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THE 31st IEEE CONFERENCE ON VIRTUAL REALITY AND 3D USER INTERFACES

Future of Surgical Mixed Reality: Cutting-Edge or Cutting Too Deep

Talha Khan

Edward Andrews

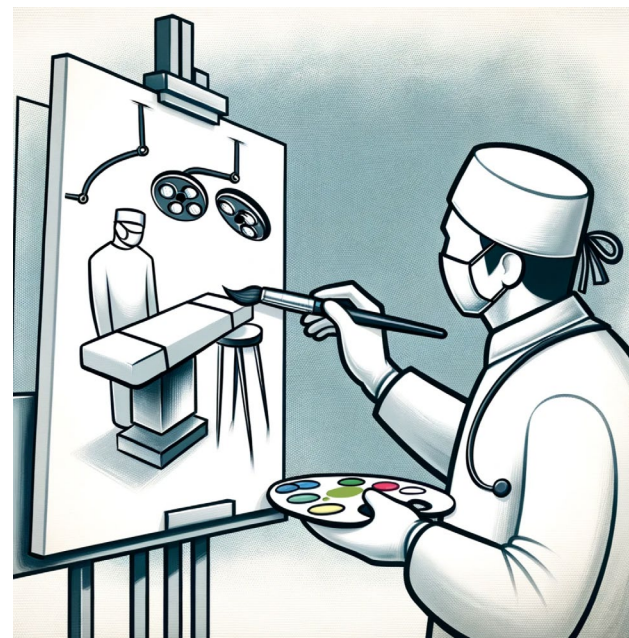
Jacob Biehl





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Let's paint a picture!





