates digital and physical projects such as video games, virtual reality and escape games. Our objective is to impart knowledge and skills, to amaze or to entertain through an immersive and playful experience. We leverage the properties of entertainment such as aesthetics, narrative and interactivity to arouse a wide range of emotions. Our creativity and R&D allow us to highlight the content of our customers and partners through appealing, effective and meaningful solutions for richer and more engaging experiences.

Hôpital Foch is a private health institution of public interest located in Suresnes (France). It has celebrated its 80th anniversary in 2017. With 2,000 members of staff, including 300 doctors, and 600 beds, Hôpital Foch is one of the largest healthcare institutions in the Ile-de-France region; it provides 260,000 consultations (excluding maternity and emergencies) and receives more than 37,000 admissions per year. Hôpital Foch is the biggest private university hospital in France. The hospital also hosts the Foch Institute in Health Training. The latter relies on 48 experts in health and training and has 600 m² of rooms and technical facilities equipped with video systems, high and low fidelity mannequins, medical equipment and furniture.

In France, all health professionals must follow a continuous training system called Continuing Professional Development (CPD). The training module for nurses requested by Hôpital Foch related to the procedure to be followed in the event of an incident during the transfusion of packed red blood cells. Until now this training was provided in a reconstituted patient room where 11 errors were scattered: difference between the patient's name on his ID bracelet and the medical documents, not the right product to transfuse, etc. While the playful aspect has pleased and worked during the first years, the nursing staff began to show some weariness. Hôpital Foch therefore asked SYKO studio to think about a new training system by analysis of practice.

The procedure to be applied in the event of an incident during a transfusion includes the following 6 non-detailed steps:

1) Stop the transfusion, initiate a hemodynamic assessment, inform the patient
2) Call the doctor and describe the situation
3) Launch a hemodynamic assessment, check all the documents
4) Apply the doctor's prescription, inform the patient
5) Call the dispensing store
6) Report the transfusion incident in the business software

Hôpital Foch was open regarding the form that the training system should take, if it entered the budget and validated the following two educational objectives :

1) Raise nurses' awareness about transfusion risk
2) Strengthen their knowledge of the procedure to be followed in the event of a transfusion incident.

The aim was therefore to provide a training instrument that enables, in a sufficiently interactive manner, to implement the procedure to be applied and that provides a sufficiently realistic experience in order to support a debriefing phase. The latter is considered by the training staff as the phase allowing a real deep learning through a reflective approach. Different media could have been considered, more or less immersive and interactive: movie with real characters or animated film, more or less advanced serious game (quiz, 2D or 3D, static or dynamic, explorable or not explorable), augmented reality or virtual reality.

A pedagogical work was then necessary to explain the potentialities and limits of each of these media. We relied on various examples ranging from the existing simple product to the current research project. Different criteria such as immediate appeal, degrees of immersion, interaction and autonomy in decision-making were assessed and put into perspective regarding the two objectives set by the hospital.

Compared to a real simulation, digital technologies, taken in a broad sense, offer several advantages :

1) Accessibility : by simulating complex, inaccessible, dangerous or expensive situations ;
2) Tracking and diagnosis of learning ;
3) Standardization or adaptability of the learning situation.

In addition to the previous benefits, virtual reality has unique strengths : complete immersion of the learner in the

« The patient shows shivering and has a fever » Blood transfusing training in VR // © Syko

environment at scale 1; natural interactions and immediate feedback to offer active learning, by doing; learner's engagement in the training situation; sense of presence felt: when the learner embodies her/his role in the training situation and consequently, reacts and behaves in the simulation as in real life.

Thus, virtual reality offers learning in immersion and by doing and provides in addition, a rich and memorable experience on which the trainer can build her/his debriefing for a more impactful training.

To be effective, immersive training must be considered useful by the learner in relation to her/his professional practice. The learner's judgment is based on two factors that have several criteria: acceptance of the system and appropriation of the simulation. **The key factors for the learner to accept immersive technologies as a training tool are:**

1) To propose a virtual environment, here a room of patient and its equipment, credible. This means consistent with her/his daily life to facilitate the projection in her/his professional environment.
2) To provide intuitive interactions so that the learner, during the simulation, only thinks about what to do and not how to do it. Therefore, we have developed a room scale simulation with HTC Vive so that the learner can walk around the room and grasp and manipulate the different elements.

The key factors for the learner to appropriate the simulation:

1) To propose an authentic situation in relation to her/his professional practice in order to facilitate her/his projection and embodiment in her/his role (sense of presence). Then the learner will adopt a behavior during the simulation similar to the one s/he would have had in reality.
2) The pedagogical engineering at the heart of simulation: mastery of the field and adaptation of the content to the learner for more engagement.

Several hundred nurses have completed this training as part of their CPD, both day and night. The training began with a knowledge audit (pre-test) followed by a 5-minute briefing during which the trainer presented the virtual reality device and the medical context of the simulation. Then, about 15 minutes of simulation. The training ends with the debriefing with the trainer.
Feedback was very positive, both regarding learner motivation and efficacy of the training. In addition to the immediate wow effect, learners particularly appreciated the possibility of being active, with their body, during the training.

The next evolutions we are working on concern a scenario management tool, the report given to the trainer and the learner at the end of the simulation, the deployment on autonomous headsets and the development of new scenarios to reach other audiences and address other themes.

ALEXANDRE BÉGUÉ
RELAXMIND

STRESS MANAGEMENT AND BURN OUT WITH VIRTUAL REALITY

Virtual Reality is already used to destress patients at hospital or at home and lots of studies proved the effectiveness of this technology. As a burn-out therapist, I decided to use Virtual Reality for stress management and also for other specific pathologies of burn-out as lack of energy, self confidence to act, and anxiety.

As a reminder, one of major causes of burn-out is due to an intense and chronic period (several months, years) of stress without having enough time to relax. During stress, the sympathetic nervous system (or ortho-sympathetic) is activated automatically by the body. This system produces cortisol, adrenaline and some others hormones: therefore the heart rate increases, the muscle vasodilation also and the body is ready to act quickly. After stress period, the body needs to recover a normal state. The parasympathetic nervous system allows to decrease heart rate and increases the resting potential.
There is no problem to alternate stress period and calm period. However when the relaxation period is not enough efficient, the chronic stress causes a break down.
The consequences of burn-out are multiple: Fatigue, Insomnia, Irritability, pains... My first uses of VR in therapy was to help patients in burn-out to recover serenity and calm by activating parasympathetic system. I use it during few sessions during 30-40 minutes. At the beginning of burn out, the patient needs to destress and recover progressively energy.

However instead of using relaxed VR program «ready-to-use» (with off voice), I decided to personalize the experience by letting the user to chose his best relaxed environment among several landscapes (Campaign, underwater, beach, mountains, winter....). Then the patient is encouraged to move virtually and to find his best comfort place in this virtual environment.
When someone is on burn out, his capability to act is drastically reduce (even for small tasks). That's the reason why during a VR session, I propose to the patients to move into the virtual environment without moving a lot in reality. As consequence, the patient increases progressively his self confidence to act. The VR has a real impact in cognitive perception because acting in virtuo equal acting in reality for the cognition. VR is immersive and give the « presential » feeling.

After finding his comfort zone, I guide the patient to relax by breathing slowly at his pace and to feel good emotion by connecting with all good sensation within his body. Finally I propose to the patient to close his eyes to remember this good experience with feelings.
This last point allows the patient to keep in mind longer this experience and the good effects. He regains progressively his energy even at home. He can re-activate his parasympathetic system by thinking of experience.

The first feedbacks I received were very good and positives. Several person explained that they finally could release all the tension they had. They could also feel good emotion again. They had the impression that they could not be in a good mood again.
Someone gave me a surprising and interesting feedback: She used to go on the beach during her holidays. So she choose a nice virtual island during a VR session. However I noticed that she was not comfortable with water, so I proposed her to change the environment and she selected campaign. She really liked this new environment and told me that she felt in security. It's important to explore with the patients their real needs in term of comfort zone. And with VR we can easily test it.

Another interesting feedback concerns the feeling to be reconnected with yourself. A patient explained me to feel alone every time despite her husband and children. In fact, she felt alone to face about her issues. Within virtual reality session, she was the only « human » but didn't feel « alone » because she had none constraints. She took care of her and she reconnected with herself. Thanks to that she said that her anxiety decreased progressively.

Generally I see the patients in burn-out every two weeks and I start to use Virtual Reality during the 2nd or 3rd session. Several patients told me that after two weeks, it's hard to remember lot's of details of a VR session. Indeed I practice 3 to 5 Virtual Reality session with them in order to inscribe the experience in prefrontal cortex.
Since these first feedbacks, I use VR for other consequences of the burn-out as pains and insomnia. By focusing on nice landscape and breathing calmly (heart coherence), the sensation of pain can decrease. (As proved with several studies on pain decrease with VR)
Last point concerns insomnia. By thinking to the relaxing virtual environment, the patient can activate his parasympathetic system before sleeping. He can rest easier without overthinking.
To conclude, Virtual Reality is a very interesting tool to treat first steps of burn-out. The condition is to be guided by a therapist to be personalized. It's useful to destress, decrease anxiety, to recover energy and to be resourced. It doesn't substitute a classical therapy as psychotherapy, but it's complementary at the beginning: it optimizes the impact. According to some patients, the recovery of energy can be quicker and some of them can avoid medication (to sleep). There is no official studies on these last two points. It's assumptions with the patients I had.

Example of a virtual reality training session on blood transfusion
(IFSI, Niort, France – Training Institute for Health Professionals) // © SimforHealth

WHEN VIRTUAL REALITY IS BUILT HAND IN HAND WITH HEALTH PROFESSIONALS...

The advent of virtual reality headsets both technologically and financially more accessible, now enables the health community to take on these immersive experiences as a means to adopt and develop new training tools.

NEVER TRAIN ON A PATIENT

This ethical principal which was reiterated in a 2012 report by the French National Authority for Health (Haute Autorité de Santé) is a founding tenet of the use of simulation, and more specifically digital simulation, in healthcare.

This falls within the targeted approach to develop and offer a pedagogical framework for health professionals (doctors, nurses, etc.) in their initial training, and provide a tool with which to practice and supplement their knowledge throughout their professional life. Of course, there will always be that first procedure on a "real" patient, but we are convinced that these procedures will never be conducted without having practiced on a virtual simulator first.

On this basis, technology surrounding virtual and augmented reality offers health professionals on all levels a unique training ground. Indeed, virtual reality can reproduce with remarkable effectiveness clinical and care situations and environments, and teach therapeutic procedures. It will also allow students to review situations, fine-tune their decision-making skills, and practice procedures such as caring for cancer patients and administering daily treatments.
Additionally, beyond the benefits of better knowledge retention which has been demonstrated in several studies in cognitive science, training via virtual reality also offers solutions to issues related to healthcare organization and societal changes.

VIRTUALLY RECREATE CLINICAL AND CARE SITUATIONS

Digital simulation, and more specifically virtual reality, must be an integral part of the wider scope of training with a truly complementary approach: lifelike dummies, standardized patients (doctors and nurses take on the role of the patients in role-play exercises), and internships in hospitals and healthcare establishments are all training modalities which enable health professionals to put their knowledge into practice.

However, there can be obstacles to accessing these different training modalities: difficulty accessing the simulation centers, insufficient number of trainers, lack of practice in certain situations, or high costs.
This is where virtual and augmented reality truly fulfills its purpose by offering an exhaustive pedagogical tool. A 3rd-year nursing student who will soon be starting her career - and practicing on "real" patients - comments "before using this digital simulator I had never had the opportunity to perform a blood transfusion during my internships, even though it is a frequent procedure".

VIRTUAL REALITY IMAGINED BY AND FOR HEALTHCARE PROFESSIONALS

Conscious of the importance of integrating these innovations in healthcare training, the SimforHealth teams aimed to create a collection of digital simulators which covers the entire initial 3-year nursing training curriculum. (Note : there are 600,000 nurses in France, including 100,000 independant contractors). To devise the virtual reality simulators, over 40 senior trainers from the 27 French Nursing Training Institutes of the Nouvelle-Aquitaine region (IFSI) were asked to co-conceive the modules. This region is a leader in the field of e-health.
Several creative workshops were put in place gathering working professionals, trainers, students as well as representatives from the Agence Régionale de Santé (ARS - regional governing body for healthcare). Together, they were able to conceive immersive experiences which are perfectly adapted to healthcare and clinical situations and aligned with the knowledge acquired by student nurses as part of the national framework of competencies for nursing professionals.

These virtual reality simulators of medical procedures (needle insertion in port, blood transfusion, etc.) are now deployed to over 8,000 students with the financial support of the Nouvelle-Aquitaine region, and the ARS who provided access to VR equipment.

Bringing together institutional, pedagogical and healthcare stakeholders has led to the development of a truly innovative training project which is now recognized by numerous establishments throughout France, not least of which the French Red Cross who chose to use these VR simulators in their 33 institutes in France and their VR center located in their headquarters. In doing so, the French Red Cross has made this new training tool accessible to the 140,000 people who are trained each year.

BRAVEMIND 3.0 with Samsung Odyssey Plus 2019

SKIP RIZZO, ARNO HARTHOLT, ANDREW LEEDS, DAVID KWOK, SHARON MOZGAI
UNIVERSITY OF SOUTHERN CALIFORNIA INSTITUTE FOR CREATIVE TECHNOLOGIES

BRAVEMIND: A BRIEF HISTORY OF A LONG-TERM CLINICAL VR RESEARCH PROGRAM TO ADDRESS PTSD

One example of a theoretically-informed use case for applying VR clinically is in the area of preventing, assessing and treating Posttraumatic Stress Disorder (PTSD). We commenced a project on this in 2004 with the vision to develop a long-term research program in this area. At that time, the United States was coming to the realization that the ongoing conflicts in Iraq and Afghanistan were leading to a significant percentage of military service members (SMs) who were suffering from PTSD and other mental health problems. This article describes the long-term development of the BRAVEMIND VR Exposure Therapy system for delivering treatment for combat-related PTSD that continues to the present day. This long-term process, leveraging continuing user-centered feedback and clinical outcome data has led to the iterative creation of 3 systems, a system for training psychological resilience prior to a combat deployment, the development of VR content used to diagnose PTSD, and the lateral expansion of the approach for treating PTSD following sexual assault and for helping to address stress in police officers and first responders.

CLINICAL VIRTUAL REALITY

Virtual Reality (VR) and associated digital technologies offer new opportunities for clinical research, assessment, and intervention. Since the mid-1990s, such technology-based testing, training, teaching and treatment approaches have been developed by clinicians and researchers that would be difficult, if not impossible, to deliver using traditional methods. During this time, a large and maturing scientific literature has evolved regarding the outcomes and effects of what we now refer to as Clinical VR applications that target cognitive, psychological, motor, and functional impairments across a wide range of clinical health conditions. Moreover, continuing advances in the underlying enabling technologies to create and deliver Clinical_VR applications have resulted in a widespread availability to consumers, sometimes at a very low cost. Thus, when one reviews the scientific literature, examines the evolving state of digital technologies, and observes the growing penetration and enthusiasm for these applications in popular culture, it is easy to see that healthcare has been and will continue to be positively impacted by the thoughtful application of these technologies.

POSTTRAUMATIC STRESS DISORDER

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THE USC "BRAVEMIND" PTSD PROGRAM RATIONALE

The intention of our PTSD program effort from its start in 2004 wasn't to simply create a one-off VR system, give it to clinicians, and move onto another project. Rather, we viewed this as a long-term effort to build a system, test with clinical users (patients), and then to continually evolve the system with feedback we gathered.

Due to the limited knowledge base for VR PTSD treatment at that time, it was felt this was the only way that such a complex problem could be optimally addressed. Moreover, our view was to create VR simulation content that could be reused for both preventing and assessing PTSD, in addition to expanding the application to address PTSD due to other forms of trauma (sexual assault), pending successful outcomes from our combat-related research.

The therapeutic rationale for the system was driven by the desire to amplify the delivery of prolonged exposure (PE), a theoretically informed and evidence-based treatment

Early User Testing of BRAVEMIND prototype in Iraq 2005

for PTSD (Rothbaum, 2001). PE is a form of individual psychotherapy based on the Foa and Kozak (1986) emotional processing theory, whereby successful treatment requires emotional processing of trauma experiences via the systematic confrontation and re-processing of trauma memories. This is done in practice by having a supportive clinician guide the patient through the narrative and imaginative recounting of the trauma in a safe environment. This approach is believed to provide a low-threat context where the client can begin to confront and therapeutically process the emotions that are relevant to a traumatic event as well as de-condition the learning cycle of the disorder via an extinction learning process. More details on this approach can be found in Rizzo & Shilling (2018). Our approach in BRAVEMIND was to create a wide variety of virtual worlds that mimicked the varying contexts in Iraq/Afghanistan where patients could be immersed to confront and re-process traumatic experiences, beyond what was possible with the exclusive reliance on the hidden world of imagination. Clinicians used a "Wizard-of-Oz" control panel to adjust the content of the virtual scenarios (e.g., time of day, number of people, ambient sounds, explosions, etc.) in real time to customize the exposure to match the patients experience while they recounted the story of their traumatic events.

BRAVEMIND VERSION 1

In 2004, in an unfunded effort, we build a PTSD VR exposure therapy (VRET) prototype by recycling the art assets from the video game, Full Spectrum Warrior, which was developed by a professional game studio, based on an Army training application designed by our institute. This single world system was sent to Iraq with a military psychologist to acquire feedback from "boots on the ground" as to the credibility of the content and user interface. This initial user-centered design feedback was essential for guiding the development of the first clinical version of the system, upon receiving funding in 2005. This first clinical version had 4 worlds (three HUMVEE driving and one foot patrol within a 12 block Middle Eastern themed city) and in late 2006 it was deployed to a military

testing site for the initial clinical trial. The results of that early effort produced positive clinical outcomes (Rizzo et al., 2009), and led to approximately 70 other clinical sites (e.g., veteran's hospitals, military clinics, university clinics, etc.) acquiring the system for clinical use and research. In 2008, based on the positive technical/clinical outcomes from the project, BRAVEMIND won the Laval Virtual Reality International Conference and Exhibition Competition in the Health and Medicine Category. During the time of this initial deployment, we also embarked on developing tests of cognitive function (attention, memory, wayfinding) within the BRAVEMIND simulation scenarios (Parsons et al., 2008). In this manner, we were able to economically recycle the virtual assets into another relevant application area—assessing cognitive function within military-relevant VR contexts to study the impact of traumatic brain injury and concussion; another commonly cited "wound of war". During all of the PTSD and cognitive testing trials we continued to acquire feedback from clinicians and patients regarding the VR content and interaction that was recorded for later use in the next iteration of BRAVEMIND.

BRAVEMIND VERSION 2

In 2012, based on the initial success of BRAVEMIND Version 1, we received funding to fully update the system based on research findings, user feedback, and the rapidly advancing state of both VR hardware and software. Version 2 was built from the ground up on the Unity game engine, increased VR scenarios from 4 to 14, and added additional audiovisual features, all based on the needs communicated to us by clinicians and patients. This thorough update was released in 2014 and was quickly adopted by 40 additional clinical sites. At the same time, the Infinite Hero Foundation funded the development of content for inclusion in BRAVEMIND to address the psychological trauma needs of combat medics and the True Patriot Love Foundation supported the modifications to the system for making it relevant for use by the Canadian military. This new version supported research efforts that continued to document the effectiveness of VR exposure therapy for treating PTSD (Rothbaum et al. 2014 ; Reger et al., 2016; Beidel et al., 2017; Difede et al., 2019).

Prevention and Assessment of PTSD: While building Version 2, we also began to design applications re-using the BRAVEMIND simulation content for PTSD prevention and assessment. For prevention, we created the Stress Resilience in Virtual Environments (STRIVE) project: a set of immersive narrative VR "episodes" designed to give SMs the experience of emotionally challenging combat simulations prior to going on a combat deployment (Rizzo et al., 2013). These "emotional obstacle course" simulations were designed to better prepare SMs, for the emotional challenges of combat. Following exposure to these events a virtual human "mentor" would then walk into the VR simulation and engage the user in psychoeducational training in stress management, coping skills, and general tactics designed to promote psychological resilience with the aim to prevent the later occurrence of PTSD and other mental health conditions. The STRIVE system has also been investigated as a tool to measure resilience. Thus far, both physiological studies and user endorsement of the content have been positive (An et al., 2019 ; Squad Overmatch, 2014). On the PTSD assessment front, the BRAVEMIND content has been converted for use as stimuli to present to users following a deployment to measure their physiological reactivity and recovery to diagnose PTSD. This effort to objectify the PTSD diagnosis, going beyond the exclusive reliance on patient self-report, has produced four publications documenting the viability of the approach (Costanzo et al., 2014 ; Highland et al., 2015; Norrholm et al., 2016 ; Webb et al., 2015).

BRAVEMIND VERSION 3

In 2019, we again updated BRAVEMIND to more modern, better and less expensive equipment (Oculus, VIVE, Samsung MR HMDs) and the system is now being deployed to clinical sites. While reducing system costs, the new version has significantly amplified capability, including enhanced usability, stereoscopic rendering, wider field of view, higher resolution, and better user comfort in the operation of the headset. This all leads to a much better user experience at a significantly reduced cost. Referred to as BRAVEMIND 3.0, the system has been primarily funded by non-govt. entities, including donations from Dell Computers, Intel, AMD, Samsung, and most recently from the Soldier Strong Foundation, who is also donating the equipment needed to run BRAVEMIND at any qualifying Veterans Medical Center. Moreover, the Canadian, Norwegian, and Danish militaries are currently using the system, with interest express by other military groups.

