

Transforming Medical Education and Training with VR using M.A.G.E.S.

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The problem

Expensive training Model



Master: Educates while working
Apprentice: Builds career & learns while operating
(Estimated Costs: \$48,000 per apprentice per year in OR time alone)

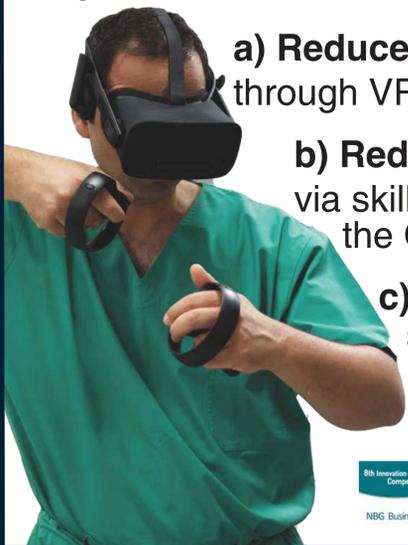
Limited Surgical Simulation



Robotic simulators: expensive, anchored, not for open surgery
(Estimated costs: \$ 150,000 per robotic simulator)

Our solution

The most advanced Virtual Reality (VR) software simulation platform that builds surgical skills based on M.A.G.E.S.



- a) Reduces surgical errors through VR psychomotor training
- b) Reduces training costs via skill transfer from VR to the Operating Room
- c) Democratizes and scales up training



Platform SDK exposing M.A.G.E.S.

Applicable to any gamified, psychomotor training need (e.g. cultural heritage restoration)



References

- George Papagiannakis. 2013. Geometric Algebra Rotors for Skinned Character Animation Blending. In SIGGRAPH Asia 2013 Technical Briefs (SA '13). ACM
- George Papagiannakis, Panos Trahanias, Eustathios Kenanidis, and Eleftherios Tsiroidis. 2018. Psychomotor Surgical Training in Virtual Reality. Springer International Publishing, Cham, 827–830.
- Margarita Papaefthymiou, Dietmar Hildenbrand, and George Papagiannakis. 2016. An inclusive Conformal Geometric Algebra GPU animation interpolation and deformation algorithm. The Visual Computer 32, 6 (01 Jun 2016), 751–759.

Our novel technology: M.A.G.E.S.

Multi-player, shared virtual collaborative operating room

Our innovative networking layer, allows cooperative operations.

Our Custom **Conformal Geometric Algebra** (CGA) GPU interpolation engine groups transformations under a single mathematical framework:

$$T = 1 - \frac{1}{2}te_{\infty} \quad R = e^{-b\frac{\phi}{2}} \quad D = 1 + \frac{1-d}{1+d}e_{\infty}^{\wedge}e_0$$

New character vertex position = $T * R * D$

- ✓ Network data transfer
- ✓ Interpolation quality
- ✓ 7+ simultaneous users



Analytics engine with cloud-based assessment



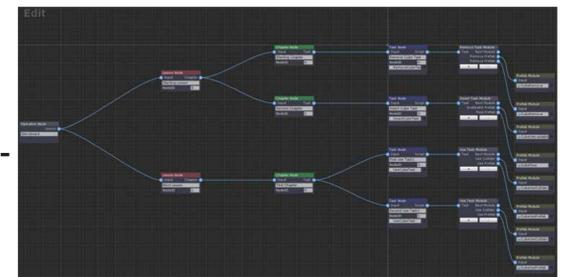
Another novelty is our own Analytics engine with **cloud-based user assessment** to track, monitor and present important feedback regarding each gamified operation.

- ✓ Unlimited user event tracking and analysis

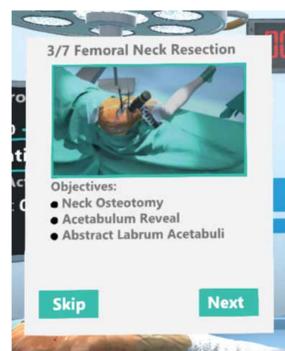
Gamified rapid prototyping

Medical operations can be **modeled, modified** and **generated** through scriptable nodes using our custom visual scripting editor.

- ✓ Coding-free SDK
- ✓ Content creation



Educational Curriculum



Our products integrate an educational curriculum to **enhance knowledge and skills**.

- ✓ Adaptive visual guidance
- ✓ Gamification elements
- ✓ Curriculum Objectives
- ✓ Live webinar support
- ✓ Scoring system

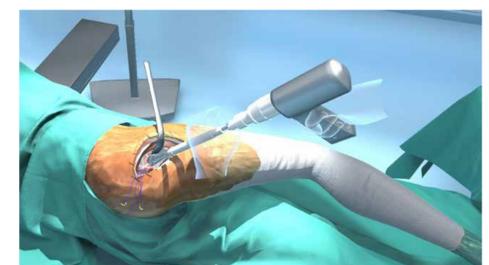


Semantic Representation of Medical Operations

By **prototyping commonly used patterns** and surgical techniques we managed to create a **customizable platform** able to populate new content with minimal changes.



Total Knee Arthroplasty



Total Hip Arthroplasty