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The Operating Room





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The Operating Room

Endoscope display





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The Operating Room



Endoscope display

Image guidance



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The Operating Room



Image guidance

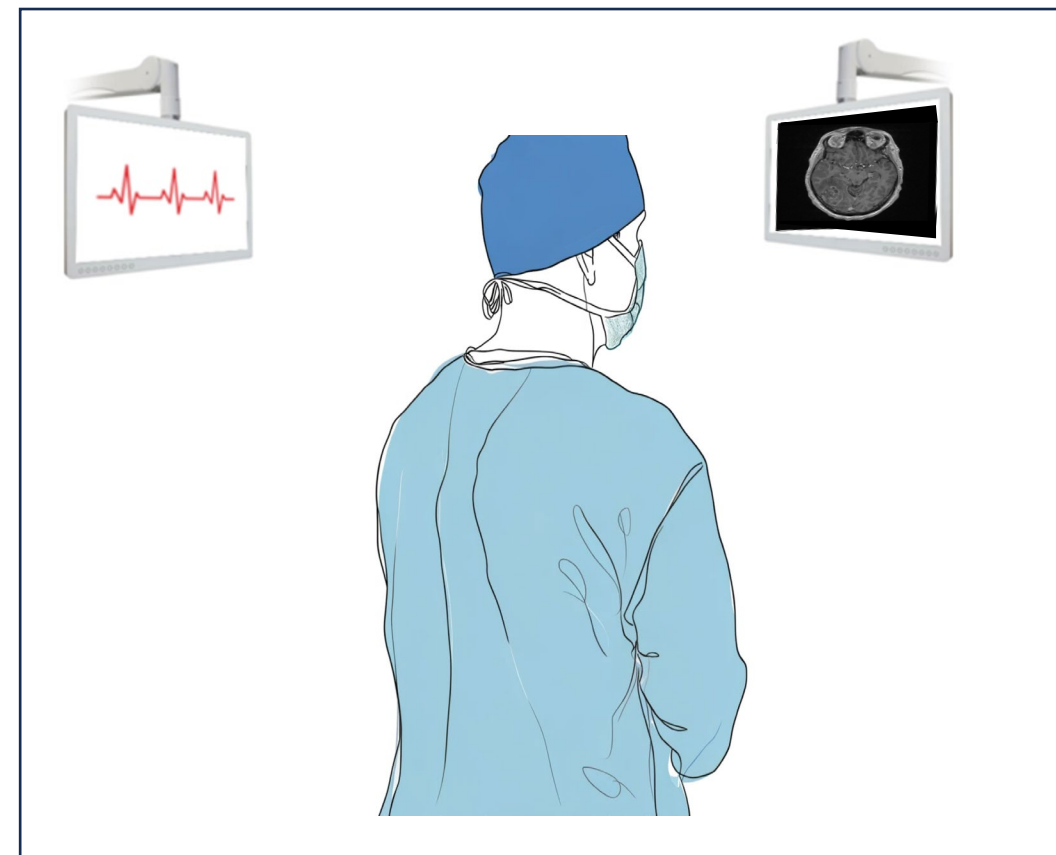
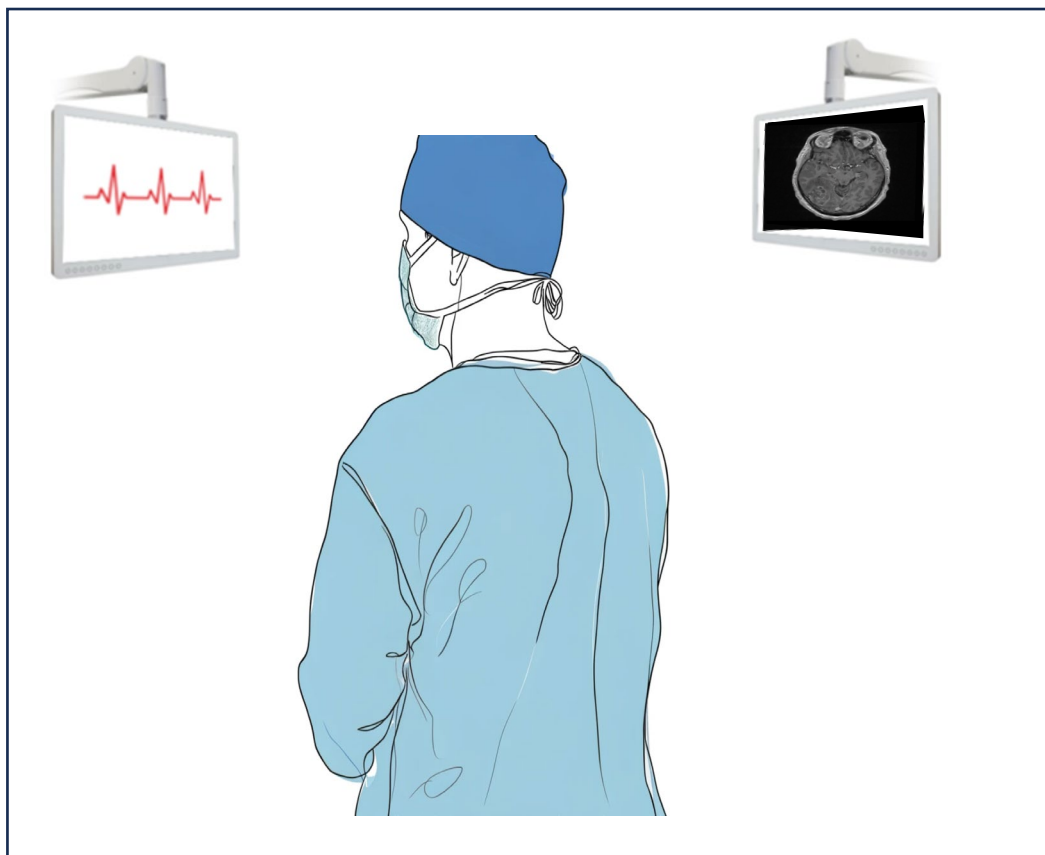
Endoscope display