BRAVEMIND FOR OTHER SOURCES OF TRAUMA

Finally, our research program has taken what we have learned over the last 15 years of R&D to implement this evidence-based approach to other sources of trauma. For example, in 2016 BRAVEMIND was expanded with new content to address the needs of persons with PTSD due to Military Sexual Trauma (MST). Details on the system can be found in Rizzo et al. (2018) and initial results indicating positive effects for MST can be found in Loucks et al. (2019). The success of the MST clinical trial is now setting the stage for civilian deployment of the system. Regarding other civilian needs, we are now collaborating on projects to bring the VR approach to address the needs of police officers (NYC and Los Angeles) and other first responders–occupations that are at high risk for stress related disorders that often go unrecognized.

CONCLUSION

This detailing of the BRAVEMIND project serves to illustrate the integration of VR technology into a long-term R&D program that is investigating its value as a tool to remedy a very significant societal problem. Chronic stress and trauma are ubiquitous in modern society and the potential power of these types of technologic innovations as a counter-weight to the pain and suffering that people endure demands a level of focus that only a long-term parametric research program can deliver.

For an online collection of videos clic here

Early User Testing of BRAVEMIND prototype in Iraq 2005

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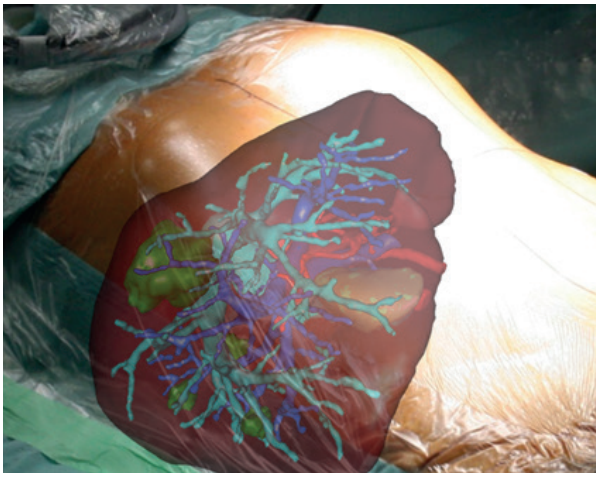
VIRTUAL & AUGMENTED HEALTH REALITY: A NEW WAY OF TREATING

Until 10 years ago, virtual and augmented reality appeared as futuristic technologies with a high entertainment potential by offering immersive experiences that are larger than life. Today, the health sector has appropriated this technology to invent a new way of training the medical profession, preparing for surgical procedures and treating the patient. Get ready for an immersion in health innovation, which may seem futuristic but is real!

// © Biovalley



TRAINING WELL, TO CARE WELL

Training is fundamental for health professionals to gain the required in qualifications and confidence to offer the best care possible for the patients. For example, lumbar puncture is a delicate procedure than can be stressful for both the patient and the practitioner and can prove to be painful if not perfectly controlled. Yet, medical students often train to this gesture directly on the patient, increasing the risk of pain and complications. So how to combine training and practice without using the patient as a guinea pig? The solution was found by the start-up InSimo, which is developing a training tool for the medical student mixing force feedback and augmented reality. The system developed by InSimo aims at reproducing digitally all the sensations of a real lumbar puncture and immerse students in a realistic context, so they can train efficiently before performing on their first patient. To prove the efficiency of this solution, an upcoming clinical study will assess the reduction of pain and anxiety for the patient when students are trained on InSimo's simulator. Simulation is the key to train future medical professionals while improving patients safety, that is why InSimo develops other educational tools in the field of eye surgical training, robotics surgery or patient-specific surgical planning, most of them already being used on the field by students.

100% PERSONALIZED SURGERY

Surgery has made considerable progress, and we are reaching a stage of knowledge where it is necessary to understand a surgical procedure not through operating diagrams but through the individuality of the patient. For example, in the case of a patient suffering from liver cancer, the operating diagrams of this pathology cover only 40% of human livers, so it is impossible to offer to the patient personalized surgery. To meet this need, Professor Luc Soler has developed Visible Patient, a start-up that aims to reduce surgical errors while offering to patients a 100% personalized surgical procedure. This innovative solution provides for the surgeon an online medical image analysis service reconstructing in 3D any patients' organs from medical imaging (MRI - Magnetic Resonance Imaging, CT - Computed Tomography scan, radiology, etc.). The surgeon can then plan his operation using the Visible Patient Planning software by taking into account the specificities of patient anatomy. More than 4000 patients have benefited from Visible Patient Solution that is already covered by major French private Health Companies.
This 3D modelling can be exported in STL 3D printing format but also in a Unity format making it compatible with several Virtual and Augmented reality display software.
Visible Patient Solution is so not only used by surgeon directly, but also by simulation companies to provide new generation of patient specific simulator. In the future, Augmented Reality solution based on Visible Patient will finally allow for an intraoperative virtual patient see-through, guiding the surgeon as a GPS.

TREATING DIFFERENTLY WITH VIRTUAL REALITY

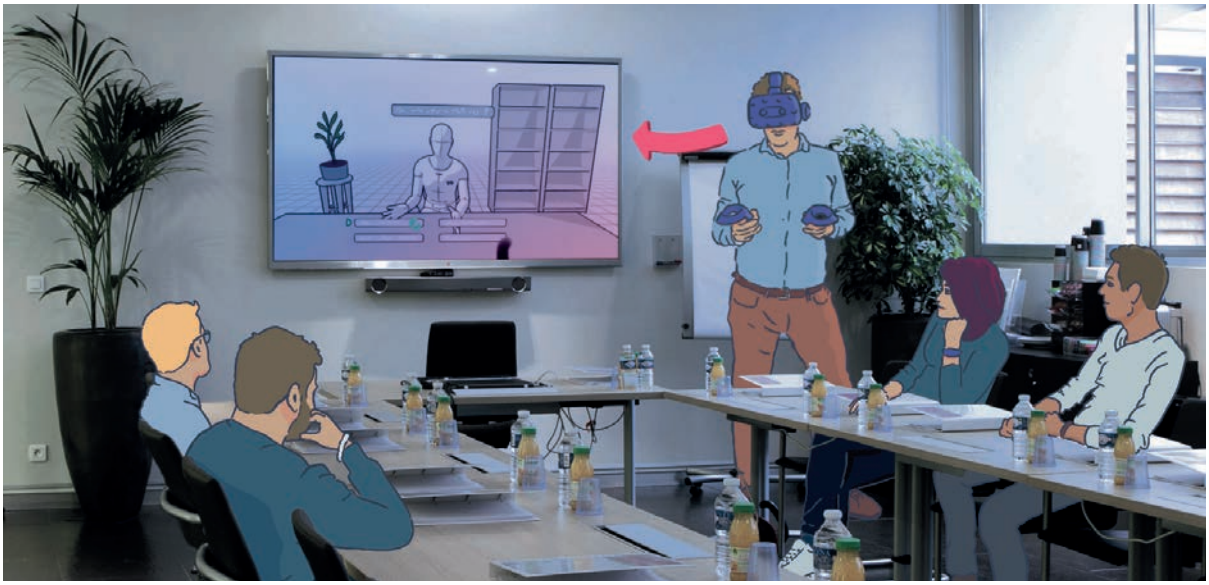
During a medical procedure, stress is often omnipresent in the patient. Who has never feared dental surgery? Until now, pain relief and anesthesia had to be done chemically. Virtual reality makes a difference by offering patients a non-drug alternative.
The start-up HypnoVR has developed programs compatible with virtual reality headset to allow surgical procedures to be performed using medicalized hypnosis rather than chemical anesthesia. With this solution the patient is in a state of great serenity and chooses the universe in which he wishes to evolve during the procedure: beach and coconut palms to the bottom of the sea all tastes will be pleased! This innovative method allows doctors to provide care under optimal conditions and patients to avoid side effects following drug administration. Today the HypnoVR solution is used by several French health institution in various departments including pediatric surgery, oncology surgery, dental surgery, gynecology and urology. The start-up is currently in the research and development phase to use its solution in the treatment and management of chronic pain to prevent patients from taking analgesic medicine.

Health has made virtual reality and augmented into a real tool to support the medical profession in order to always provide better care for the patient. All these solutions are time-consuming to implement because they follow the same regulations than drug discovery. The health competitiveness clusters, including BioValley France, work alongside innovative companies to support them from the idea to the market. Concerning health innovation through virtual and augmented reality, it is indeed the dynamism and curious spirit of the medical sector that have made it possible to draw on and reveal the potential of this technological innovation, a first step that leads us to the patient and the augmented surgeons of tomorrow.

NORA YENNEK, IFISLAB
CORENTIN DUBOC, SEGULA TECHNOLOGIES

HOW TO DESIGN IMMERSIVE VIRTUAL ENVIRONMENTS SUPPORTING MOTIVATION TO LEARN?

The aim of this article is to propose a conceptualization approach of design of immersive experience 3D contain through a use case developed by IfisLab with the support of SEGULA Technologies. This project addresses the question of the effectiveness of use of virtual reality to design learning situation of soft skills through audit scenarios in the health industries sector. We will explore the question of the motivation to use immersive technologies in the context of professional training sessions for adults.



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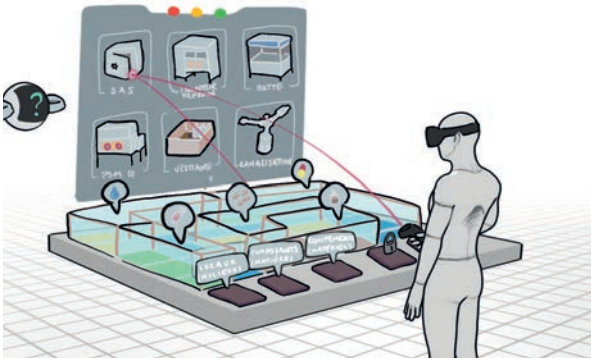
The health industries sector, in particular the pharmaceutical industry, is a highly regulated sector given the drug-related safety issues for the end user, the patient. The evolution of the training methods that are associated with these challenges, especially virtual reality, has led us to ask the following question : how could we use immersive 3D content as a tool to effectively train employees in this sector on an audit issue, involving both work environment analysis skills and soft skills.

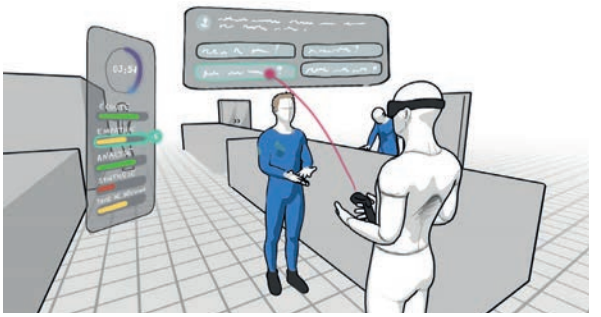
In order to answer this question, we suggest to base our reflexion on research in cognitive psychology, more specifically motivation theories, to design a VR capsule integrated in a three-day training course on audit.The VR design requires thinking carefully about the experiences that will be offered to the learner so that they are emotionally rich and allow for involvement. This approach has an impact on the choice of personas, graphic environments and interaction models.

WHAT ABOUT MOTIVATION?

The question of motivation to learn is more crucial in this training context as the scripting of this type of experience needs a strong focus on the learner. The challenge is to create an optimal interaction environment between the person and the object of learning and choose the appropriate device to make a real life immersive experience.

Therefore, two forms of motivation approach seem to us to be essential to consider during the content design phase: on one hand, the motivation to learn, to be more aware of the object of learning, in other words, the concern for the content of the training. On the other hand, the motivation to use this





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type of technology as a medium to learn.
The theory of self-determination (Deci and Ryan, 2000, 2002) focuses on the degree to which an individual's behavior is self-motivated and self-determined in different contexts, particularly in the learning process.
It assumes that the satisfaction of the three basic psychological needs, which are autonomy, competence and social relations, generate a self-determined motivation, in other words an intrinsic motivation linked to the pleasure of learning and to the individual interest in the content of the training (Yennek & Fenouillet, 2016). Therefore, this theory seems insightful for the design of immersive 3D content, which we will illustrate in the following. In practice!

HOW TO SUPPORT AUTONOMY?

During the immersive experience, the scenario should ask the question of the level of guidance to be offered by the 3D environment. Should we give the learner the effective choice to build his training course and thus participate in the design of his experience by his actions ? In order to give choices and support learners autonomy, it is possible to act on variables like the use of decision-making trees when interacting with personas, as well as the possibility of having support at the start of the experience (presence or not of a facilitating personas, visual or sound elements that guide in the virtual environment towards points of salience, the possibility of being in free exploration mode...).

HOW TO SUPPORT THE PERCEPTION OF COMPETENCE?

We have set up a real-time feedback system visually represented by a skills gauge built based on a soft skills repository. The quality of social interactions with people (empathy, decision-making, assertiveness...) is materialized by a fluctuation in the skill gauge, which gives feedback allowing the learner to interact more effectively with the environment and readjust their behavior to better perform.

HE NEED FOR SOCIAL INTERACTIONS:

The idea is to provide content that allows people to feel connected with others in the learning experience. In our context, the content of the VR capsule is an integral part of the training and allows feedback through the device that presents the experience to other participants by projecting it on a screen in real time. The user experiences will also be recorded to generate case studies that will be used to facilitate face-to-face interaction with other participants.
Another experience that we are considering is to design a VR capsule where two participants are connected at the same time, with the roles of the auditor or the audited, depending on the situation, and the use of microphone-based communication as an integral part of the experience.

FROM MOTIVATION TO LEARN TO MOTIVATION TO USE VR TO LEARN

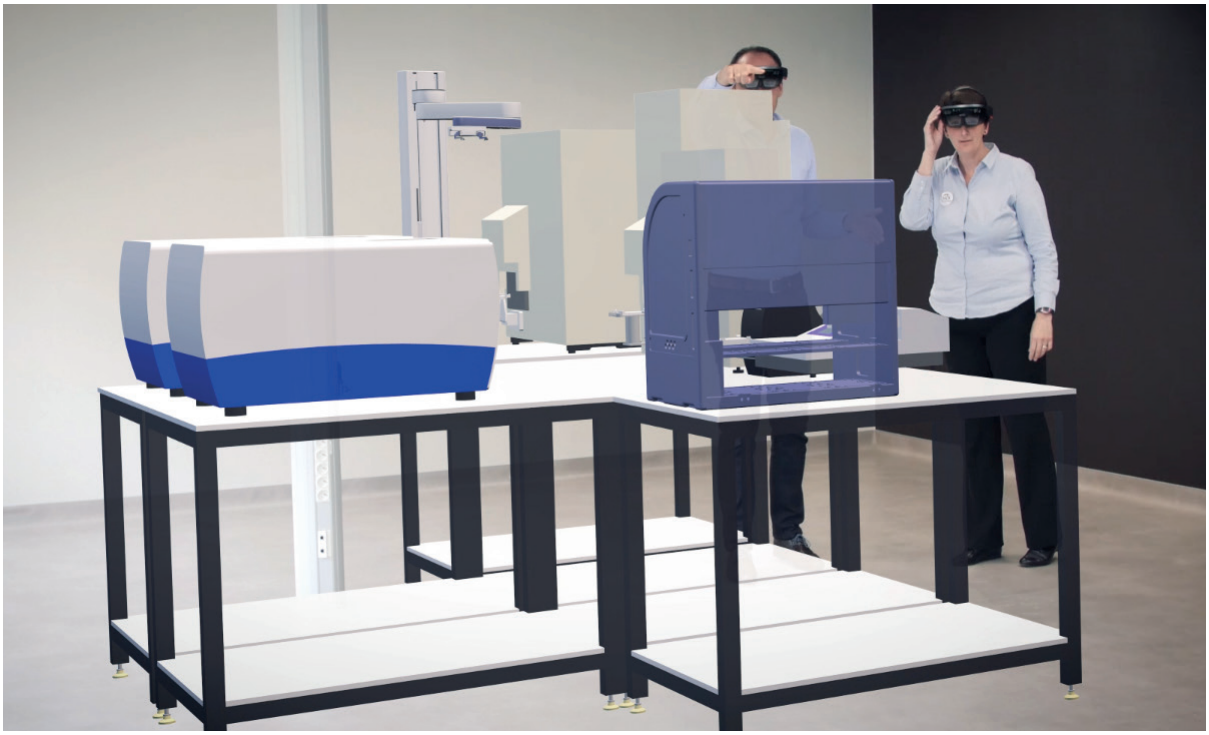
The Technology Acceptance Model (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989) appears to be the most widely used model in the literature to clarify the fundamentals of the use of Information systems (Lim, Saldanha, Malladi & Melviller, 2013). This model answers to a concern of institutions or companies, which, despite implementing highly available and functional technologies, observe that their use is not always effective, as this "under-use" can lead to considerable costs (Fenouillet & Kaplan, 2012). Recently, this model has been used to connect the VR development with consumer acceptance, and return on investment for this technology (Manis & Choi, 2018).
Both the perceived usefulness of a system and its perceived ease of use predict the attitude towards technologies, which has an impact on the intention to use the technologies, this variable being related to the effective use of the technologies. In particular, we considered the dimension of perception of ease of use of VR, in other words the individual's estimated perception of the cost/benefit ratio associated with this technology. For this purpose, we have scripted a timespan to become more familiar with the VR environment in a decontextualized content to reduce the cost dimension related to the cognitive effort required to use this technology.

NEXT STEPS?

The next step will be to include in the technical design a transversal approach to be able to provide several versions of this module in an industrialized way for other soft skills development. Stay tuned!

GREGORY MAUBON HCS PHARMA
GRACE MANGIALARDI (EX MOLECULAR DEVICES, NOW WORKING FOR SCIEX)
#RESEARCH

HOW TO IMPLEMENT IMMERSIVE TECHNOLOGIES WHEN YOU ARE AN INDUSTRIAL COMPANY IN HEALTHCARE?



AR can time and resources at both ends and provides the assurances to fit and functionality of the custom built platform ahead of time. // © HCS Pharma / Dad Agency

Many companies in the healthcare and biotech sector know that immersive technologies are real game changing tools to increase productivity and customer satisfaction through training, maintenance and tele-assistance. Often though, they don't know exactly how to implement such tools and made POC (Proof of concept) after POC to find the best way to introduce these new technologies.

One company that has embraced such technology is Molecular Devices, a global provider of instrumentation and reagents for life science research, drug discovery & development, including microplate readers, high-content imaging systems, automated microscopy solutions and cell screening Molecular Devices chose to experiment with the use of augmented reality (AR) in a robotic platform design and implementation. It was done in partnership with a customer, HCS Pharma (my company) and the results were good enough to encourage them to continue the "practical" exploration of these technologies. Let us talk with Grace Mangialardi, Director, Advanced Workflow & Engineered Solutions (AWES) at Molecular Devices, about immersive technologies and how to "really" implement them.

Grégory : As a company in a very specialized sector, how did you see immersive technologies before this experiment ?

Grace : Prior to using Immersive Technology tools, we saw them being used in the gaming and entertainment industry primarily. Although really interesting and exciting, it was difficult to see the benefits of using this type of technology

within a corporate environment, or efficiently to reduce risk or resources to a project. We also had an incorrect assumption that preparing and using AR would require extensive programming or detailed work, consuming significant budget and resources.

Grégory : You used augmented reality with one of your customers, HCS Pharma, to validate a robotic platform design. What were the advantages you saw in this use ?

Grace : We were able to communicate the layout and demonstrate size, scale and usability of the instruments before the unique platform was even built. A common concern of customers who buy our products is that they will not be able to fit the instrument in their current space, and that they will need to plan to put in utilities like air and electrical lines in very specific places in the lab. Using the augmented reality model, HCS Pharma was able to "see" the concept system in their lab, so that they could properly assess location and utilities spacing, as well as provide us feedback on any changes they wanted prior to build. Ultimately, this meant that we were able to settle these details very quickly, saving time and resources at both ends and provide the assurances to fit and functionality of the custom built platform ahead of time. This meant a faster timeline for the project and less issues onsite once installed.

Grégory : Now, in which domains do you think IT can help you? How do you imagine the benefits ?

Grace : As technology improves, we are excited about the potential to make more realistic concepts. We hope that we will be able to use it further for richer context such as video demonstrations or walk-throughs of custom products. There will be benefits to both the vendor and our future customers. Our customers will benefit from the ability to review and see a "custom" concept brought to life, before they purchase, thus allowing them to optimize or make changes to suit them best upfront, limiting cost over-runs and delays to the project that happen during testing. As vendors, we benefit from the ability to truly show and demonstrate concepts and products before they are built and installed. This helps us secure buy-In and confidence from our customers and allows us to save time in the build and commissioning process of these systems. This ultimately saves both vendor and customers time and money and prevents frustrations and mis-communications between all parties. This strengthens our partnership with our customers.

I think there are even more areas where AR/VR can be used by companies such as ours. We have already started to use tools for marketing purposes, and to "virtually" present at trade-shows and events where space is limited, and instrumentation is difficult to place. This technology is so portable, that it makes it easy for us to bring our instruments and concepts to customer location instead of having them travel to our demo sites or factories.

Grégory : Today you have made several experiments, what works really and what are the difficulties?

Grace : Our customers really love to see their concepts brought to life through virtual or augmented reality before they purchase. This helps them to communicate to their management and internal stakeholders, what they are commissioning and allow more rich information and parameters to be considered before they finalize their order.

One thing that really works for us is using the same components and blocks over again. We find we can do the time-consuming steps once and then use the same components with minor changes for other projects. In reality, we are building a library of tools that we can more easily deploy for different projects.

The most difficult part is that not all immersive technologies are compatible. There can be some challenges importing in or converting images, files and other properties of the files into the desired format. For example, converting 2D models to 3D models with the proper scale and level of detail. We are able to address the challenges; however it does take more time than planned sometimes to reformat or re-work the original components or drawings.

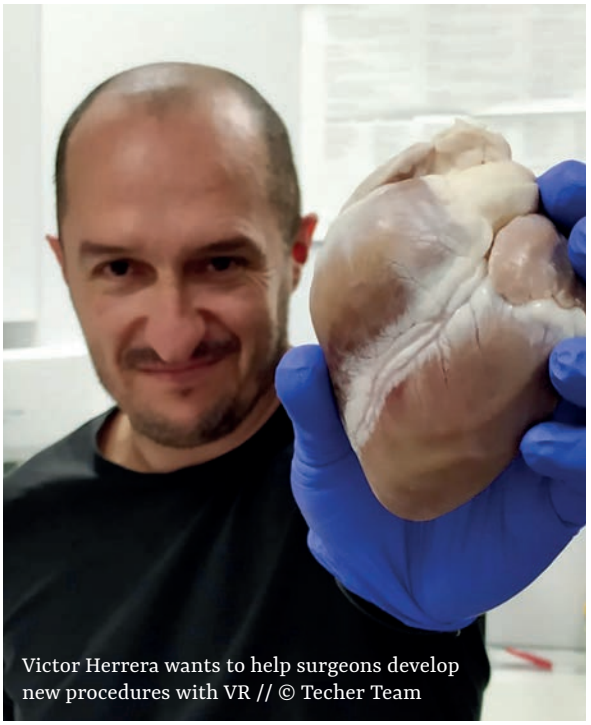
Grégory : How do you see future uses of immersive technologies in Molecular Devices and how to implement it?

Grace : I believe we are just starting our journey with immersive technologies and I am excited to think of where we will be five years from now. We plan to take advantage of technological advances and new software tools as they become easier to use and more cost effective. There are plenty of areas we would like to evaluate and use immersive technologies to help our business. Primarily for marketing, project design, training and on-site service of our instruments. This will have a benefit to our sales team, to help them demonstrate our portfolio of products to customers, and to our field service team who will be able to use the tools for troubleshooting and perform onsite repair with virtual experts and easy to access information. Training will become easier to perform in any country even without access to instruments, which will enable us to reach more customers and to develop our global team faster.
I predict that in the future we will be able to manage more of the components in-house and deploy tools for our field teams to use at customer sites. As we build our experience with sales and marketing tools, we will be able to more readily deploy tools for service and training.

VÍCTOR HERRERA & HELENA ORTIZ GIL TECHER TEAM
DR XAVIER RUYRA BALIARDA HEART INSTITUTE QUIRONSALUD TEKNON

TAVI VR PROJECT: 'STEPPING INSIDE' THE AORTIC VALVE

TECHER TEAM and the cardiovascular surgeon team of Dr. Xavier Ruyra work together on the development of a new gold-standard in the way TAVI procedures are done, providing and improving the required data to make these procedures safer and with a lower complication rate. The idea is to include throughout the diagnostic process an immersive experience for the surgeon with 6 DoF VR devices.



Victor Herrera wants to help surgeons develop new procedures with VR // © Techer Team

Heart valve diseases are a major public health problem in industrialized countries. Aortic valve disease is common and its prevalence increases with age. For people over the age of 75 years, the prevalence of aortic stenosis is 3%. More than one in eight people over the age of 75 have moderate or severe valve disease.

The Transcatheter aortic valve implantation (TAVI) represents a revolution for these patients and this pathology. This minimally invasive surgical procedure repairs the valve without removing the old, damaged valve. Instead, it wedges a replacement valve into the aortic valve's place.

The rate of TAVI adoption has increased throughout Europe and is currently the most frequently used strategy for treating aortic stenosis in elderly patients. The number of TAVI procedures in the last 10 years has increased massively, with annual growth of 25%. Over 300,000 patients have now received a transcatheter aortic valve in the world and another 144,000 will be added every year. It is expected to double in 5 years.

In any TAVI procedure, and especially in low or intermediate risk patients, it is necessary to demand the highest security level and a very detailed procedure to avoid complications and adverse effects as much as possible. The more thorough we are in the diagnostic procedure, the fewer potential problems will arise.

Although TAVI procedures have become part of the daily routine in many hospitals around the world with cardiology and cardiac surgery care, and the different implants have been evolving to more effective and safe designs, there are still associated problems that are may be potentially very severe.

While computed tomography (CT) was initially used primarily for the assessment of peripheral access, the role of CT has grown substantially and CT is now the gold standard tool for annular sizing, determination of risk of annular injury and coronary occlusion, and to provide co-planar fluoroscopic angle prediction in advance of the procedure.

VR : A NEW POTENTIAL FOR HEART SURGERY

The use of Virtual Reality in the preliminary analysis of the surgical procedures responds to a series of considerations:

- Visualisation and mapping gives the surgeon a huge advantage when it comes to planning particularly difficult procedures.
- The measurements made with Echos and TACMD techniques are crucial in order to choose the implant, its size, position and technique of it.
- A VR model can enhance the understanding of a patient's anatomy so that the clinical team can plan a surgical procedure in the virtual world prior to theatre
- VR can be a tool to engage with patients

We're just now beginning to even realize its full potential

As well as the additional data provided by other medical tests used in the diagnostic stage, we firmly believe that Virtual Reality can help in the analysis of the patient's aortic root and aortic valve, choose the type and size of prosthetic valve, as well as provide and improve the required data to make these procedures safer and with a lower complication rate.

// © Techer Team

Virtual Reality provides surgeons and their teams with the ability to check the root and aortic valve « from within » in an unimaginable way until the arrival of this technology.
Aware of all this, Doctor Xavier Ruyra contacted TECHER TEAM to explore the new possibilities offered by this technology and try to implement a new gold-standard in the way TAVI procedures are done. Dr. Xavier Ruyra-Baliarda is a specialist in Cardiac Surgery and leads The Heart Institute QuironSalud Teknon CM Teknon. Barcelona. With over thirty years of experience and 10,000 heart surgeries performed, is considered one of the best cardiovascular surgeons in Europe. For Dr. Ruyra's team, their main goal is to provide patients with the whole range of possibilities that exists in modern heart surgery. Dr. Ruyra specializes in mitral valve repair, Minimally invasive aortic valve procedures in high risk patients, Bloodless cardiac surgery and cardiac cavity reconstruction surgery.

" Every day we treat elderly patients with greater risk. Minimally invasive approach is the cornerstone to reach the best results with fewer complications and patient safety. Transcatheter aortic valve implantation (TAVI) is a revolution in the therapy of ederly and highrisk patient with severe aortic stenosis " says Dr. Ruyra

Virtual Reality provides surgeons the ability to check the root and aortic valve « from within », and have a very real perception in a three-dimensional way, which allows to plan the procedure with greater precision.
After the initial meetings where VR was introduced to Dr Ruyra's team in terms of both software and devices, we jointly had working sessions for the development of a specific visualization software of the internal structure of the aortic valve for surgery planning, as well as, different ways of interaction to optimize the TAVI procedure.
The options initially opened to us were immense, but we-commonly- focused on two targets :
First, to develop a "Proof of concept" to verify the viability of this new method. To this end, based on the results of the CT scan data, we developed 3D models to «step inside» and to be able to enlarge, explore and analyse the aortic root, providing an immersive experience for the surgeon and for the relatives of the patient with 6 DoF VR devices far beyond the capabilities of traditional procedures. The aortic valve as it has never been seen before. Subsequently, we designed an initial benchmark study between the classic TAVI procedure (Eco/CTscan) and the new standard with Virtual Reality.

TAVI VR FOR EVERY SURGERY

We expect Virtual Reality will provide a better understanding of the area where the implant will be placed, as well as the opportunity to study it more precisely through the different degrees of interaction that we have endowed the virtual experience.
We firmly believe that if TAVI VR can be implemented in every surgery, surgeons will be more confident before making an incision, and it will help reduce errors and improve efficiency, for the patient's benefit.

The TAVI VR project leaded by Dr. Ruyra, Teknon Hospital and the Quirón Salud group clearly shows us that Virtual Reality is and will be a key tool in the diagnosis and surgical planning of all types of pathologies.
Many advantages of Extendend Realities are foreseen and already being used in Healthcare; in fact, economic forecasts predict a great future of VR medical developments:

- The Global Healthcare AR-VR Market was valued at US$ 933.1 Mn in 2018 and expected to reach US$ 3,192.2 Mn by the end of the forecast period, growing at a CAGR of 36.2% during the period from 2018 to 2023.
- By 2028, that is expected to increase dramatically to 4.64 billion U.S. dollars

Healthcare professionals bet on this technology and confirm the extraordinary future ahead. We, in Techer Team, are committed to research and collaborate as much as we can with all enthusiastic medical staff who are keen to integrate any project with Extended Realities into their diagnostic and learning processes, and provide them with the best software to improve patient's health. the health of their patients. Even if only we get it once, it will be worth it.
Long live VR!

THE APPROACH TO SPACE FOR EXTENDED REALITY

In the process of developing medical Holodecks // © Christopher Lafayette

SPACES

With new and scaling adoption of virtual and augmented reality. Hospitals are discovering more ways to incorporate this technology into their programs.

From Alzheimer empathy engines to Surgical Theatre Development, we're seeing an increase in spatial computing in the health and wellness ecosystem more so than most participating industry adoptive verticals.

Of this new adoption arises questions and curiosity. Questions of what are best use cases; up-to-date success metrics, measurement standards, regiment processes and etc.. for XR. However, the question that lingered with me for sometime was on the subject matter of space availability. This has been a quiet discussion within the XR industry and its participating enterprises, but a very vocal inquiry within the ranks of the medical and architectural sectors.

From the architectural level to the surgical field, there's been tremendous enthusiasm regarding the question of available spaces for XR use. An industry I've focused on for some time. The XR industry as a whole is tied into spaces. Augmented Reality by way of the AR cloud is gestured heavily toward making planet earth machine readable. With Virtual Reality, we're able to envision, build and enter into spaces that were not there before. The need for more space has made this narrative a key and integral player in the ecosystem of spatial computing.

THE APPROACH TO IMMERSIVE SPACES

So, in order to better understand immersive spaces. I came to the conclusion that I'd either have to use someone's space or build my own. There were no ideal spaces already built for me to use. Now, to note, in order to build my own, this would take time with high costs associated with it. Silicon Valley is a terribly expensive place to build in. However, given the importance of the mission in better understanding tangible environments for intangible uses, It was justified. In 2016, I began to endeavor to better understand the approach to building environments for spacial XR.

With the advent development of virtual headsets infused with six degrees of freedom, it was key to understand where we were headed.

In exploring how many industries could benefit by using virtual and mixed reality, it wasn't hard to figure out that they would be at a severe disadvantage by the lack of available dedicated spaces for immersive use in most commercially occupied buildings. Having already been in exploration of the vastness of the medical world, primarily the human body, it didn't take long to know which industry I'd focus on for this endeavor. Health & Wellness.

Now, narrowing it down with a firm focus on the Medical industry, it began to dawn on me that your average and traditional hospital setting was not made for six degrees of freedom usage and that the

use of immersive technology itself will never be as great as it can be until such space was available.
Furthermore, when we think about the beginnings of adoption - it should be of keen and wise considerations that we start off right in order to maximize are known and undiscovered goals and focal points of achievements in using this technology.
Rudimentary, I believed it was important to natively go to the beginnings of understanding to first inform the medical world on what Extended Reality is and how it can help them in the growth of patient care and revenue, even to the very foundation of each hospital itself.
Consequently, I knew in order to do this, I'd have to speak with experts on these subject matters. My targets were architects and health professionals.

In 2018, I was invited to meet and speak with a delegation of hospital architects in Las Vegas Nevada. I happily accepted and knew that the information presented could go through a proper refinement for better understanding as to what this technology actually is and means to the med and architectural sector, best use cases, and overall, how to lessen the gaps of communication between the Health Wellness community and the XR industry. I met with representatives from Stanford Health, Kaiser Permanente and Kaleida Health. Relationships were beginning to develop.
I covered the subject of the current and future state of medical technology, with the addition of the approach to spaces for XR usage. The approach to developing XR spaces with great consideration as to what will be done in these spaces. The feedback, teaching and learning have been great and well received from both sides.

ENTER MEDICAL HOLODECKS:

A medical chamber or facility that's built for Immersive Medical training and implementation using holographic or computer simulated visual, audio, and haptic hardware. A Holodeck platform located within hospitals for education and experienced based learning. A focus on male & female internal and external body image exploration, individual body models, 3D CT Scan Image Displays, 3D patient charts, pain therapy displays, body, environmental, emergency training protocols and simulations.
The original intent of using head mounted displays was never to utilize such devices from a desk chair in a classroom. These devices are being built to mirror reflect our bodies in how we naturally operate them in ingress and egress. The plea for safety almost goes unquestioned. Even with gated technology barriers equipped inside our headsets, we aren't free from incoming projectiles and furthermore we don't want to limit our immersive experiences by lack of physical space to enjoy the digital space interaction. To move, hear, touch and experience in human fidelity is what we're after.
It's at this moment I state that it's critical for every member of the XR community to be educators of what we build, each and every time an opportunity such presents itself.
In the given life-career of every individual on the planet. He or she is trained, governed or imbued with a skillset of contribution to their societies. Moreover, each of us in the technology arc, are also provided with workable skills for contribution as well.
Under the banner of emergence, Spatial Computing and Artificial Intelligence have begun their growth sprints within the eco habitat. The ideals of its trajectories and understanding when it comes to this technology are limited, finite and naturally not easy to be understood.
It's partially of this understanding that we begin to set a course toward organic and meticulous true growth. To go outside of our ecosystem and to venture toward and into others is key. How else will we ever understand where we're going for in the greater scheme of things? Today we're building spatial tools and experiences, but tomorrow we'll be building populated immersive worlds. This cannot be done unless we build together.
If in the ethos of something rising, though many may find themselves caught up in the rise of a thing, even often euphoric
There must be those few, those willing few, who are able to stop, pause and consider what we've built, where we are and where we're going. It's pertinent toward the refined progress of well developed immersive content and hardware development. This same understanding can be applicable toward additional emerging applied sciences as well. With that said, I began building and launched Silicon Valley's largest holodeck.
A 50x50 space; a chroma keyed infinity green screen pool which took us months to set up.

IN THIS PROCESS, I LEARNED MANY THINGS.

Now, mind you, there is no blueprint on how to best build Immersive Holodecks. There's examples on what could be done, but no clear direction on best practices. You take from what's out there, pair this with your instinct and build the best way you can.
Though I could write for sometime on the materials and process of building my Holodeck. I'll refrain and digress to some of the areas in which we focused on: spatial sound resonance, distance cognitive perception, group usability, ground feel, temperature control, presence and more.
In the medical world, we face the reality of dealing with the whole body and the internal and external effects of it. Therefore within this space, we cannot content ourselves with visuals and poor sound only. We must encourage ourselves to work with all senses, reasonably. It's not to say that what we have today isn't appropriate and useful. It is. It's great for the time now present, but we must have more.
Though we're explorers in immersive digital spaces. Real world spaces are very much a symbiotic constituent to the technology itself. If we're to capture true emotional presence and hyper fidelity, then we must have appropriate move ability to reach these levels. In our daily lives, we operate upon a sphere, grounded by gravity. In XR, we can unchain the limitations that bind us and go deeper and further.
We're in the process of developing these medical Holodecks, though the journey is not swift, nor easy. It's a challenge almost every step of the way. The electric speed and growth in which emergent technologies are rising, we continually find ourselves working and building with those in our industry and more importantly those outside our industry in the Health and Wellness world.
Those that find themselves in similar feats, truly understand that we're pioneers and we have much road to trek and with confidence I feel that what we're building here in Silicon Valley and with global collaborators and allied participation is bringing new and awesome discoveries often.

VALENTIN JOUET, LAURIANE CAUCHON, HRV
AMINA MOHAMED-SOILIHI & DAN BENHAMOU, LABFORSIMS 2

HEALTH SIMULATION CENTER: COLLABORATIVE IMMERSIVE ENVIRONMENT

The challenge is to give a growing number of learners high quality training thanks to a more realistic and immersive simulation. The currently available technologies are too difficult to setup, more teachers are needed than in traditional education methods and the existing simulators have a poor compatibility with multiple teaching units which results in very high integration costs. This project aims to make innovative digital tools in the service of ambitious pedagogical objectives more affordable.

Ultra-high-fidelity simulation with a neonatal resuscitation scenario as a model

INTRODUCTION

At present, simulation faces various technical limitations that limit the number of students that can be trained, and the realism of simulation.

The LabForSIms 2 2 project aims to develop simulation to offer an ever increasing number of learners high-quality training in a wider range of specialities, while enabling them to acquire transversal relational skills.

Supported by the ANR (Agence Nationale de Recherche), the LabForSIms 2 2 project has obtained funding for 4 years (2016-2020), and corresponds to the evolution of the existing LabForSIms 2 simulation centre into a "second generation" centre in which an immersive and collaborative environment that will play an essential role.

METHODS

This project is essentially based on two pedagogical simulation models :

- Simulation by a second generation serious game describing the diagnostic strategy of an abdominal surgical emergency.
- Ultra-high fidelity simulation in a neonatal resuscitation scenario

These are crossed with two main technological axes :

- Collaborative immersive environments, such as virtual reality and mixed reality
- Conversation analysis.

Interacting in natural language in serious games helps to create ultra-realistic scenario. In addition, verbal communication is a major contributor to successful care for patients.

Simulation by a second generation serious game as part of a diagnostic strategy for an abdominal surgical emergency

The game consists in the management of a patient for abdominal pain. In this serious game, in full virtual reality, the learner will be present in a 3D virtual environment representative of an emergency room. He will be able to converse with the patient and request additional tests.

When the immersion starts, the student learns basic information about the medical file. The patient, who is facing the player, is a woman aged 42, who has come to A&E for stomach pain. The medical file, a VR panel here, is always readable and will autofill itself when new information is uncovered. For example, when the result of an exam is completed and when the patient responds to various questions posed by the user.

The student is evaluated about the chronological order of his questions and actions, and the relevance of them. It is necessary to speak naturally to be understood by the software, conversation is fundamental for the consultation. This is allowed thanks to a chatbot which handles voice to text translation and conversational agents, then a text to voice translation is performed so the player can hear the response. Conversational agents are built on a decision-making tree and then improves over time using machine learning algorithms. A lot of students have taken part in this, and thanks to their efforts the conversational agent comprehension has increased from 85% to 98%.

More than text and voice responses, the recognition on a student's intent allows to trigger events or start interactions in the virtual reality environment.

It is possible to ask the patient to lie down, or to remove certain clothes during examination.

Thanks to those natural interactions, the learner can have a unique interaction with the virtual patient without an enforced workflow.

This game has several pedagogical objectives for the learner:

- conduct consistent clinical reasoning.
- understand and act on the attitude to deal with abdominal pain.
- learn to argue their therapeutic attitude and plan patient follow-up.
- improve communication skills, both with the patient and with other health professionals.

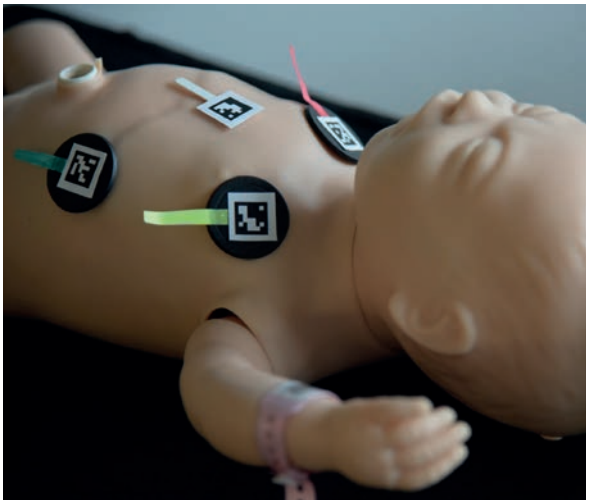
The use of pure virtual reality is the simplest approach from a technological point of view. This technology uses proven equipment (Vive HTC or Oculus Rift headset for example) and does not involve interaction with a tangible manikin, objects or instruments. These new methods will thus make it possible to train learners through simulation more independently and will also make it possible to train more students with the same number of teachers.

Ultra-high fidelity simulation in a neonatal resuscitation scenario

The game consists of the management of a newborn child as described in the international recommendations (ILCOR protocol). This game, which may involve up to 2 learners simultaneously in phases A and B of ILCOR, and up to 4 players simultaneously in phases C and D of ILCOR, has a secondary goal to develop interprofessionality. In this game in mixed reality, learners will be able to interact with objects both in the real world and in the virtual world. The student will be equipped with a virtual reality helmet and will remain immersed in the room still equipped with the mannequin and medical instruments. The virtual reality headset then displays a set of real elements re-displayed in the headset (the room, furniture, instruments) and virtual elements (improved mannequin, avatars) relocated in the middle of the real elements. The mannequin, furniture, walls and instruments remain tangible, allowing for increased realism through touch. The whole issue remains to correctly reproject the real elements of the piece into the headset so that what the

Table 1. Comparison of the rates of consistent, inconsistent answers and misunderstood questions

Questions	System based on dialog rules			System combining rules and semantic distances		
	Consistent answers	Inconsistent answers	Misunderstood questions	Consistent answers	Inconsistent answers	Misunderstood questions
From students	88%	2%	10%	**95%**	5%	**0%**
From ChicagoMed	71%	1%	28	**90%**	5%	**5%**



student sees remains consistent with what he or she touches. In addition, the conversational analysis tool will allow learners to be trained in pedagogical exchange with the parents of the newborn.

RESULTS

As the project is under development, we will be describing the intermediate results here.

Collaborative immersive environments

Mixed reality

For a successful experiment, the real environment of a neonatal resuscitation room was faithfully reconstructed in 3D, as well as the various objects handled by the user (mainly small medical instruments). The challenge for the team is to transcribe the actual movements of the mannequin representing the newborn and medical devices into the virtual environment. Indeed, the spatial positions of the medical instruments handled by the student must be estimated continuously, despite their size (thermometer, probe), and this without latency.

Virtual reality

The neonatal scenario allows to test if motion sickness could be an obstacle for education purpose. An article has been published in the start of the project. Virtual reality is a satisfying tool for training sessions because the scenario is repeatable and it is exactly the same each time. Nevertheless it shows limitation for movement and gesture assessment because of controller interfaces, that's why mixed reality is wanted for this kind of learning.

The learner is fully immersed in the 3D virtual environment and takes care to make the right choices. The different graphic elements influence his or her speech, questions, and decisions. Morovere, we can more easily add non-realistic information to deal with important feedback such as a good or wrong intent of interaction. Finally, the full virtual session is a very interesting tool for measurements, evaluation and statistics analysis because every intent and every action is recorded.

Conversational analysis

The learner's communication action with the digital standardized patient is done by speech. Conversational avatars are created for the roles of healthcare professionals, patients' relatives or virtual patients interact with the players.

Two methods have been implemented : the first method based on standard rules of dialogue for the interpretation and understanding of a question based on model conversations and a second method which is the first enriched with deep learning algorithms (combination of neural classifiers and semantic distance calculator) to extend the coverage and comprehensiveness of questions/answers.

A set of approximately 400 questions collected with the assistance of 25 medical students and a set of 250 questions from the dialogue subtitles of the ChicagoMed TV series were used to evaluate the performance of both methods. The rates of consistent, inconsistent responses and misunderstood questions are compared in Table 1. Consistent response and mis-understood question scores show that deep learning algorithms effectively complement the dialogue rule-based system.

CONCLUSION

One of the next steps of the projects will be the implementation by doctors of pedagogical evaluations to evaluate the contribution of the global system integrating conversational agent and collaborative immersive environments to student training.

© FitnessVR

SPORTS ACTIVITY IN VIRTUAL REALITY

CONTEXT AND PROBLEMATIC

Since 2012, physical inactivity has become the leading cause of preventable death worldwide, responsible for more deaths than smoking. According to the World Health Organization, physical inactivity alone accounts for 10% of deaths in Europe. In France, 55% of people do not practice much, if not any , physical activities anymore.

Conscious of the impact of sports practice on health, public authorities decided to supplement the various awareness campaigns with a call for proposals. The purpose is to give the general sedentary public a way to practice sports thanks to new technologies.

VR Connection in partnership with the City Council of Angers was selected with its innovative solution to reinvent sports practice through virtual reality, named Fitness VR. It is a VR setup made for wide audiences and integrated into a space dedicated to sports and health («Maison Sport Santé»).

THE SOLUTION

The app draws several advantages of the VR technology, mainly its fun and immersive aspects, with the goal to motivate users by compelling them with ever-growing sport challenges, while having fun and without apparent effort.

Specifically, each 4 minutes VR session consists in performing a series of movements and positions in sync with a predefined musical rhythm. The user can choose from several visual or sound environments to feel comfortable in his exercises.

At the request of Maison Sport Santé's management (doctors, sports coaches, researchers...), the app answers several special needs. Let's give three examples. First, each session is configurable and adjustable in real time by a coach equipped with a tablet (difficulty of the exercise, nature of the movements...) to adapt the experience to each user. Secondly, the positions and movements of Fitness VR have been designed and validated by a certified sports coach (APA) to avoid improper body movements and ensure an effective exercise.

Finally, the user data is retrieved, stored and shared with the entire connected Health Sport Information System, in order to individually analyze and adjust the overall tracking of the participants (sessions duration, number of successful gestures, etc.).

NEXT STEPS

The opening of the Maison Sport Santé" took place at the beginning of November 2019 in Angers. A team of researchers and sport coaches observed the qualitative and quantitative results of the VR experiences during several weeks, in order to measure the limits and health contributions compared to more traditional exercises. The results will be sent to the ministry to help them decide whether to support the massive deployment of this concept in France or not. Without having to wait for results though, many proposals for improvement have already been mentioned: new physiological measures, designing a home based version for the general public, new exercises, user perception of the body parts working during the exercise, etc.

Finally, there still remains a complexity due to the hardware : wearing a VR headset for sports practice causes discomfort (sweating). New immersive devices are currently being discussed (Cave, RA ...).

© Mirage Holograms // Merck laboratory used this interactive solution to train physicians for the launch of a new product

PROVIDING A COLLECTIVE, MULTIMEDIA AND INTERACTIVE EXPERIENCE FOR THE LAUNCH OF A DRUG

As part of the launch of RebiSmart(TM), the pharmaceutical company Merck wanted to train doctors in the use of the device. It is an innovative and customizable electronic injection device for the self-administration of Rebif(R) (interferon beta-1a), its drug that modifies the progression of multiple sclerosis indicated for the treatment of relapsing forms of the disease.

Introduce and Inform during the break times of a symposium : During a symposium, our client's challenge was to propose an innovative and interactive display solution to bring together as many physicians as possible during coffee breaks (3 x 15 minutes), introduce them to the device and train them on its use. The experience had to be collective, multimedia, and interactive.

A PERSONALIZED HOLOGRAPHIC SOLUTION

As a specialist in holographic display, we were asked by Merck laboratory to find a customized solution to this situation.
We are used to manufacturing custom holographic display cases for our customers, for retail operations. But this time, we took up the challenge of making an holographic display case capable of holding the real injection device on the one hand, but also designing a system capable of displaying 3D animations around the device and allowing the user to control the holographic content via an intuitive interface.

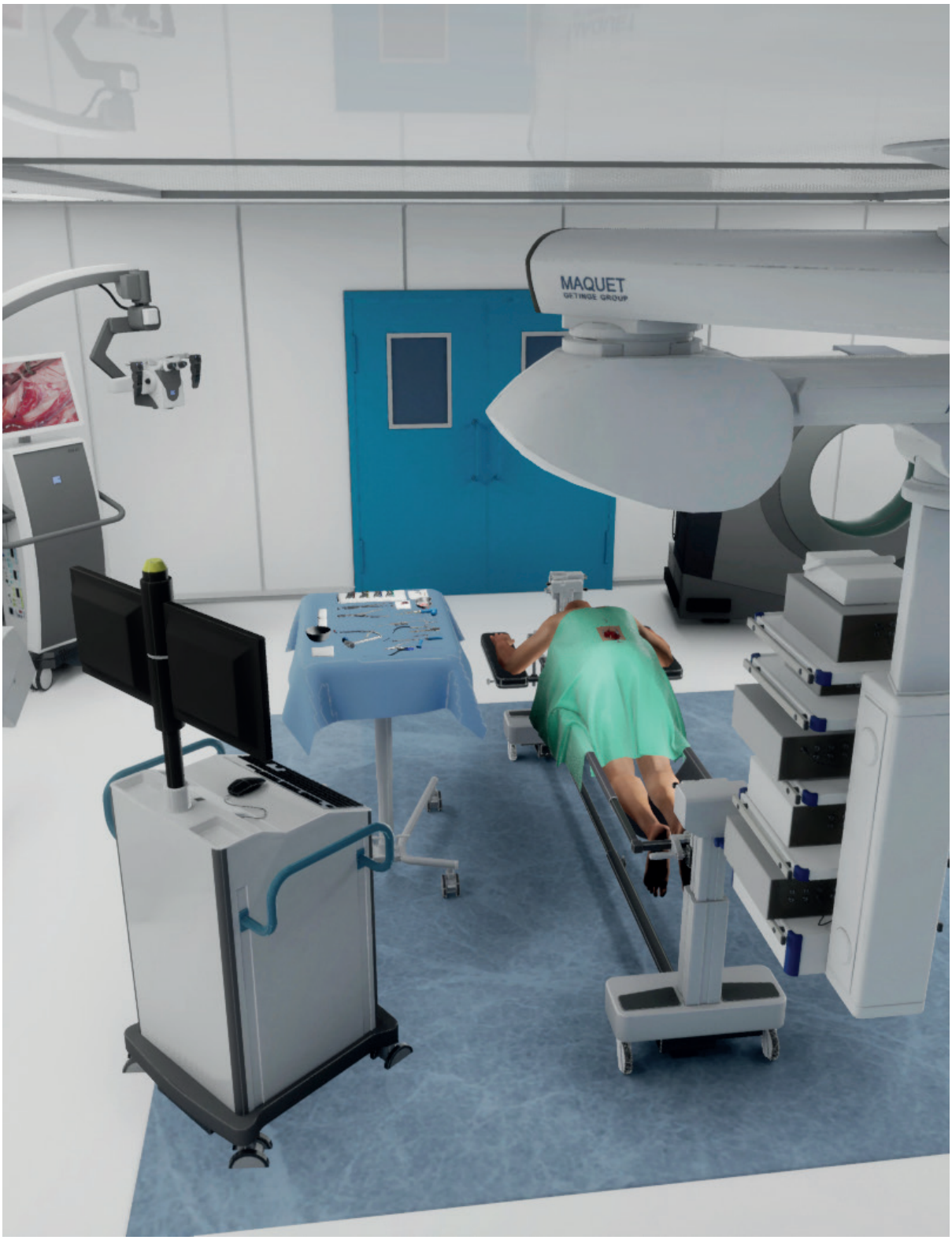
THE ADOPTED TECHNOLOGICAL SOLUTION:

- In order to widen the viewing angle as much as possible, we opted for a 32-inch holographic display case, capable of displaying the contents on 3 sides, once placed inside the medical device is visible on 180° which allows doctors to examine the buttons and the screen without having to hold it in their hand.
- We drew inspiration from our expertise in 3D mapping projection to enrich the experience and turn on the screen of the real device "virtually", simulating all the navigation steps.
- To ensure interactivity, we set up a 23-inch touch screen linked to the holographic display case. This screen contained 3 examples of clinical cases requiring the use of the injection device. The doctors will be able to read or listen (via headphones) the detailed description of the case, and see on the holographic display case a 3D simulation on the use of the injection device according to the selected clinical case.
- In order to ensure the consistency of the entire user experience, we took care of the 3D design of the device from a real model, we developed the application on the touch terminal (in 3 languages: French, English, and Arabic) and we ensured the graphic design of the solution in accordance with the customer's charter (window dressing, graphic interfaces...).

A SOLUTION EXTENDED ACROSS AN ENTIRE REGION

During the 3 days of the symposium, the client not only managed to attract doctors to his stand but also to use the coffee break time to ensure the presentation of his new product.
Following the success of this operation in Tunisia, the Merck laboratory decided to reuse it via all its subsidiaries in the Greater Maghreb.

Thanks to this operation, we have proven our ability to direct our know-how to customer requirements, which are rather specific in terms of scientific content and technical constraints. Today, we have opened up to the field of scientific content for pharmaceutical companies and we have several clients operating in this field, namely Merck, Pfizer and Abbott.



SharpSurgeon offers highly realistic and tailor- made tactile interactions in an immersive training environment that reflect the modern operating room // © SharpSurgeon

CARINE DE POTTER
UMUT ELESTEKIN, UFUK AYDINLI,
TOLGA GUNGOR, SINAN VURAL
NOYA ENTREPRISE
#SURGERY

FORGING THE MISSING LINK IN SURGICAL EDUCATION

Our surgery education platform SharpSurgeon is a virtual reality enabled simulator with haptic feedback capability which provides a repeatable and standard tutoring environment as an add-on to any current training curriculum with a vision to make standardization of surgical training possible. SharpSurgeon offers highly realistic and tailor-made tactile interactions in an immersive training environment that reflect the modern operating room. In medical education, medical students and doctors are exposed to live patients so that they can acquire the necessary skills. There is also a necessity to provide optimal treatment and to ensure patients' safety and well-being.

TODAY'S CHRONIC PROBLEMS IN SURGERY TRAINING

Today, we cannot provide enough repetition to residents we train to memorize the very complex and ever-evolving procedures they need to learn. Residents have 1000 - 1500 fewer hours to teach, and they can perform 25 percent fewer surgeries during their study. Faculty have less time to educate residents while an ortho resident must learn more than 150 procedures.

WATCH-LEARN-APPLY TRAINING IS OUTDATED AND OBSOLETE

Increased cost and regulatory pressures are decreasing investment in resident training. There is no standard assessment in surgical training, while many complications are training related. Surgical complications cost lives, and the economic impact of only the annual 1 million training-related orthopedic complications is $5 billion per year.

There is no standardization in surgery training worldwide. Democratization is also needed and currently not achievable. The measurement and assessment in medical education cannot be done objectively, as there are no standard metrics available. Finally, there is a need to reinforce the learning before and after advanced surgery courses. We tend to forget 80 percent of what we learn in three days, but unfortunately, we cannot help young surgeons repeat what they learn.

THERE IS AN OPPORTUNITY IS TO CREATE DISRUPTIVE CHANGE!

Simulation-based training is a technique which evokes or replicates substantial aspects of the real world in a fully interactive fashion and replaces and amplifies real experiences with guided ones which are generally immersive in nature.

Simulation is not new. For instance, pilots are training with simulators since the 1980s. Simulators also started to become a part of surgical training at that time, but they were expensive and not easy to reach at all. However, the swift technological advances of the 21st century enable us to create portable, feasible and reachable virtual-reality simulators with tactile feedback to use in medical education.

With this new generation of simulators, simulation-based training can be used to design structured learning experiences, measuring outcomes of targeted teamwork exercises, and overseeing learning objectives. Simulation-based training allows learning and relearning as often as needed to correct mistakes, enabling the trainee to perfect steps and fine-tune skills to optimize clinical outcomes. It is possible to filter and select trainees for further procedural competency-based training. Simulation-based medical education protects patients from unnecessary risks while developing health professionals' knowledge, skills, and attitudes. It also is a valuable tool for a trainee for understanding ethical issues and overcome practical dilemmas. Moreover, the trainee has the advantage of being in a familiar environment and do not need to take days off and to travel, which means saving money and time!

SHARPSURGEON LIBRARY

The procedures in the current SharpSurgeon library:

- Lumbar Posterior Instrumentation with TLIF
- T1 - S1Screw Placement
- Cervical screw placement
- Thoracolumbar Deformity Correction

**All procedures will include different anatomical models and pathologies.*

SHARPSURGEON ANALYTICS MODULE

SharpSurgeon offers a convenient and cost-effective way to assess surgeons' psychomotor skills, commitment, and compliance. It is possible to measure, grade, and log every action of every user and to filter and select surgeons for further procedural competency-based training.

TECHNOLOGY COMPONENTS

SharpSurgeon provides haptic force feedback, which alleviates the physicality responsiveness. As virtual reality is explored further, it has become evident that only sight is not enough for immersion, for tactile interactions, there is a need to feel. To address this issue, we have developed Tactile Engine for Surgery Simulation (TESS), proprietary software to drive the haptic component of VR. Thanks to TESS, the user can feel the real-world softness or hardness of the tissues when operating.

Activities in the field of health and disability are notably carried out within the Laval Institute of Arts et métiers

MORE THAN 10 YEARS OF PROJECT RESEARCH IN VR AND HEALTH

The « École Nationale Supérieure d'Arts et Métiers » (ENSAM) is an engineering school historically rooted in the landscape of the French Engineering « Grandes Ecoles ». It is part of an approach to developing a technological engineering school serving the industry of the future and four main societal challenges (transport, housing, energy, health). ENSAM has an original structure as a single national, territorialized establishment, carrying out its missions on 11 sites in France (8 campuses and 3 institutes). Activities in the field of health and disability are notably carried out within the Laval Institute. The Laval « Presence and Innovation » team, led by Simon Richir, is developing skills in the design of therapeutic applications based on virtual technologies. It is involved in numerous projects concerning, among others, awareness, stimulation and cognitive re-education (AccesSim, Sensivise, EHPAD, AGATHE,...).

ACCESSIM PROJECT: AWARENESS OF MOTOR DISABILITY AND ACCESSIBILITY ASSISTANCE

The design of accessible buildings and environments requires the consideration of both prescriptive and usage-related aspects. Indeed, normative aspects are in some cases insufficient or sometimes contradictory with reality and require an adaptation of accessibility rules for access to the services offered by the environment. It is therefore necessary to check beforehand that the environment is going to meet the needs for which it was created.

The aim of the project was to explore and develop ways to raise awareness among the general public and decision-makers of the difficulties faced by people with reduced mobility in their daily lives and to enable expert centres to assist in the design and assessment of accessible environments. The aim was to create a hardware and software solution, enabling expert centres such as CEREMH to work with architectural or urban planning firms to assist them in the design of accessible environments, and possibly to certify them.

Realistic wheelchair navigation in 3D environments is achieved through a force feedback platform that can accommodate all types of wheelchairs. This research project was funded by the Ile de France Region and has been approved by the Move'o, System@tic and Images et Réseaux clusters. It also received the Laval Virtual Award, in the Transport & Mobility category, during the international virtual reality meetings in Laval.

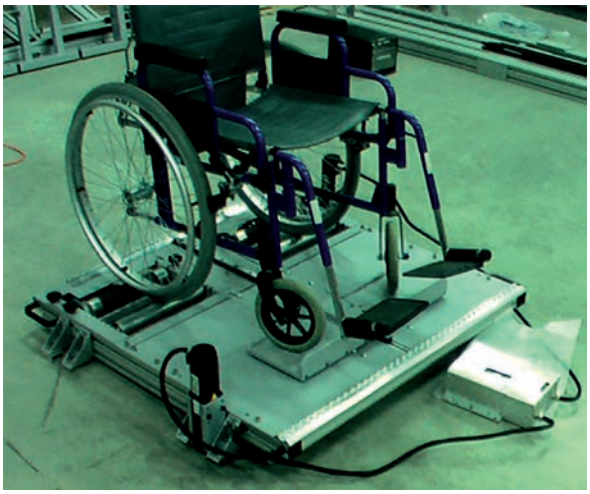
SENSIVISE PROJET: VISUAL AWARENESS RAISING

Visual impairment affects about 2 million people in France and nearly 300 million people worldwide. The objective of this project was to raise awareness of the difficulties encountered by visually impaired people in their daily lives. To do this, we designed a virtual environment of the apartment type with several rooms, in which the visually impaired person can evolve and interact. During his visit, we can disturb his vision by simulating visual deficiencies (blurred vision, scotoma and tubular vision), of varying levels. After having confronted the user with the difficulties of visual impairment and having informed him/her about the different types of pathologies, we propose simple adaptations of the virtual environment (contrast, lighting, dimensions,...) to help him/her in his/her virtual visit.

After this experience in the skin of a visually impaired person, the experimenters are better aware of the difficulties encountered by their visually impaired relatives. They also have ideas on how to adapt their common living space, using simple and inexpensive tricks to put in place. These adaptations do not change anything in the daily life of people without visual impairments, but greatly help people with visual impairments. The first version of this application was developed in partnership with the Haut Thébaudière institute for the visually impaired and financed by Dassault System's « passion for innovation » program. A new version is currently being developed in collaboration with StreetLab.

"STROLL AT THE EHPAD*" PROJECT: PHYSICAL AND COGNITIVE STIMULATION

The Stroll at the EHPAD project is part of the context of the aging of people and the decrease in their physical and cognitive capacities. The progressive installation of dependency leads people to live in EHPADs (Establishment for Dependent Elderly People).
*Establishment for Dependent Elderly People.



ACCOMMODATION LIKE EVERYONE ELSE

Dependent elderly people need to relax, "replenish" their batteries, move around, change space, and so on. Limitations due to their impairments and the necessary logistics do not allow them to perform enough of these activities. The project « Stroll at the EHPAD » aims to offer them adapted and accessible physical and cognitive activities, thanks to virtual technologies.

Dependent elderly people are immersed in different virtual environments and interact with them using a connected exercise bike. Immersion in these environments provides well-being and relaxation to users, while ensuring physical and cognitive activity to preserve their autonomy as much as possible.

This research project was financed by the Laval Agglomération « Réalité Virtuelle et Situation de Handicap » support fund. It led to the creation of a startup, Cottos Medical, which now markets Cycléo, a bicycle simulator for seniors in retirement homes.

AGATHE PROJECT: COGNITIVE REHABILITATION

Impaired cognitive function is a major factor in loss of autonomy and dependency. Rehabilitation is a global process in which evaluations and interventions follow one another. Traditional rehabilitation methods are based on an analysis of deficits and/or prolonged confrontation with everyday life situations. This approach is cumbersome and often insufficiently effective. The individualised methods that are most appropriate are costly in terms of time and clinical resources. Too many patients are excluded from access to care. It is therefore necessary to find adapted and customizable tools that can be used by everyone and more often, from the specialized centre to the patient's home.

The benefits of VR in addressing this important public health problem are now scientifically recognized, but the availability of commercial solutions is almost non-existent.
The AGATHE project has enabled the design and development of an original tool for cognitive re-education aimed at activities of daily life and autonomy (supermarket shopping, mail posting, outdoor orientation). Based on virtual technologies, it addresses the two components of rehabilitation: assessment and therapy.

This research project was funded by the ANR-TecSan programme and was approved by the Images et Réseaux cluster. It also received the ACM SIGGRAPH Emerging Technologies award and was invited for a presentation at the SIGGRAPH show in California-USA.
Health is a major area of development for our college. In Laval we are convinced that virtual technologies have an important role to play in this field. The projects presented above are only a glimpse of what virtual technologies can bring to the field of health and its many components (awareness, rehabilitation, surgery, training, diagnosis, ...). More generally, the virtualization of health care tasks can improve playability, control, repeatability, savings, adaptation, security, evaluation, and so on.

Our primary objective is to support healthcare professionals in the design of VR systems focused on end users (professionals and patients), in order to best adapt to their needs.

REALITY AND THE VIRTUAL FOR DISORIENTED PEOPLE

Reality and virtual, the association of these two words may seem contradictory at least paradoxical. Reality is in fact the result of our 5 senses: sight, touch, smell, hearing, taste but also the sum of our experiences that have confirmed our relationship to reality and objects.

The virtual is often used to signify the absence of existence, a digital world as opposed to the physical world where everything is possible even the unreal.

The complexity of the challenge we faced with COTTOS Medical was to create a virtual reality experience for people who are vulnerable, disoriented, losing their autonomy, with cognitive impairments. Indeed these people, the progressing disease, disconnects more and more from reality. The goal of bringing them back to it through the use of a virtual environment may seem at first view too paradoxical.

The objective of the product CycleoONE is to provide well-being and relaxation to older people, more or less dependent, suffering from neurodegenerative diseases like Alzheimer's disease, while ensuring physical and cognitive activity for the purpose of preserve their abilities, and therefore their autonomy, in a playful and secure environment.

In addition, if the benefits of physical activity are proven, it must still be able to impose and achieve.

One of the safe and fun ways to achieve this is the virtual reality that allows a human to immerse themselves (partially) in an artificial world. In addition, the interaction with this virtual world results in the implementation of almost all cognitive faculties: perception, action, memory, emotion, etc.

The «physical activity» function is provided by a bike derived from a fitness bike in a semi-recumbent position.

Sensors transmit the information to a PC (handlebar position, brake, pedalling speed, etc ...) to act on the virtual environment that is projected on a screen via a video projector. Speakers allow the diffusion of the sound environment.

The virtual environment, also called «ballad», is a virtual reality application that offers a recreational bike ride in various universes that represent virtual spaces, with their light and sound atmospheres.

During this fun ride, patients relax, perform physical activity and stimulate their cognitive functions via simple games but never put them in a situation of failure.

The challenge was to create virtual universes simulating the most realistic ballads possible, recalling memories to users, with realistic concrete elements (flowers, sets, other characters, etc ...), while keeping a playful side.

Our intervention focused on the generation of the course. By our expertise in 3D computer graphics and 3D animation, in the creation of photorealistic virtual images but also in the development of real-time applications, we had all the necessary skills to create these realistic immersive scenes.

the use of virtual reality solutions combined with our expertise in the creation of realistic immersive environments allows us to meet a wide variety of needs //© C Jouannet - Angers University Hospital - France //

First and foremost, we focused on creating realistic 3D environments. All elements of decoration, flowers, trees, buildings have been carefully chosen and created so that their presence is logical.

Moreover, so that each experiment is particular, it was necessary that the course can be very varied. We have therefore developed a multitude of elementary blocks of terrain and developed a system of random generation of the course. The user has the impression at each experience to discover a new course since it is almost impossible to duplicate the same.

In order to reinforce the immersion, in addition to the sound system, we used the electromagnetic brakes of the bike to differentiate the various floor coverings. The user thus perceives the difference between smooth, stony, or sandy terrain, directly by acting on the behavior of the bike.

In conclusion, the use of virtual reality solutions combined with our expertise in the creation of realistic immersive environments allows us to meet a wide variety of needs, such as for CycleoONE, but also for product simulation and marketing presentation solutions. training while adapting the level of realism to the desired goal.

BENJAMIN COSSE
COTTOS MEDICAL
#AUTONOMY

SUCCESSFULLY DESIGNING A VIRTUAL REALITY SOLUTION FOR THE VITALITY OF VULNERABLE PEOPLE

A situation of fragility frequently leads to withdrawal, which most often leads to social isolation of the person concerned. How can VR reverse this process? By mobilizing at the same time the body, emotions and cognitive functions, well designed and adapted to their target, VR solutions are very suitable to put these users back into activity, we reveal some guidelines.

A situation of temporary or permanent fragility frequently leads to withdrawal, which most often leads to social isolation of the person concerned. The decrease in activity and the feeling of dependency have a very negative impact on self-esteem. In recent years, many projects have been working to reverse this vicious circle in order to improve the quality of life of these people. How can Virtual Reality technologies support these approaches while respecting the fragility of the people concerned? This approach is not without raising certain questions:
How can we overcome the isolation associated with the «visiocasks» (more commonly known as VR headsets) and the lack of interaction between its user and stakeholders (carers, families, etc.)? How can these innovative solutions be adopted by populations that are resistant to technologies and changes and suffer from cognitive and balance disorders?

HOW CAN WE ENSURE THAT THE TECHNOLOGIES USED PROVIDE MORE BENEFITS THAN DISORDERS?

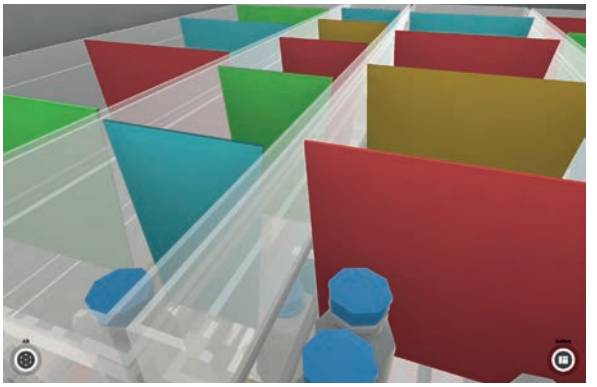
In our situation, we initially decided to focus only on the elderly in retirement homes. This allowed us to think about a very specific target presenting necessarily a fragility (loss of physical and/or cognitive autonomy) while remaining very heterogeneous (ages, pathologies, motor and/or cognitive disorders, etc.).
The challenge for this population is therefore to restore their self-esteem, get them active again and fight against apathy.
Moreover, let's briefly recall the definition of Virtual Reality according to Philippe FUCHS: «The purpose of Virtual Reality is to allow one or more people to live an immersion experience allowing them to carry out a sensory-motor and cognitive activity in a world created digitally, imaginary or inspired by reality». This exhaustive vision is fundamental, in our opinion, in the objective of reinforcing self-esteem because it simultaneously mobilizes the body, emotions and cognitive functions. This is all the more relevant because to be active, our brain needs to be well oxygenated (physical activity) and to be solicited on 3 components: the taking into account of its body (Soma), the psychic aspect and the social aspect.
Finally, to encourage the adoption of a Virtual Reality solution, we will not surprise anyone by specifying that we must start with a user-centered design and that the technology must only be at their service and not the other way around. Thus, for any project of this type, it will be necessary to be totally immersed in the universe of the users: what are their needs? who are the stakeholders around them? how is their daily life going? etc. Each target will have its own constraints and the solution will have to evolve according to the target users. This is obvious, but it must be remembered that it is necessary to remind them regularly.
For our audience, it is, for example, essential to imagine simple solutions (instantaneous use without explanations), non-stigmatizing and promoting exchanges to remove their main objections and allow a quick adoption. Moreover, they must be imagined in their context of use: establishment with very few highly solicited personnel, etc. No adoption will then be possible without thinking about these stakeholders:
Thus, starting from these few basic rules, we design vitality generating solutions based on Virtual Reality with the following components:
A complete solution that makes BODY, HEART and SPIRIT work simultaneously,
Very simple, non-intrusive (no headphones, glasses or other sensors), non-stereoscopic and as large as possible to allow collective sessions: video projector or large screen,
Very simple and popular ways of interacting in the virtual environment: cycling simulator, walking or other everyday gestures,
Technology as invisible as possible,
Non-stigmatizing and robust design, giving a strong sense of stability,
Accompaniment in the creation of usage routines using the power of collective challenges,

We have thus created a whole range of products including CycleoONE - a virtual walking simulator - and UBLO - an activity window - to meet the vitality needs of our users who self-adapt to their motor and cognitive abilities (setting bot) and also to their desires (facial and emotional recognition, etc.).
Thanks to numerous research partnerships, we have succeeded in setting up :
Clinical trials (long term) to reinforce the value of our solutions (our goal is to transform our solutions into geriatric diagnostic tools),
Field experiments demonstrating the benefits of the solutions we implement (they have a positive effect on feelings of depression, on the fear of falling and on functional capacity).
This is critical to the adoption of solutions in our business lines.
Now that we have successfully launched our first products and built a solid reputation for the relevance of our solutions, we are now beginning to evolve our products for new types of frailty and users outside of retirement homes.

GABRIEL DAVID
KAMUI DIGITAL REALITY
#SALES #SUPPORT

DIGITAL FOR THE BENEFIT OF HEALTHCARE MANUFACTURERS

The medical instrumentation industry is rapidly evolving to meet the needs of a changing society. This sector has become highly robotized to improve productivity and the quality of results. For example, automation chains are being set up in hospitals to help manage drugs or analyze blood parameters. The solutions offered to health professionals are therefore increasingly complex and technical, with increasingly large investment budgets. These changes also impact the relationship between the manufacturer and the health professional. The presentation of these machines must be accompanied by new and more suitable tools. The creation of immersive sales support tools with an optimized customer experience is one solution.



Immersive concept for a better experience // © Kamui digital

INCREASE THE CLIENT'S EXPERIENCE

Thanks to their visual and sensory impacts, virtual & enhanced technologies make it possible to develop a valuable customer experience that is at the heart of companies' marketing concerns. With the application we have developed, the sales team using a tablet or smartphone will bring a full-scale 3D product or equipment into the customer's environment. The latter will thus be able to visualize the manufacturer's solution directly in his workspace and project himself into a more tangible future. This immersion allows you to see the advantages of the solution in terms of space requirements and the necessary adaptations to be made. This makes it easier to organize the laboratory. An interaction game allowing to manipulate the 3D instrument ensures a very positive impact in the user experience and contributes to the appropriation of the solution. In addition, simple features such as taking pictures during a customer visit or at a trade fair are also an excellent way to develop customer relations. In addition to photos, applications can also include detailed information on the configuration tested, the name of the customer, and technical information. This data is easily transferable to feed exchanges during the sales process.

TOOLS IN THE CONTEXT OF USE

In addition to improving the customer experience, these new technologies offer many facilities in logistics management, either in customer meetings or at conferences and trade shows. Indeed, the sales representative will be able to bring with him all the desired solutions, since they will be visible via the virtual reality or augmented reality application. This simplifies «product» presentations and is an excellent complement to the showroom visit organization where the solutions are installed in real time. Although relevant and impactful, this type of visit does not integrate the projection dimension as strongly into the professional's working environment. At a trade fair, the advantage is also very tangible. The use of virtual and augmented tools that can show a considerable product catalogue limits the number of products/demonstration equipment required on the stand. For example, it is sufficient to have a standard solution and all the associated versions in the application, or to show only the new ones and keep the old models in virtual format. This translates directly into reduced transportation costs, technical time, support and downtime. The cost saving of the event can reach up to 20% of the total investment. It is a real saving of time and especially money! Thanks to these tools, the relationship between healthcare professionals and manufacturers has been renewed to better adapt to the presentation of solutions that are increasingly complex in terms of technology and size.

A Mixed Reality medical emergency sponsored by the UK's Defence Medical Services at the University of Birmingham // © University of Birmingham

ROBERT STONE
UNIVERSITY OF BIRMINGHAM

A MIXED REALITY MEDICAL EMERGENCY RESPONSE TEAM TRAINING SOLUTION: "BLENDING THE BEST OF THE VIRTUAL WITH THE BEST OF THE REAL"

This article summarises the achievements of, and lessons learned from a major programme of defence medicine research and development, sponsored by the UK's Defence Medical Services via the Royal Centre for Defence Medicine (RCDM) and undertaken by the University of Birmingham's Human Interface Technologies (HIT) Team, together with their partner commercial organisation Modux. The project set out to deliver an innovative solution to supporting future training for Medical Emergency Response Teams (MERTs), exploiting commercial off-the-shelf interactive technologies emerging from the Virtual, Augmented and Mixed Reality (VR, AR and MR) community. It was also stipulated by the RCDM early on that the simulations should focus on exposing trainees to contextual experiences and possible stressors during the transfer of casualties from the point of wounding to a field hospital, and not on clinical training. By doing so, the simulator would enable small teams of trainees to practice their classroom-learned procedural and clinical skills in a realistic setting, without having to call upon the operational vehicle, aircraft and manpower resources of the UK's Armed Forces.

The challenges faced by the team at the outset were driven by a requirement to move away from a costly and low-fidelity fixed-location training facility, representative of a single MERT platform, as exemplified by the Chinook helicopter rear-cabin mock-up, located at the Tactical Medical Wing of RAF Brize Norton. Thus, a portable (originally inflatable), rapid-assembly modular enclosure, of a size suitable for small-team training, was designed. Equipped with inflatable cuboids ("space fillers"), representing platform seating, fixed structures and equipment, the enclosure was designed to impart a feeling of physical "confinement", similar to that experienced on a range of defence platforms.

Whilst within this enclosure, up to three trainees can experience a shared MR scenario, in effect a "blending" of the "best of the virtual" with the "best of the real". Importantly, and in line with the strong human-centred design process followed throughout this project (e.g. ISO, 2010), the real (physical) components of the MR scenario are selected based on their relevance to the training procedure. This serves to enhance the credibility and "believability" of the virtual scenario into which they are integrated. Previous defence projects, conducted for the RAF (helicopter voice marshalling) and the Royal Navy (close-range weapons training), have demonstrated positive outcomes and savings through the use of an MR approach, particularly in areas such as ammunition savings, fewer trainee failures and positive transfer of skills, knowledge and experience from the simulator to the real world (Stone, 2012). Uniquely in the case of the MR MERT trainer, this blending is achieved by means of an innovative Chroma Key ("blue-/green-screen") technique, which presents users wearing "pass-through" camera-modified HTC Vive Pro VR headsets, in this case modified with a single industrial camera, with virtual views of the platform they are operating within (NB. evidence suggests that a stereoscopic pair of cameras would, in this instance, be ineffective and costly). The pass-through design was adopted, as early research discounted the use of commercial AR headsets, such as the HoloLens or Magic Leap, because of their inability to present wearers with a convincing and seamless blend of virtual and real, particularly in dynamic simulation conditions with variable lighting effects. When donning the modified Vive headsets, trainees are presented with a convincing dynamic scene where, not only do they experience presence inside a virtual military platform in motion, they are also able to see their own hands and bodies, and those of their colleagues, together with the important, training-relevant items of medical equipment and a realistic human casualty mannequin. Furthermore, all of the real objects can be touched and interacted with realistically without having to resort to complex, unreliable and expensive wearable gloves or "haptic-enabled" devices, which were also discounted in the early stages of the research.

The MERT training system is configured via a single multi-window curved screen console, enabling instructors to program a range of operational scenarios and effects, such as such as changes to a simulated Tempus Pro casualty lifesigns monitor, the onset of external and internal small arms/close-range protection weapons discharge, "brownout" (dust entering the cabin when landing in desert-like terrain) and night vision conditions. Digital video images from trainees' headsets and enclosure-mounted cameras can be recorded. Headset-integrated

eye tracking technologies are also now being evaluated to support future analyses of trainees' reactions, interactions and attention. The virtual platform context can be changed via a single key-press to represent (currently) an RAF Chinook, an Army Mastiff vehicle and a Royal Marines' Landing Craft or Hovercraft. The team is indebted to the RAF, Army and Royal Marines for allowing the team to take part in vehicle and aircraft missions, collecting appropriate media to support the representations of different military platform interiors, external environments, communications "chatter" and other sound effects

Future plans involve extending the platform database to include new technologies (when proven to be of an appropriate level of maturity for this application domain) and new scenarios – urban, Arctic, at-sea, to mention but three. In addition, new MERT platform representations will be regularly added to the existing 3D model database, ensuring the system's relevance to the Armed Forces is maintained.

The resurgence of interest in the fields of VR, AR and, more recently, MR is – as was first witnessed in the 1990s – demonstrating the challenges and pitfalls facing interactive systems developers and adopters when confronted with a myriad of potential "high-tech" solutions from an increasingly saturated and confused product marketplace.

This is particularly evident in the healthcare sector, where examples of immature, inappropriate and unproven VR and AR technologies being used for training – or worse still in (alleged) surgical contexts – abound, most all without any clear justification for their adoption. Yet, despite this worrying state of affairs, there has, over the past two to three decades, been a growing body of evidence confirming that the discipline of Human Factors has an indispensable role to play in the choice and subsequent exploitation of these technologies for a wide range of real-world applications. The result of three years of intensive research, development and testing (including three major design iterations, driven by inadequacies in present-day VR, haptics and AR technologies, plus the results of an important mid-term usability trial with potential end users), the delivered MERT MR trainer represents a unique development on the world-wide XR-for-training stage. The final system, which will be further developed in a Phase 3 programme of research and development, including evaluations with the UK's Armed Forces, is not just a novel technology-based training system for our future Armed Forces, but serves as a reminder to how important it is to adopt strong human-centred design processes at the outset, engaging regularly with end users throughout the design lifecycle, thus helping to ensure that these exciting – and ever-evolving – technologies are fit for purpose.

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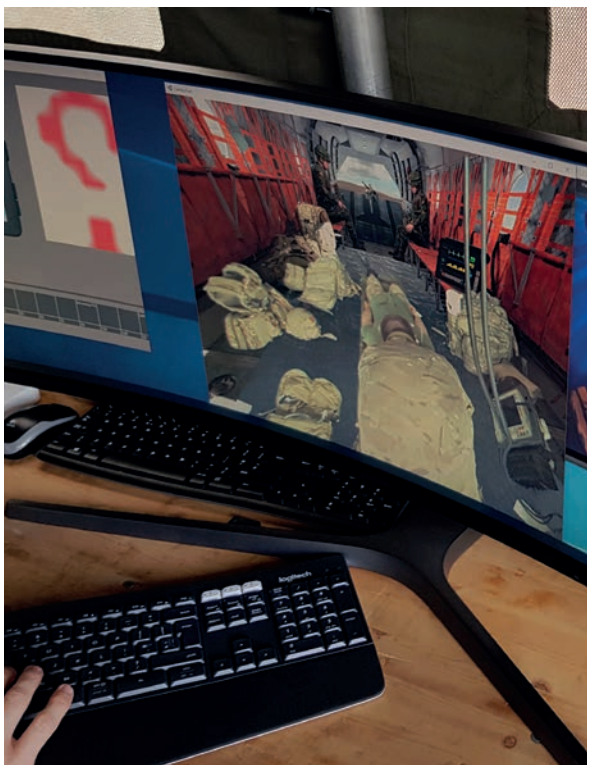

LOÏC FLAMENG, OPENSCRIPTVR
CLAIRE PATOUILLET, CONSULTANT
#KINETOSIS

BEWARE OF KINETOSIS!

Kinetosis is what we commonly call motion sickness. A virtual reality program with a poorly controlled scenario can trigger an unpleasant sensation of dizziness or loss of balance, to the point of nausea, even in a static position. The kinetosis effect occurs when the individual in immersion finds himself in a situation of discordance between visual perception through the helmet and the vestibular or sensory system. In other words, in virtual reality, or 360° video, it is poorly supported by the user of the program via a virtual reality helmet, to be embarked in an object that moves while the user, physically, does not move and experiences, in fact, the experience in a sitting or standing position.

THE HEALTH INDUSTRY'S CROWNING GLORY

Early adopters of virtual reality quickly experienced this with the first few programs a few decades ago. Professionals talk about motion sickness.

However, the adoption of virtual reality by the drug industry is much more recent. So we do not sometimes fall back into the same lack of development. Let's take the example of a pharmaceutical company that wants to offer health professionals a virtual tour of its manufacturing plant as far as the logistics area, which in itself is a good idea: except that the scenario puts the user in a box that moves at the speed of a conveyor belt, and that's guaranteed kinetosis. The experience is poorly supported and the headset is immediately ripped off.

VIRTUAL REALITY, A SCENARIO FIRST AND FOREMOST

Virtual reality, this sub-segment of the film industry takes up all the codes of virtual reality. In virtual reality as in cinema, the balance of a good realization is between the strength of a scenario and the rendering of the images. One must not be treated to the detriment of the other. A story is still a story, whether it is in 2D, 3D or immersion, it is the user's experience that counts and the conditions in which it is made to live it.

So, from the very beginning of the project, it is a question of trying to answer the question «How to tell it?» and then, above all, «How to film it? ». Because writing or thinking for RV is first of all about creating an experience designed for the spectator, the person who will put the helmet on his or her head. Even the most seasoned filmmakers still have this obsession with the risk of kinetosis in the corner of their head when it comes to apprehending movement, displacement or integrating new points of view, according to the technological and cognitive constraints inherent in virtual reality.

GIVING CUES TO THE BRAIN

Some practical research has led technology professionals to recommend making a «virtual nose» visible as a landmark, for example. In fact, giving the field of vision some distance back to see the image of a transparent nose when viewing would send the brain the impression of being present in the frame. The same applies to hands or feet in certain situations. For the whole body, it is more delicate.

THE POSITION OF THE USER IN THE SCENARIO

The user's position should be addressed by asking the following question: «Is he omniscient or subjectively aware of the situation? It all depends on the expected experience; and whether the program provides for rendering in real or computer-generated images. The place of the body and the notion of presence are part of the immersive process. These are major data to manage the risks of kinetosis in the best possible way. «The visual system is not only used to see, but also to stabilize in space» (Philippe Fuchs, virtual reality expert and author). As long as you make good films and experiments where movement is controlled, without causing cognitive «shock» to the user: you have to take care of it

THE LEVEL OF IMMERSION VARIES DEPENDING ON THE TECHNOLOGY INVOLVED

There are now many 360 devices to create universes, to invent stories. With the 360 cinematic film, the user is often static, screwed on his chair or standing, he can neither move nor interact physically. In animation, and with a much more consequent device such as a room scale, he can move, gain freedom of movement, the position of his body is more or less present, he can interact. In the case of a serious game close to a video game, he participates in the story, even becomes an actor and determines its progression. Finally, thanks to the «Cave» process, a volumetric capture technique, the spectator is freed from his helmet and experiences a collective immersion.

The case of behavioral therapies in virtual reality

In the treatment of phobias, such as the fear of emptiness for example, technology allows the development of virtual environments based on the exposure principles of behavioral therapies. Virtual reality exposure therapies allow the patient to work on mastering the cognitive, emotional and behavioral responses elicited.

The scenarios developed, such as the exercise of walking along the virtual cornice of a building without falling into the void, make it possible to manage the discomfort while overcoming the effect of motion sickness. Different levels of difficulty can then be envisaged by evolving not only the technology, but also the narrative and its realization.

JOHNNY DUERINCK, MD, PHD
FREDERICK VAN GESTEL, MD
UZ BRUSSEL

AUGMENTED REALITY ASSISTANCE IN NEUROSURGERY CURRENT DEVELOPMENTS AND ONGOING RESEARCH

The Surgical Augmented Reality Assistance (SARA) research project sees potential in the use of AR to revolutionise the surgical field. The augmentation of a surgeon's workflow, however, needs to be adapted to the physicians' needs before it can efficiently provide greater accuracy and safety. Through simultaneous clinical validation, the SARA project aims to develop an AR solution suitable for surgical navigation in an everyday clinical setting.

The boost in development and implementation of virtual (VR) and augmented reality (AR) devices over the past years has shown their possible proficiency in a variety of industries and disciplines, including medical practice and, more specifically, surgery. However, implementing an AR solution for surgical use not only requires certain technical developments that aim for maximal accuracy, but a simultaneous validation in an actual clinical setting as well. The software needs to be adapted to the needs of their end-users in order to allow a smooth adoption in an everyday setting. This idea materialised through the SARA project, a collaboration between people with relevant technical expertise and physicians expressing a clear clinical need. The project investigates the use of AR for preoperative planning, intraoperative visualization and navigational support, while simultaneously validating all technical developments in a clinical setting. This provides a unique opportunity to assess real-world accuracy and usefulness of the AR solution and to quickly adapt the provided support where necessary.

Other research groups have tried a first implementation of such AR devices as the Microsoft HoloLens in a clinical or even surgical setting. However, we only saw a few of the essential phases of the complete image processing pipeline being developed and reported in each of these studies. Small, single surgeon trials without any significant validation that often use generic open-source software for 3D model creation and visualization. Unfortunately, these are typically not adapted for intuitive use by an unfamiliar end-user. Moreover, they relied on the device's built-in simultaneous localization and mapping (SLAM)-algorithm for stability of the manually placed hologram, without any tracking or registration to the patient. Although they nicely show the potential of AR for neurosurgical procedures, this approach provides insufficient accuracy. During our initial proof-of-concept we tried to implement a tracking solution using the RGB-camera instead of the SLAM algorithm. Although this resulted in an improved navigational accuracy (1.41 ± 0.89 mm), we ran into several practical limitations, such as the narrow field of view and a generally lower tracking reliability, that interfere with its implementation in an everyday surgical practice.

Our project addresses these shortcomings with a structured and clinically focused workflow that guides the surgeon through hologram creation, planning and visualisation. This comprehensive pipeline is continuous from the planning station to the AR device, and provides a newly-developed proprietary application for inside-out infrared (IR) tracking and semi-automatic hologram-to-patient registration, which optimises both accuracy and stability of the hologram relative to the physical world. Its validation is currently being performed at our centre through preclinical testing, with a phantom trial for neurosurgical drain placement, as well as clinical testing, with patient trials for both drain placement and preoperative tumour resection planning. Intracranial drain placement is an example of the aforementioned clinical need for optimisation. It's a frequently procedure for patients with intracranial hypertension or an intracranial haemorrhage, yet it's most often performed freehand, relying on anatomical landmarks and minimal planning on CT images of the patient. This results in an optimal placement in only 60 to 80% of cases. Augmenting the scene with a 3D representation of planned trajectories towards relevant patient anatomy or pathology shown on top of the patient in their true anatomical location has the potential to vastly improve these accuracy results.

HOLOLENS SOFTWARE SOLUTION

The SARA project targeted the Microsoft HoloLens for further development of its navigational software solution with custom-made hardware and software adaptations to optimize it specifically for neurosurgery. Starting from the aforementioned pipeline, we included a sequential set of advanced, semi-automatic algorithms responsible for image processing, pre- and intraoperative tracking and hologram-to-patient registration.

The implementation of surgical AR assistance first and foremost requires a uniform and unambiguous UI that

Surgeons will be able to use augmented reality as a new type of navigational support, revealing deep-seated anatomical structures even before any incision is made. // © Frederick Van Gestel

helps rather than challenges the surgeon throughout both planning and procedure. Our planning station UI guides the user through the entire semi-automatic planning sequence in a such way that even those without experience in image segmentation can create a valid 3D model in less than 10 minutes. Its step-by-step approach creates layer after layer of patient anatomy and allows the surgeon to verify and make adjustments whenever necessary. While this multi-layered 3D patient model is being created, the system also asks the surgeon to indicate several landmark coordinates, which will be used for the automation of trajectory planning and hologram-to-patient registration. After a final quality control of the entire model and the preoperative planning, the multi-layered 3D model is transferred to the HoloLens along with the essential patient information and the collected landmark coordinates.

As mentioned before, we already created a working tracking solution using the device's RGB camera. Anticipating the solution's surgical implementation, however, we committed to switch from RGB to IR tracking for a couple of reasons: not only does it considerably improve overall tracking performance through better robust identification of surgical instruments and a larger field of view of 120 degrees (nearly 3 times that of the RGB sensor); the real-time, inside-out IR tracking also supports mobility as well as the ability to integrate and track existing surgical equipment. Thus, using continuous IR tracking, a higher reliability can be achieved for both preoperative and intraoperative tracking without the need to create additional hardware. The hologram-to-patient registration feature uses IR tracking of a pointer and reference star for the establishment of an anchor for accurate and stable hologram registration through the predefined landmarks. From here on, the hologram's position is continuously tracked and adjusted to assure its visualisation remains in its true anatomical location, even after the patient is covered with surgical drapes. With this anatomical overlay in place, the impression of a "see-through vision" is created. The surgeon can interact with these holograms through voice and gesture commands, which allow him/her to display only relevant structures, cycle through different anatomical layers, and even adjust predetermined planning information whenever necessary. This results in an intuitive user experience that alleviates some of the cognitive load created by the current use of on-screen 2D images as a way of surgical navigation.

CONCLUSION

Reshaping surgical navigation through the use of AR has the necessary potential, yet requires a straightforward UI for both planning and procedure. Our AR solution offers a custom-made, comprehensive pipeline: through sequential automatic and semi-automatic algorithms we are able to create a valid 3D model of the patient and display it on the HoloLens as a registered anatomical overlay with several interaction functionalities in a way that requires little to no additional time or effort from the surgeon. This fully integrated and completely mobile navigation setup, allows its use in everyday surgical procedures while maintaining accuracy and an intuitive end-user experience. The simultaneous clinical validation gives our AR solution the potential to allow widespread adoption in an everyday clinical setting.

HOW CAN SOCIAL VR IMPROVE ELDERS' MENTAL HEALTH?

Imagine that you're 90 years old and living in a nursing home. With your physical condition, you can't walk very far and your mobility has decreased dramatically. What if, without moving from your seat, you could visit the pyramids, go back to your childhood's town or witness your grandson's wedding? Let's dive into how virtual reality will expand the elderly's world, improve their mental health and reconnect generations.

Reconnecting generations with VR // © Lumeen

The population in nursing homes is from a generation that didn't have low cost airlines and didn't travel as much as we do today. There are so many things they can discover. From our experience building Lumeen, we quickly realized that elders love virtual reality. They instantly express the feeling to be transported and want to renew the experience on a regular basis. One of our early users said « I've always dreamed to go to Cambodia and thanks to you it's like I've been there. It's not like TV, we're there, we live! ». Building on that interest, we can design VR experiences to be playful, social and stimulating to keep elders in good shape as long as possible. Swimming with dolphins is amazing at any age, but what's more important when you're 90 years old, is the ability to learn new things to build neuronal connections and share this moment with your peers to create social bonds. Thus, we should use VR as a way to bring elders together around shared experiences that stimulate social interactions and cognitive functions. At Lumeen, we provide nursing homes' staff with a turnkey solution that allows them to easily organize virtual reality workshops and more importantly to give context and stimulate discussions around the experiences.

Activity leaders and occupational therapists are not always keen on new technologies and they don't have much time to figure out how things work. With current solutions, organizing shared group VR sessions and launching an app synchronously on multiple headsets is complicated. Furthermore, VR headsets

controllers are not adapted to elders and when they fail to use a technology, they give up quickly. For our solution to be adopted in this environment, we had to simplify usage for both activity leaders and elders. From our tablet app, an activity leader can easily select a theme such as Machu Picchu and we provide him with all the information, fun facts and illustrations he needs to stimulate a 20 minutes group discussion around the story of the Incas and Machu Picchu. Once he piqued the interest of the participants, he can launch the VR experience on multiple headsets and teleport everyone on top of Machu Picchu in just 1 click. Even during the immersion, we don't want VR headset to be isolating. With our tablet app, the activity leader has a visual feedback of what participants see and he receives tips to better guide them through the experience. Finally, after each experience we integrate a quiz to help participants share their emotions and work their memory. We don't want to simply offer VR experiences but to optimize social interactions before, during and after the immersion. What's important is what happens around the experience and bringing a human touch is central to the product we build at Lumeen.

Family relationships have an important influence on well-being and VR can be interesting to strengthen intergenerational relationships. If you go on vacation to Italy for instance, your grandmother could do a quick VR trip to Rome to have a more profound discussion with you when you come back and tell her about your trip. In addition, 360 degrees camera quality is improving fast while the cost is going down to a price that can be accessible to consumers. This opens the door to capturing and sharing important life moments with our elders. We can empower them to remotely attend the wedding of their grandchild, or view the first footsteps of the new baby in the family. Increasing inclusion will drastically improve elders' well-being.

In nursing homes, there are also many residents with cognitive impairments who can have behavior disorders and sometimes become violent. It has been widely proven that reducing stress reduces these behavioral disorders. When we combined peaceful VR environnements with relaxation music, we noted that participants feel more relaxed almost instantly. This is very powerful and shows how VR could help improve dependant elderly care and defuse anxiety behavioral disorders. VR can also help those who suffer from apathy. Apathetic people are shut up on themselves and have difficulties communicating. Just like listening to our favorite song, revisiting a place we loved can bring back old emotional memories and act as a reminiscence therapy. One day, we had a great outcome with Monique, a very dependant lady who is at an advanced stage of Alzheimer's disease. Accompanied by her doctor, we immersed her in a 360 video where we could see different animals. At the surprise of the doctor, she accepted to put on the headset, mainly because we use a tablet as a mediation to show a preview and spark interest. Once in VR, she started to look around and smile; and after a few minutes she started to talk about Hopy, a dog she used to have for many years. The doctor could not believe it, he had been treating her for several years and it was the first time she mentioned she used to have a dog. We later asked Monique's daughter about the dog and she confirmed they used to have a dog called Hopy. All of these findings need to be scientifically proven and that's why we're launching clinical researches with several public hospitals in France.

The world's population is aging. By 2050, the population aged 60 years and older is expected to total 2 billion. We need to find solutions to keep elders healthy as long as possible and VR may be part of the solution. As we saw, social VR has already many use cases for aged care. Interactive 3D games can also open new doors for brain stimulation to keep seniors healthy. The companies that will succeed in this market will be the ones able to integrate many use cases in simple-to-use products; and we're working hard on it.

REINVENTING AND RETHINKING ANESTHESIA WITH BLISS AND VR

At the very beginning of the project, I looked for existing solutions to fight pain beyond medication. Mindfulness meditation (MBSR program), sophrology, physiotherapy, neurostimulation, etc., are some of these solutions. Some of these techniques are recognized and effective, but also very unevenly documented scientifically

Bliss© uses Virtual Reality with effects on patients' Real Health. Bliss is a Digicament or Digital Therapeutics.

The trigger for this is often being patient or close to a patient. And for me, it was having a loved one with leukemia between 2007 and 2009. We had to deal with all the difficult stages of the patient journey: chemotherapy, radiotherapy, bone marrow transplant and the inevitable side effects of these treatments. I was also interested in what is called "support" care, and I discovered that music or video games play a very important role in this context: when you are alone in a sterile room and you can't open the windows, playing a game like "World of Warcraft (it was the reference game at the time)" brings a very concrete effect on pain and anxiety. And it gives you the sense of escape that you need at times like that.

ESCAPE: A CHALLENGE MADE POSSIBLE BY VR.

In 2009, there was the film "Avatar", and I thought, "It would be extraordinary to offer a similar world for people in hospital for better pain management. It's like a little light bulb went on in my head. ». That's where it all started: we had to create specific 3D content and I then sent a message to everyone to mobilize together: patients and Laval Mayenne Technopôle teams responded. With the whole ecosystem, we set ourselves in motion to present a project at Laval Virtual 2011. We carried out a project with six students from Arts et Métiers and the ESIEA engineering school. It was great: Bliss was born.

We installed a Kinect, a PC and a 3D TV during the show where we had reconstructed a hospital room, it was a precursor and it earned us a lot of media coverage: nearly 500 to 600 visitors tried out and validated the concept.

In 2011, I went to Quebec to see the North Americans, forerunners in VR. I had the chance to meet Dr. Stéphane Bouchard, cyber-psychologist and world expert in therapeutic virtual reality. Stéphane holds the Canada Research Chair in Clinical

Cyberpsychology at the Université du Québec en Outaouais. He joined the Scientific Committee of "L'Effet Papillon" in order to evaluate what we were going to do with Bliss and to validate its scientific and clinical protocols.
Between 2011 and 2014, we worked on developing the concept, refining it. And to finalize the first prototypes. Then, with cancer specialists from Le Mans and Dr. Bouchard, we launched our first clinical study in 2014.
For 6 months, the objective of this clinical study was to evaluate 3 techniques in parallel: Sophrology, Socio-Aesthetics and Virtual reality with BlissThe whole thing was organized with cancer. patients. We studied the impact of these techniques on drug use, quality of life, and self-esteem with health economists and researchers. Thirteen patients made up this first study which included for the first time the experience of Virtual Reality with Bliss. This first step made it possible to validate the positive impact of this supportive care on drug consumption and the quality of life of the patients (stabilized during the study and the six months of observation during their cancer treatments).
For me, it was confirmation that I was on the right track and that VR had a very great potential for the management of pain and anxiety in patients. My wish was to develop a solution that was ever simpler and easier to use and that could be adopted at all ages.

TOWARDS DEVELOPMENT

We started with a crowdfunding campaign in May 2016, we received the support of a community of 332 people and we were able to raise the first 25,000 euros: our first autonomous wireless headset was born. Among the tests I particularly remember September 2016, when we performed a test with Bliss on a volunteer patient during a bone marrow aspiration. The patient had already had five painful punctures before. For this one she told us "I don't feel anything! "This amazed us about the strength of the effect and reassured us about the quality of our developments.
The positive results with Bliss were there! The alternative route to conventional anaesthesia with the nitrous oxide often used was open.
Between 2016 and today, doctors have put Bliss into practice in new ways: catheter placement, capsaicin dressings, lumbar punctures, orthopaedic surgeries, removal of thoracic drains etc. with promising results every time!
We work with institutions and co-construct protocols for use. We are currently conducting a clinical study on pain, anxiety, patient comfort and drug use. And three other clinical studies are currently being filed.
Bliss has now reached the finished product stage. We are already working on the next developments that we wish to keep secret for the time being. Discussions with distributors are under way to allow, we hope very soon, a maximum number of patients to have access to Bliss in France and throughout the world. Our struggle against pain and for the betterment of our lives has only just begun.

The Bliss medical device developed by the company l'Effet Papillon is used in each patient pathway for better pain management.
Bliss is deployed in hospitals and is used before, during and after invasive care, in addition to analgesics or anxiolytics. It is a universal medical device, for all ages and all patients. For invasive and painful procedures, the use of Bliss has important measured effects on the reduction of pain, and on the reduction of 30 to 40% of the use of anaesthetics. In the management of chronic pain, Bliss reduces the level of pain, contributes to better adherence to treatment and improved quality of life.
We are developing Bliss with the support and expertise of carers, doctors, but also patients and developers: our project is collaborative and we test collective intelligence, for the benefit of the patient, so that the solution is the easiest to use and benefits the greatest number, everywhere and for everyone.

THE BAIS-HAMBERS MEDICAL-SOCIAL CENTRE HAS OPTED FOR BLISS

ALEXANDRE JACQUES
Bais-Hambers medical-social centre

Since 2014, the Bais-Hambers medical-social centre, with a capacity of 186 people, has built its strategy on the convergence of support for dependent elderly people and people with disabilities. In close connection with its values, non-drug support is actively promoted on a daily basis in professional practices.

«Also, when the Bliss device was presented to us as an alternative to the consumption of analgesics and anxiolytics, it seemed normal to us to test this tool,» says Alexandre Jacques, Director of the Bais-Hambers medical-social centre.
Three schemes were introduced in the disability and elderly sectors in November 2019. After one month, the initial feedback was very encouraging. Around thirty residents were able to try out the system under the supervision of nurses and after authorization from the coordinating doctor. The experiment will be continued in 2020, announces the Director.

«Because of its ease of operation and transport, the device was used at the resident's place of residence. The resident does not need to move around and can thus be in the best conditions to relax before a medical procedure,» says Katy Picart, project manager.

«Digital innovation is a major challenge for our establishment. It enables staff to question their professional practices and thus give meaning to their daily actions», explains the Director.
Finally, the Director points out that «*this 100% Mayenne-county-based project is a vector of attractiveness for our businesses and our region among our young citizens. It is in this respect that it is also in line with the strategy of the Medico-social Sector*».

VALERIE RIFFAUD-CANGELOSI
EPSON EUROPE B.V
#EYESIGHT

EPSON MOVERIO: MAKING THE WORLD MORE VISIBLE

In 2010, when a team at the University of Oxford undertook research to understand how the brain manages visual information, a remarkable story began to unfold. Six years later, OXSIGHT was born, and an image interpretation technology was developed that is enhancing the lives of those with visual impairments. This innovation found its perfect partnership in the form of Epson Moverio smart glasses. Using intelligent, iterative design, OXSIGHT has successfully married its technology with Epson's device to produce a groundbreaking product that is changing lives.

In OXSIGHT's own, and beautifully unscientific words: "EPSON Moverio is...an eye opener". // © EPSON

The simple action of putting on a pair of glasses to improve our vision is something that we all take for granted, however for someone with tunnel vision, the effect of donning the OXSIGHT smart glasses can be profound; allowing the wearer to interact much more with the world around them and enabling them to enjoy social situations, exhibitions, read books and watch cinema and TV. In OXSIGHT's own, and beautifully unscientific words: "...an eye opener".

OXSIGHT's aim is to make a real difference to the daily lives of people with conditions that cause peripheral vision loss. These include Glaucoma, Diabetic Retinopathy, Retinitis Pigmentosa, Myopic Degeneration, Retinopathy of prematurity and other degenerative eye diseases. The glasses have also helped people with visual impairments caused following a stroke. This is achieved by enhancing the remaining sight of individuals with such conditions, via the onboard camera streaming a live feed into the two HD video displays, which, as with all Epson smart glasses, appears in front of the area of usable vision. In such cases this can potentially increase the field of view to 68 degrees horizontally.

But why Epson Moverio glasses? Dr. Rakesh Roshan, OXSIGHT's CEO, says the decision was made on three criteria where Epson excels: wearability, usability, and functionality. He also points out that Moverio's colour-rich, OLED display is of paramount importance, as visually impaired people need to see bright, high quality images and, in addition to that, the Epson product has allowed them to build the lightest device on the market.

Dr. Roshan's team has adapted the Moverio platform into two models: OXSIGHT Prism™ and OXSIGHT Crystal™. Both models make full use of Epson's inbuilt design features, such as the light frame, state-of-the-art digital display and the ability to easily fit corrective lenses.

The OXSIGHT Prism™ version features a comfortable occluder that blocks out external light for users who are ultrasensitive, whereas the OXSIGHT Crystal™ includes clear screens which allows social interaction through eye contact and also offers the user a customised look with a removable shade.

Well-designed smart glasses combined with vision enhancing software is a formula that works, and the OXSIGHT story perfectly illustrates the potency of AR technology in the right hands; but the more you learn of this story, the more you are struck by the way the products improve everyday life for the users. On a practical level, one would not be surprised to learn that the glasses help gain awareness of surroundings, an easier location of objects, and the 'edge enhancement' mode helps to define objects and doorways. The 'enhanced colour' mode enables a better view of signs, the choosing of clothes, selection of food, identifying money... there is even a 'Text Mode' that helps with print, signs and handwriting.

But this goes further. The sum of these parts means more support at work and play, and more confidence in the office, outdoors or at hobbies. Talking to Dr. Stephen Hicks, OXSIGHT's Head of Innovation and Co-Founder, can be a heartwarming experience as he recounts individual stories of OXSIGHT users. There is the woman who remarked, "You need to have a shave!" on seeing her grown up son's face properly for the first time. The mum who was able to see her daughter swimming for the first time, not to mention a host of users who can see clearly the faces of their grandchildren, nieces and nephews as never before. You can understand Dr. Hicks' pride when he says, "It's a real privilege to provide that benefit".

One of the more recent success stories is with a teenager called Callum, who has the condition Retinitis Pigmentosa, a form of tunnel vision. This causes a constriction of the visual field, which the OXSIGHT products are able to expand by up to 68 degrees, allowing the user to see an entire face, or entire line of words or section of text. Callum's dad surprised him by giving him the glasses as a present, and on first trying them, Callum described the experience as "life changing". He can now play his favourite computer games, peruse manga comics more thoroughly, see the whole TV screen, and even see the whole cinema screen. He says the glasses help him with his school work and give him greater independence. Teenagers are not noted for their emotive use of adjectives, so you appreciate what Callum feels when he describes the experience as "magnificent".

So what are the next steps for OXSIGHT? Stephen Hicks says they will continue to innovate and continue to improve the functionality, branching out into solutions for other visual conditions. With around 350,000 people registered as blind or partially sighted in the UK alone, one can sense OXSIGHT's appetite for the challenges ahead. For Stephen, it is also about exceeding expectations. In the same way that technology in sport continues to push forward the capabilities of Paralympic athletes, a visually impaired person could have better night vision than a sighted person.

Dr Hicks says, "we want to create something magical, something much closer to science fiction".

Judging by the reactions of the early adopters, and the feedback of OXSIGHT's users, the magic is already happening and the science is no longer fiction.

VINCENT RIEUF - LEAD DESIGNER & UXVR RESEARCHER - ICEBERG
AMAURY SOLIGNAC - CHIEF EXECUTIVE OFFICER - ICEBERG
PAUL MONNIER - PROJECT MANAGER - DEFIS D'HOMMES
#HANDICAP

VIRTUAL REALITY BASED PARALYSIS REHABILITATION

Grounded in forefront scientific knowledge, DéfisVR is an immersive experience which provides disabled users with motor and sensory rehabilitation. Thanks to electromyography and body tracking the users' gestures and intentions are reproduced in virtual reality. Immersed into a realistic virtual training environment, users can benefit from their avatars movements in order to further progress in face of their handicap.

Setting up DéfisVR - Vincent RIEUF (ICEBERG, Lead Desiger)

ICEBERG is a Research and Development team specialized in the design of immersive solutions. DEFIS D'HOMME is a patients association assisting people with paraplegia and tetraplegia rehabilitation. Both organizations combined their resources to create the DéfisVR project.

Tetraplegia and paraplegia take the form of a partial or total impairment of motor and sensory functions of the limbs. These functions are required to both control the limbs and receive sensation from these limbs. Limb impairment is one of the many symptoms that these paralysis generate. Immobility can also in turn induce additional medical conditions.

An approximative 75% of para- and tetraplegic conditions are caused by traumatic incidents on the spine. Lesions to vertebrae in the spine can in turn damage the spinal cord. As part of the central nervous system, the spinal cord provides the human body with routes for the transportation of nervous messages from the center (brain) to the periphery (limbs and organs). An interruption in one of these major routes can keep the messages from being sent or received by the brain. Thus the altered circulation of motor and sensory messages can result in impaired motor and sensory functions.

Through specific physical rehabilitation processes, patient struck by paraplegia and tetraplegia can partially (in rare cases fully) recover their motor and sensory functions. One of the traditional approach to rehabilitation resides in asking a tetraplegic or paraplegic person to focus on intending a specific gesture while his/her limbs are manipulated by a physiotherapist to match the corresponding gesture. Unfortunately this rehabilitation process is long, resource intensive, and only available in specialized rehabilitation centers.

From this finding, our innovation team investigated ways to provide a new rehabilitation system, to foster healing through immersive serious gaming. This system had to be inexpensive, self explanatory, mobile and accessible.

Modern scientific discoveries provide with greater insights on paralysis. Technological innovations unlock greater opportunities for new rehabilitation program.
Severity in spinal cord injuries can vary from total to partial loss of motor and sensory functions. In some tetraplegic and paraplegic cases, partial sensory-motor messages are able to travel between limbs and brain, yet they are not strong enough to enable control or sensation.

Although these weak messages are insufficient for optimal function, they can be captured, read and measured with electromyography. Electromyographic recordings capture the electric potential liberated by contracting muscular cells, providing an opportunity to detect when a user intends to activate a targeted muscle, even if this muscle does not react in a visible way.
By use of body tracking and head-mounted display, the DefisVR system gives our users an opportunity to superimpose a virtual body (avatar) onto their physical body. The targeted limbs are equipped with a tracking system that guarantees a consistent and precise overlap of both real and virtual bodies.
This combination of body tracking, head-mounted displays and electromyography represents the basis for a new generation of rehabilitation programs. Once equipped with the full DéfisVR system, here is what occurs:
1) An equipped tetraplegic or paraplegic user intents a gesture.
2) His/her intention is encoded by his brain and sent along the spinal-cord neural route towards the targeted limb.
3) As the command message travels, it is altered by the lesion along his route.
4) The altered messages arriving to the limb is not sufficient to trigger the intended gesture.
5) The electromyographic system detects, analyzes and categorizes the captured message before sending it to the software.
6) The virtual limbs are moved to visually represent the intended gesture.

This sequence provides the user with the pleasure of visualizing a valid motor response to his/her initial gesture intention. The DéfisVR system closes the broken sensory-motor loop, restoring a virtual yet functional body.
Recent scientific findings show that closing an impaired sensory-motor loop has an impact on the trained nervous system at a very low (physiological) level. People with spinal cord injuries have shown significant regeneration of the neural routes through this approach. This method improves the communication between the central neural system and the muscular system.
While we were still in early developpement, it became very clear to the team that a first benefit of the DéfisVR platform is emotional. It is very satisfying for our users to observe an instantaneous virtual recovery of their motor function. Furthermore, this immersive experience crystallizes a sometimes fuzzy goal: This is how a controllable body feels, this is what my objective is.
Like most training, the rehabilitation process is catalyzed by clear objectives, measured progress, real-time feedback, motivational incentives and repetition.
The DéfisVR rehabilitation experience benefits for its digital nature on multiple level. DéfisVR acts as a "black box" device through which muscular contraction data is recorded, analyzed and categorized. This data is a very rich basis to produce diagnoses, set objectives and measure users' progression. For instance, one can identify if the electromyographic signal intensity tends to increase or decrease during a training session or between sessions. This can for example give insight on motivation, fatigue and neuromuscular improvement.
The DéfisVR experience also provides real-time bio-feedback on specific muscular contractions. During a muscular contraction, the user can monitor the intensity of the contraction, his/her goal, and thus identify and regulate the effort expanded towards this goal. Once again this is a crucial step towards increased body control.
Like many other digital platforms the DéfisVR offers very high repeatability. It provides our users with the opportunity to isolate specific parameters while observing their training effort. For example, one can program and repeat a specific gesture and observe progress associated to these parametric conditions.
These various digital features contribute in sustaining motivation towards the rehabilitation objective, and ensure a punctuated progress towards recovery. Both acting on self perception and benefiting from digital resources, DéfisVR opens a compelling space for tetraplegic and paraplegic rehabilitation.
Our goal is to move towards the development of a simple yet effective functional rehabilitation platform. We want to push the boundaries of the existing solutions by relying on human and technological means in order to hatch a new generation of rehabilitation strategies. Virtual reality-based rehabilitation implies a long term material and human investment. In order to continue the development of the DéfisVR project, ICEBERG and DEFIS D'HOMMES are actively looking for financial and scientific partners to steadily grow towards a radical goal: offering a new challenge to people with disabilities.

The DéfisVR Team showcasing the experience, Paul Monnier (DEFIS D'HOMME, Project manager) Amaury Solignac (ICEBERG, CEO) Vincent Rieuf (ICEBERG, Lead Designer)

WHY A DIGITAL COMPANY JUMPS INTO HUMANOID ROBOTICS?

Created in 2013, with a strong desire to propose a different model, Conserto wanted to launch a robotics pole in its Labs. The initial objective was to make its staff work between missions on multidisciplinary projects, as well as to make all players understand the needs and constraints of other professions.

Humanoid robotics has the ability to bring together in the same project a wide variety of profiles and skills such as :

- The functional for understanding the need and transcription
- Design and ergonomics for intuitive application creation
- The application architecture for the development of an easy to maintain and scalable application
- Embedded technologies for programming the robot's behaviour
- Front-end technologies for user interface development
- Back technologies for business developments
- Testers to ensure compliance and quality of the deliverable
- The scrum masters for the animation of the ceremonies
- Project managers for team coordination

OUR FIRST MEETING WITH PEPPER

The first steps taken by robot manufacturers in 2014 and 2015 were not followed up. Softbank Robotics, Conserto's primary target with its NAO and PEPPER robots, was requesting robot purchase volumes that were inadequate for Conserto's projects and piecework distribution was not envisaged.

It was at the end of 2015, at a conference in Nantes attended by Softbank Robotics and Conserto's General Manager, that the story began.

Softbank Robotics was beginning to prepare the launch of PEPPER in Europe and was looking for partners to carry out the first cases of use of the robot in different sectors such as retail, health or education.

The robot has the enormous advantage of offering motivating and visible results quickly with short project durations.

The first goal was to understand the constraints and objectives of all the actors of the project. Conserto was willing to train and educate its consultants to understand the importance of the deliverables and the impact of inaccuracies on the activity of the other project trades. This can be summarized by: be more precise individually to be a more efficient team.
After an internal brainstorming, the Conserto teams decided to position themselves on the fields of education or health. The « education » community had already been expanded, so the choice of health was validated.
The recruitment of the core of the robotics team was launched and at the beginning of 2016 the team and Pepper arrived on the premises with great ambitions and very strong motivation.

THE PEPPER LAUNCH PROJECT AT CONSERTO

Already marketed in Japan, Pepper was eagerly awaited in Europe, so the launch had to be up to scratch. Sofbank Robotics set up a partner village at the Innorobo show in Paris in May 2016 where each partner presented the use cases imagined and realized.
Conserto was present with a solution for supporting patients in hospitals.

Pepper ensures interaction with the patient and the guide both vocally and graphically from his tablet throughout the exchange. The major functionalities presented had to highlight the capabilities of the robot.
Facial recognition with an identification doubled by a personal question such as his date of birth allowed a personalized interaction and the historization of the collected data. The robot interacted with equipment such as thermometers or blood pressure monitors for the collection and follow-up of measurements. Pepper also asked about mood, painful parts of the body with an evaluation of their level of intensity.
For its part, the medical team had the possibility of defining alarm thresholds for each constant and for each patient according to his pathology, in order to be notified by sms of a value reached.
Since this first POC, Conserto has worked with different health care institutions to deepen and develop the use of Pepper in this ecosystem.

FIRST EXPERIMENTATION WITH THE UNIVERSITY HOSPITAL OF ANGERS

A first project in the emergency department was considered but was not retained. The medical team did not have the required availability to support the project serenely and the constraints of robot movement in the corridors increased the risk of project failure.
This risk taking for a first project and a first experimentation was not desired by any of the actors.
Other services were consulted, and other ideas were proposed.
It was therefore in anesthesia consultation that Pepper took its first steps with the aim of improving the level of information for patients and increasing their level of satisfaction with the service. Inside the waiting room, Pepper was available to explain the patient pathway, the different types of anesthesia with their desirable or undesirable effects and how to prepare for surgery.

The medical team at the CHU and the Conserto graphic designers worked long and hard to find the right words from Pepper and the associated pertinent illustrations.
The measurements made during the experiment showed a gain of nearly one point in the level of satisfaction on an already high score, but the good feedback was the acceptability of the robot by the patients, the majority of whom were over 60 years old.

FIRST EXPERIMENTATION IN PATIENTS' HOMES

In partnership with a clinic in Montpellier, the project was to accompany patients who had just been operated on as outpatients at home to encourage convalescence in their family environment. Pepper acted as a link between the patient and the different actors of the medical supervision outside the clinic's walls.
The major features (apart from entertainment) were:
• Keeping and sharing the tracking book where everyone could bring their notes and consult those shared.
• The taking of constants (pain, mood, temperature, tension).
• Alerting the medical team in the event of a threshold or alert.
• Dosage reminder
The monitoring logbook records interactions with the patient and the data collected and makes them available to the team from a web portal that can intervene on the robot's parameters remotely in order to adjust the monitoring to the patient's evolution. An evolution of this solution with a videoconferencing system using the camera and the tablet of the robot is still in the future evolutions.

BUT ALSO...

Conserto has accompanied and continues to support other clients on a wide and varied range of projects:

- In EHPAD (Residential Institutions for the Elderly dependent persons) to welcome and assist facilitators
- On pediatric ward to entertain children
- As a trade show to present our customers' solutions and services
- At trade fairs for stand animation and data collection
- In companies for the reception, information and orientation of visitors
- In events for parties or entertainment

Conserto has great ambitions for the development of service robotics and we are convinced that a revolution will take place in the next few years and will provide answers to the problems of home care and aging well, among others.
We are accompanied by a group of experts from the health sector such as Oratorio (a subsidiary of the NEHS group) and Medipep to co-construct new uses in health and care pathways.
Our boxes are full of ideas, but most of our projects are still mostly in the POC or experimentation category. The French market is not yet ready and technologies are still too limited.
To go further, we are eagerly awaiting the next generations of robots that can integrate real artificial intelligence and autonomous movement modules.

VIRTUAL OR AUGMENTED HEALTH REALITY FROM A LEGAL PERSPECTIVE

Created in 2013, with a strong desire to propose a different model, Conserto wanted to launch a robotics pole in its Labs. The initial objective was to make its staff work between missions on multidisciplinary projects, as well as to make all players understand the needs and constraints of other professions.

Virtual Reality and Augmented Reality applications have tremendous potential in healthcare, particularly and respectively, to improve compliance and reduce patient discomfort, and to improve the effectiveness and efficiency of medical procedures.
In order to grasp the legal issues relating to virtual reality on the one hand and augmented reality on the other, it is first necessary to understand these respective concepts. In the absence of a legal definition, only a technical approach can delimit their contours.

TECHNICAL AND APPLICATIVE UNDERSTANDING OF VIRTUAL REALITY AND AUGMENTED REALITY

Understanding virtual reality
Virtual reality is a technology that simulates the physical presence of a user in an environment created artificially by software. The user can interact with this digitally created environment, allowing a sensory experience.
Virtual reality is mainly used to relieve patients' pain, as the change of environment allows them to focus their attention on something other than care.

Understanding augmented reality
- Augmented reality can be seen as an interface between digital data, described as «virtual», and the real world. It has three characteristics:
- associating the real world and digital data;
- adapt in real time with the user and the environment: a change in the environment (a displacement, an interaction) leads to an adjustment of the digital layer;
- use the 3D environment.

Augmented reality has obvious applications in surgery, especially with robotic 3D imagers that make it easier for surgeons to learn and work.
In addition, it can make painful medical procedures more

tolerable, for example, a scanner that illuminates veins on a patient's skin helps healthcare workers locate them before inserting a needle.

LEGAL UNDERSTANDING OF VIRTUAL REALITY AND AUGMENTED REALITY

With regard to their respective applications, each of these technologies must be approached differently from a legal point of view.

Legal understanding of virtual reality

In virtual reality, the main legal issue is whether the application constitutes a medical device (MD) within the meaning of the current Directive 93/42/EEC, and within the meaning of the EU Regulation 2017/745, applicable in respect of Class I devices from 26 May 2020.

Currently, this MD is defined as «software intended by the manufacturer to be used specifically for diagnostic or therapeutic purposes. (1)» .

Specifically, it is software intended for :

«to be used for the purpose of:

1° The diagnosis, prevention, control, treatment or mitigation of a disease;

2° Diagnosis, control, treatment, mitigation or compensation of an injury or handicap;

(...) » (2)

The question that arises is therefore whether a virtual reality application can be considered to be intended for use in the treatment of an illness, injury or disability.

It is possible to answer in the affirmative since the application, by helping to alleviate the pain felt by the patient, constitutes an aid to treatment.

In this respect, virtual reality applications can be considered as DMs.

In practice, on the market, some virtual reality applications benefit from the CE DM marking and others do not, the ANSM having already considered in one of my files :

«The broadcasting of images using this digital application to reduce symptoms of pain and anxiety that can be assimilated to visual relaxation sessions is not a medical purpose within the meaning of Articles L5211-1 and R5211-1."

The definition of MD under the new «MDR» (3) is substantially identical and therefore subject to the same interpretation.

The provision of these applications will have to be formalized in order to include the necessary stipulations regarding intellectual property, use and limitation of liability in particular.

Legal Understanding of Augmented Reality

In terms of augmented reality, the issue of qualification as a medical device is less controversial, the application being more clearly intended to be used specifically for therapeutic purposes, for the treatment of a disease, injury or disability.

In this respect, it is therefore necessary to identify the class of the MD, and to carry out the marking with the help of a notified body.

Furthermore, in the context of their use in «clinical routine», these applications work with personal imaging data.

In this context, the protection of the data processed with the application must be ensured.

In particular, the principle of limitation of storage within the application must be respected, i.e. personal data must be kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the data are processed.

Similarly, it is necessary to ensure, by default and from the design stage, the protection of data processed with the application (4).

In addition, the application must allow the implementation of appropriate technical and organisational measures to ensure a level of security appropriate to the risk, including pseudonymisation where appropriate, and the means to guarantee the confidentiality and integrity of the data (5).

In this respect, the «appropriate» measures are defined in the sectoral reference frameworks, in particular those referred to in Article L1110-4-1 CSP, the guides of the PGSSI-S, whose rules for connected devices of a health information system must be respected (6), as well as the rules for authentication (7) and accountability and traceability.

n addition, remote interventions must be carried out in a secure (8) manner.

Finally, the supply of applications presupposes an adapted BtoB contractualization, including in particular stipulations relating to proper use, the license of course, associated integration services if necessary, maintenance and hosting (approved or certified), and also liability, limitation of damages, but also the mandatory clauses under Article 28 RGPD, failing which a penalty of 10 million euros is incurred (9).

In the same sense, conditions of use intended not for customers, but for users themselves, must be defined and accepted, it being specified that they must include in particular the mandatory statements under Article 13 of the DPA intended to inform users about the processing of data concerning them.

Thus, a very specific legal framework is required in the context of the provision of the application.

REFERENCES:

1) L5211-1 CSP

2) L5211-1 CSP

3) For "Medical Device Regulation"

4) Art. 35 RGPD

5) Art. 32 RGPD

6) https://esante.gouv.fr/sites/default/files/media_entity/documents/Guide_Pratique_Dispositif_Connecte.pdf

7) https://esante.gouv.fr/sites/default/files/media_entity/documents/pgssi_referentiel_authentification_v.2.0.pdf

8) https://esante.gouv.fr/sites/default/files/media_entity/documents/pgssi_regles_intervention_distance_v1.0.pdf

9) Art. 83 RGPD

THEY CONTRIBUTED TO THIS SPECIAL EDITION

ROBERT FINE

Robert is the Executive Director and Founder of IVRHA (International Virtual Reality and Healthcare Association). Robert has over ten years of additional work experience as a systems and sales engineer with various companies including CMGI, Hughes Network Systems, ioWave and Raytheon. Robert has a bachelor's degree in mechanical engineering from Villanova University, a master's degree in environmental science and public policy from Johns Hopkins University, and is ABD at George Mason University.

SÉBASTIEN SERLET

Sébastien SERLET is researcher at ULB (University of Brussels in CRCN-CO3 laboratories). After a Master degree in Psychology and neuropsychology in France, he works in a clinical neurology unit in Brussels. He discovers R.O.G.E.R during his formation and now, he is the project manager. He develops the program to create a company for the software and its management.

PAULA SÁNCHEZ MARTÍNEZ

Paula studied Advertising and Public Relations at Jaume I University. Now she's working for Innoarea Projects as Content Marketing Manager.

ALFONSO SORIANO BALLESTER

Alfonso is professor of design at the Polytechnic University of Valencia. He's the CEO and founder of Innoarea Projects.

CHRISTOPHE GOUET

Christophe Gouet is at the head of MiddleVR Studio, the MiddleVR entity developing VR and AR training applications and pedagogic contents to answer professionals' needs.

DAVID PLIQUET

Director and creator of E-Mage-IN 3D, designer of the TMS Studio solution, David PLIQUET is a mechanical and production engineer. From 1994 to 2005, he was a sales engineer in 3D solutions for industry and from 2005 to 2013, in the field of machine tools. David created E-Mage-IN 3D in 2013, driven by new ways of looking at issues through digital and 3D, he saw extremely powerful impulses to improve and transform traditional operating modes.

JAMES MARKEY

James Markey, Product Owner at Virteasy Dental, has given haptic and VR presentations, training sessions and workshops in more than 10 different countries. Currently based in Montreal, Canada, getting a greater understanding of simulation needs to improve Virteasy.

MARIE POUX-BERTHE

Marie is project manager at Ouest Médias agency, she works with clients to value their expertise, culture and societal commitments on the web through editorial and social media strategies. Marie is an Audencia SciencesCom graduate, she also studied at Erasmus Rotterdam University.

CHLOÉ BIDET

Chloë Bidet is the founder of OSEOS. OSEOS offers turnkey virtual reality group activities for specialized establishments. A concept adapted to people with disabilities or in isolation, to children and the elderly, or to the prison environment.

NICOLAS AOUIZERATE

Nicolas Aouizerate has successively graduated in Social Psychology of Health and Marketing Services. After 8 years of experience in digital agencies, he joined Feelity as a partner in 2019. His favourite subjects are the contribution of augmented reality to gamification, the daily monitoring of chronic diseases and the 3D visualization of health data.

MARCO SACCO

Dr. Marco Sacco is senior researcher and head of CNR-STIIMA in Lecco, President of EuroVR Association (European Association for Virtual Reality and Augmented Reality). He has experience in VR and AR since 1994, developing applications and systems both for manufacturing and aeronautic sectors as well as in health and well-being domain. Marco is Head of CNR-STIIMA subsidiary Lecco, Smart and Human Centered Living Environment Institute of Intelligent Industrial Technologies and Systems for Advanced Manufacturing. He is a member of the National Research Council of Italy.

REBECCA GILL

Rebecca Gill is a Registered Nurse and award-winning Social Entrepreneur in the UK, with over 12 years' experience within learning disabilities, brain injury rehabilitation, mental health issues and

other neurological conditions. Inspired by the advances within immersive healthcare but frustrated by the lack of access, she founded VR therapies in 2018, a social enterprise for children with special needs and adults with disabilities.

CHRISTOPHE MALLET

Christophe Mallet is the CEO of BODYSWAPS®, an immersive learning platform built to deliver behaviour-changing soft skills training at scale with VR.

INNA KHMELNITSKAYA

Inna Khmelnitskaya, PhD is co-founder ArtoMed technology. Recognized expert in IT (Big Data, AI, IoT, AR/MR) and business development having made experience with technologies before they became trends. Author of multiple IT-products, more than 80 scientific articles. Adviser to the Minister of economy Republic of Belarus, Deputy Director international IT company, founder & CEO consulting group.

ALEXANDRE SITNIK

Dr. Alexandre Sitnik is Head of Trauma Laboratory of the Belarusian Republican Scientific and Practical Center for Traumatology and Orthopedics, member of the American Academy of Orthopedic Surgeons, AOTrauma, European Federation of National Associations of Orthopedics and Traumatology, Deutsche Gesellschaft für Unfallchirurgie, SICOT, Orthopaedic Trauma Association of North America

PATRICE BOUVIER

Patrice Bouvier received his Ph.D. in Computer Science from the Université Paris-Est, France, in 2009. His research focuses on the user experience in virtual reality and entertaining or learning games. He is Head of Research, Development & Innovation at SYKO studio.

ALEXANDRE BÉGUÉ

Alexandre is a Coach Therapist for stress management and burn-out. Alexandre is a Clinical therapist and a passionate Engineer of new technologies for well being, in order to improve the natural human potential. He was manager in an international company during 15 years in different countries. He helps his teams in their development and stress management. Alexandre is the CEO and founder of Relaxmind
www.relaxmind.be

JÉRÔME LELEU

Jérôme Leleu is the president of SimforHealth, a publisher of digital solutions for the initial and continuing education of healthcare professionals. These innovative teaching tools have already trained over 50,000 health professionals worldwide via the MedicActiV platform. The SimforHealth teams collaborate with clients such as the Red Cross, Sanofi and Stanford Medicine. The company has built a strategic partnership with HTC Vive enabling them to apply their virtual reality solutions to the field of healthcare. Jérôme Leleu is also a regular contributor as an e-health expert on BFM Business' program "BFM Santé" dedicated to health issues.

ALBERT «SKIP» RIZZO

Skip Rizzo is the Director of MedVR at the USC Institute for Creative Technologies. Over the last 25 years, Skip has conducted research on the design, development and evaluation of VR systems across the domains of psychological, cognitive and motor functioning in healthy and clinical populations. In spite of the diversity of these clinical R&D areas, the common thread that drives all of his work with digital technologies involves the study of how Virtual Reality simulations can be usefully applied to human healthcare beyond what's possible with traditional 20th Century methods.

ARNO HARTHOLT

Arno Hartholt is the Director of Research and Development Integration at the University of Southern California Institute for Creative Technologies where he leads the virtual human integration and central asset production & pipeline group. He is responsible for much of the technology, art, and processes related to virtual humans and associated systems, in particular at the interchange between research and industry capabilities. He has a leading role on a wide variety of research prototypes and applications, ranging from medical education to military training and treatment, and was the lead developer for BRAVEMIND.

DAVID KWOK

David Kwok is the Special Project Manager for the MedVR lab at the USC Institute for Creative Technologies, a DoD-sponsored University Affiliated Research Center (UARC) that works in collaboration with the U.S. Army Research Laboratory to bring film and game industry artists together with computer and social scientists to study and develop immersive media for military training, health therapies, education and more. He currently manages all MedVR lab projects including Bravemind. Previously, David was vice president at The Princeton Review, a consultant at The Walt Disney Company, and received his BA in Cognitive Science from the University of California, Los Angeles.

SHARON MOZGAI

Sharon is the Lead R&D Scientist for MedVR at USC's Institute for Creative Technologies. For the past decade, she has combined her background in psychology, organizational behavior, AI, and experimental design into cutting-edge systems, ranging from research prototypes to fielded applications. She holds a Master's degree in Human Development and Psychology from Harvard University.

GUILLAUME FACCHI

Virtual and augmented health reality: a new way of treating
At BioValley France, Guillaume holds the position of Coordinator of Strategic Programs within the cluster. Guillaume is in charge of supporting structuring projects and developing the training offer in the Grand Est region. He also contributes to the promotion of the health sector by participating in working groups with the Ministry, the

Strategic Commission for the Sector (CSF) and the European Commission. Guillaume also develops the cluster's new partnerships with the United States and Israel.

NORA YENNEK

Nora Yennek is Head of IfisLab, research laboratory part of Training Institut of Health Industries (Ifis). She has a PhD in Education sciences and is an associate researcher at laboratoire Cognition Humaine et Artificielle, Université Paris Nanterre

CORENTIN DUBOC

Corentin DUBOC is XR Digital Specialist at SEGULA Technologies, a global engineering group. He is involved in the development and deployment of immersive technologies and leads research projects on haptics and cognition.

GRÉGORY MAUBON

Grégory MAUBON is Chief Data Officer and digital coordinator at HCS Pharma, a biotech startup focused in high content screening and complex diseases. He manages IT missions and leads digital usages linked to company needs. He is also an independant consultant in augmented reality since 2008, where he created www.augmented-reality.fr and founded in 2010 RA'pro (the augmented reality promotion association)»

GRACE MANGIALARDI

At Molecular Devices, Grace was Director and General Manager for a newly developed custom engineering and automation team (AWES), concentrating on paid-per-project customizations of Molecular Devices core technologies and automated workflow to enhance our solutions for Biologics, High Content Screening & Drug Discovery Assays. Responsible for P&L, Sales & Operations for AWES team globally. Today she is Director, Global Commercial Operations & Enablement at SCIEX.

VICTOR HERRERA

Víctor Herrera is Project Manager & Founder of TECHER TEAM. With over 20 years of expertise in 3D modeling and visualization technologies, animation and programming, he has led several R&D immersive technologies projects specially VR and AR since 2015. Together with his team, they advise leading companies in areas such as Healthcare, automotive and singular architecture during the implementation process of Extended Reality technologies.

HELENA ORTIZ GIL

A postgraduate in marketing with experience in sectors such as banking, neuromarketing and biomedicine. Recently discovered digital realities and since then, passionate about them. It is the natural evolution of marketing. Now at Techer Team maling VR projects to be profitable for the brand and engaging for the user. Virtual is Real -> Future is now

XAVIER RUYRA BALIARDA

Dr. Xavier Ruyra Baliarda is an expert in minimally invasive cardiac surgery and bloodless cardiac surgery, mitral repair surgery and sutureless aortic valve replacement surgery and TAVI. He is one of the world's leading specialists in the Ross procedure, a heart operation which involves using the patient's own pulmonary valve to replace the diseased aortic valve. As well as being one of the most prestigious cardiologists in the field, he is a professor at the University of Barcelona and has developed various patents to repair and reconstruct valves.

CHRISTOPHER LAFAYETTE

An Emergent Technologist in medtech, ecotech, education, virtual, augmented and mixed reality, artificial intelligence, telepresence, disruptive media and several additional applied sciences.
Thought leader. Ecobiotic Diversity Advocate. Christopher is a Silicon Valley National & International speaker. Founder of XR platforms, Flotilla, HoloPractice and the Immersive Directory. He's creating a series of immersive medical incubator platforms, building fully equipped immersive Holodecks and creating emergent technology applications and hardware. He's also executed and managed business development for thousands of campaigns and projects. An expert in lab-to-market acceleration. He's working with corporations and startups to bring eco-culture into hardware, software, and content development.

VALENTIN JOUET

Valentin is Lead developer C# and Unity in Labforsims 2 project. His role is to integrate plugins from CEA labs into the virtual environments such as conversational agents or tracking and to build the application the students use to train themselves. Valentin now works for IMASCAP (Wright Medical)

LAURIANE CAUCHON

Lauriane is a 3D computer graphics designer. Passionate by 3D design and real-time environments and interactions, she provides all the 3D and 2D graphic content and manage the user experience listening to the doctor's needs.

AMINA MOHAMED-SOILIHI

Amina was LabForSIMS 2 Project Manager. She coordinated the actions and federated the contributions of the actors of the project. She managed the monitoring and reporting to the funding agency. She is Digital Scientific Advisor for the Janssen Pharmaceutical Companies of Johnson and Johnson.

PROF. DAN BENHAMOU

is Director of the LabForSIMS 2 simulation laboratory (Faculty of Medicine Paris Sud), he is Director of the Anesthesia Laboratory of the Faculty of Medicine Paris Sud, member of the INSERM 1195 Unit "Small molecules of neuroprotection, neuroregeneration and remyelination".

RENAUD LAMORT

Renaud LAMORT has worked for several years as a consultant for key accounts to accompany them in their digital transformation. He joined VR Connection in 2016 as Operations Director to put his skills at the service of innovative solutions.

AIMEN MAKI

From 2010 to 2015, Aimen held the position of Head of Communication and Marketing at Quinta Communications, Tunisia's leading film company. In parallel, he was able to work on several projects as an independent consultant and co-founded Mirage Holograms where he is CTO.

SLIM KHMISSI

Slim KHMISSI Providing a collective, multimedia & interactive experience for the launch of a drug. In 2011, Slim created Eidolon, a company specialized in UX strategy implementation and user-centered design. He worked on product use analysis, design and evaluation. In 2015 Slim co-founded Mirage Holograms where he is President.

CARINE DE POTTER

Carine is a Healthcare professional and passionate about innovation. Her major interests focus on training and education. She is Experienced on design and healthtech project implementation for the market. She is also Associate Founder of Moodify Asbl

ABDELMAJID KADRI

Doctor in computer science, specialized in virtual technologies. Abdelmajid Kadri is currently a Research Engineer at the Ecole Nationale Supérieure d'Arts et Métiers (ENSAM). His lectures range from traditional computer science to virtual technologies. The objective of these programs is to train project managers, mastering all the techniques and technologies of the virtual world and having in-depth knowledge of programming languages, tools, interfaces, platforms and development environments. His research work focuses on the contributions of virtual technologies (VR, AR, ...) in different fields of application. Notably in product design to meet the needs of design and decision support. But also in health, for the management of human dysfunctions, thus meeting needs in terms of awareness and rehabilitation.

ROBERT STONE

Professor Bob Stone, a Human Factors specialist and a 33-year "veteran" of the international VR, AR and MR community, is Director of the University of Birmingham's Human Interface Technologies (HIT) Team. His multiple award-winning medical research began in the early 1990s and led to the development of a world-first VR "keyhole" surgical skills trainer. Today, he works with the Royal Centre for Defence Medicine and the QE Hospital in Birmingham, researching VR for rehabilitation the training of future Medical Emergency Response Teams.

MÉLANIE PÉRON

After eight years as a librarian / documentalist, in 2011, Mélanie Péron decided to convert and create "L'effet Papillon" (the "Butterfly Effect") following her personal experience as a patient's relative. "L'Effet Papillon" is a social enterprise that offers non-drug support to help improve the quality of life of all groups. Among the accompaniments and solutions that "L'effet Papillon" develops, there is the Bliss "digication" which is the result of 9 years of Research & Development in cooperation with a scientific committee. Bliss, reduces or even eliminates the use of analgesics or anesthetics during painful and/or anxiogenic treatments. Bliss can be used for several successive medical procedures without restriction of duration or frequency for each patient.

ALEXANDRE JACQUES

A graduate of EHSEP (Ecole des Hautes Etudes en Santé Publique), the University of Rennes 1 and EDHEC Business School, Alexandre Jacques is Director of the Bais-Hambers Medical and Social Center.

BENJAMIN COSSE

An industrial engineer by training, Benjamin Cosse, 33, specialized in innovation and virtual reality at the École des Arts et Métiers in Laval. Serial-entrepreneurs, he has participated in 10 years in a dozen entrepreneurial adventures, notably in digital, 3D and Virtual Reality, including COTTOS Medical, which he co-founded in 2014.

JEAN-FRANÇOIS ZAREMBA

Jean-François is 56 and has a rich and varied professional career, going through industry, special machines, test and development benches but also solutions for people with loss of autonomy. The virtual 3D image, allows him to understand the issues in all their components regardless of the sector of activity.

JOHNNY DUERINCK

Johnny Duerinck, MD, PhD, is neurosurgeon and clinical researcher at the University Hospital Brussels. He has a special interest in both neuro-oncological research, for which he obtained his PhD in 2017, and in the application of new technologies in healthcare, culminating in an expanding series of multidisciplinary projects in augmented and virtual reality and artificial intelligence. The SARA project is one of his larger projects within this series.

FREDERICK VAN GESTEL

Frederick Van Gestel, MD, is an aspiring neurosurgeon who started his training with a PhD about the use of augmented reality in neurosurgery. Along with professor Duerinck, he guides the SARA project towards the development and implementation of an augmented reality-based neuronavigation platform.

VALÉRIE RIFFAUD-CANGELOSI

Valerie Riffaud Cangelosi is Head of New Market Development for Epson Europe. She is responsible for the development and implementation strategies of new Epson business areas currently focusing on Smart Glasses for personal & business applications and Lighting projectors throughout the EMEAR region.

CORENTIN METGY

Corentin Metgy is the Co-Founder and CEO of Lumeen, a company building the first VR tool that improves elders and handicapped people's lives. Before this, Corentin lived in New York and Kuala Lumpur and led Business Development for Sketchfab, the leading platform for 3D and virtual content.

LOÏC FLAMENG

Originally a playwright and theatre director, Loïc Flameng turned to scriptwriting and has specialised in virtual reality since 2015 as a VR scriptwriter. Loïc has put online the first VR writing website for scriptwriters and directors: openscriptvr.com, developed by Ludovic Bourely, financed by AUDIENS for its release. He has developed a VR writing method, the FLAMENG method, he is currently giving lectures, intervening in workshops on storytelling in virtual reality, and he will soon publish a book on his research

CLAIRE PATOUILLET

An expert in digital marketing and innovation techniques and technologies, Claire has been working for pharmaceutical companies in France over the last few years. Her main missions are to develop a range of digital health services to complement the ranges of molecules. Claire is a member of the ministerial working group "Ethics by design", within the framework of the "Ethics in digital health" project. As a consultant, she founded the Care shopper Institute agency and is the author of a forthcoming academic book dealing with digital issues and new technologies applied to health.

VINCENT RIEUF

ICEBERG is a studio specialized in Virtual Reality. Using new technologies to give extreme sensations, their goal is to provide the best virtual reality simulators for your projects, Vincent is Lead Designer & UXVR Researcher at ICEBERG

AMAURY SOLIGNAC

A Doctor (Ph. D) in Applied Phylosophy from the Université de Reims, Champagne Ardenne, Graduate from International Space University and a Psychologist from Ecole des Psychologues Praticiens. Amaury is Chief Executive Officer of ICEBERG

PAUL MONNIER

A graduate from Université Paris X Nanterre, Paul is Project Manager and president of the " Défis d'Hommes" Association.

LIONEL MÉTIVIER

A graduate in engineering and information systems integration (Conservatoire National des Arts et Métiers), Lionel Métivier is Director of Internal IS and Methods at Conserto.

MARGUERITE BRAC DE LA PERRIÈRE

Marguerite Brac de La Perrière, a lawyer since 2007, is a specialist in the healthcare sector, in particular digital health. As such, she heads the digital healthcare department that she created in 2011 within the law firm Alain Bensoussan, and is ranked as a key player in this field by the Leaders League. In this sector, she works for all players who process health data, in particular numerous publishers and hosts, but also health institutions, health cooperation groups, and professional unions.

MARIE LEBLANC

Graduated from the École de Design Nantes Atlantique and the Fachhochschule für Gestaltung in Schwäbisch Gmünd (Germany) with a master's degree, Marie Leblanc worked as Industrial Designer in Paris for 15 years in the automotive, railway, electronics, robotics and virtual reality sectors, among others. In 2017, attracted by the VR/AR activities of the companies in the «Laval Valley», she joined the Laval Virtual team as Head of VR/AR Intelligence Services.

NICOLAS RIBEYRE

Graduate of KEDGE Business School (Marseilles), Middlesex University Business School (London) and Marseilles/Aix-en-Provence University, Nicolas Ribeyre was Communications Manager for 18 years in industrial companies in the Oil & Gaz, Supply-Chain, Automotive and Visual Health sectors. Since 2018, he is VR/AR Intelligence Manager at Laval Virtual. Nicolas and his team monitor daily VR/AR uses worldwide in 26 sectors including Healthcare but also robotics, AI, drones and 3D printing. A service available for companies via a Newsfeeds' subscription programme. He is Editor-in-Chief of VR/AR special editions magazines.

ALPHA DIALLO

Alpha Diallo studied Law and Political Sciences at Bordeaux University and then graduated from Angers University with a Master in Competitive Intelligence and Strategy. He joined the Laval Virtual VR/AR Intelligence Dpt. in 2018. This Department reviews more than 4,000 VR/AR sources per week and delivers Newsfeeds for companies willing to keep an opened eye on immersive technologies.

LÉA PAULE

Léa studied History at La Rochelle University and then graduated with a Master degree in the field of tourism and digital. She discovered the world of immersive techniques with Laval Virtual which she joined in 2019 as an editor. She works close to the VR/AR Intelligence Dpt. and the communication team to provide contents for companies and general public.

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Because immersive technologies also contribute to improving the health of your patients, whether you are residents, physiotherapists, surgeons, dentists, nurses, engineers, technicians, hospital managers, clinic directors, psychologists, pharmacists, occupational therapists, nurses' aides, academics, students, training managers or patients: this Laval Virtual magazine is made for you.
Enjoy reading it!

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