Vital signs



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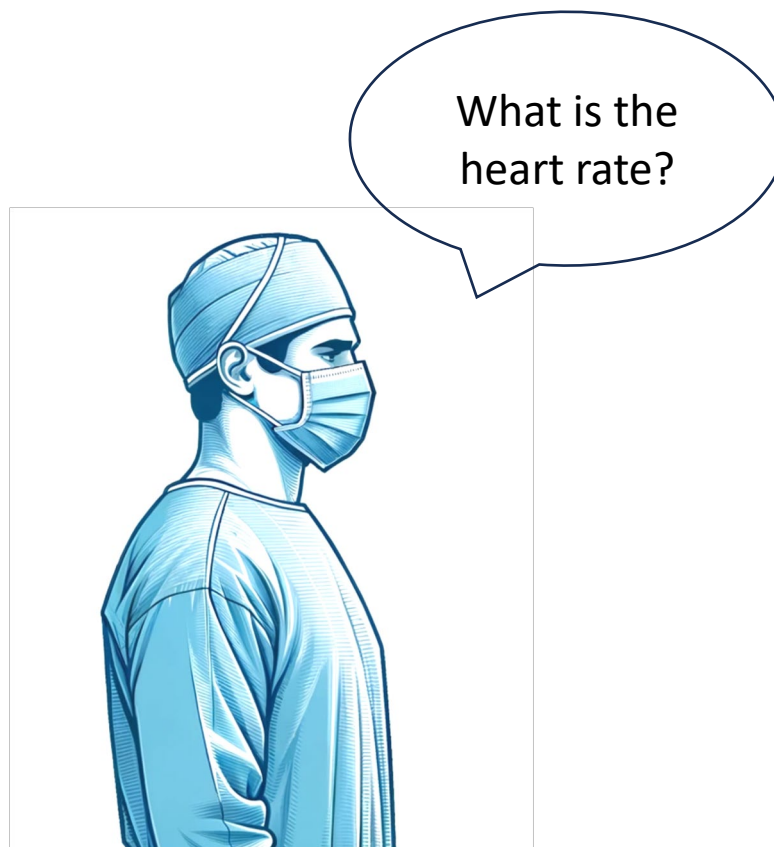
Constant Shift of Attention





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Second-hand Information

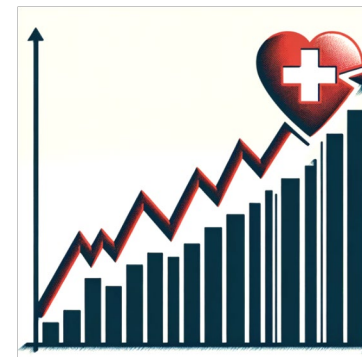




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Pitfalls

- Higher costs
 - Average OR cost per hour is about \$2200 [1]



[1] Childers & Gibbons (2018) JAMA



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Pitfalls

- Higher costs
 - Average OR cost per hour is about \$2200 [1]
- Injury
 - 80% of surgeons suffer work related injury [2]



[1] Childers & Gibbons (2018) JAMA
[2] Schlussek et al. (2019) CCRS



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Pitfalls

- Higher costs
 - Average OR cost per hour is about **\$2200** [1]
- Injury
 - 80% of surgeons suffer work related injury [2]
 - 11% result in chronic issues [2]



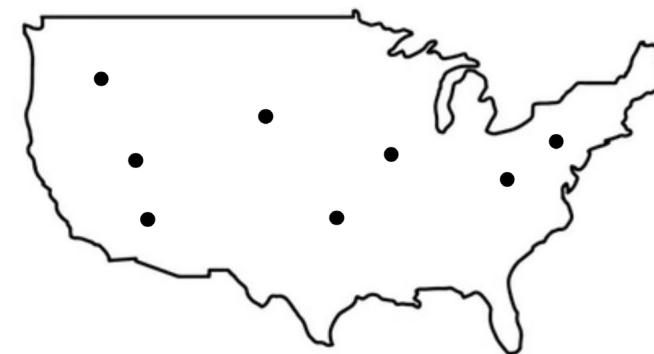
[1] Childers & Gibbons (2018) JAMA
[2] Schlüssel et al. (2019) CCRS



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Alarming Situation

- Scarcity of surgeons
 - 1 neurosurgeon per 66,000 people [1]
 - ~5000 neurosurgeons



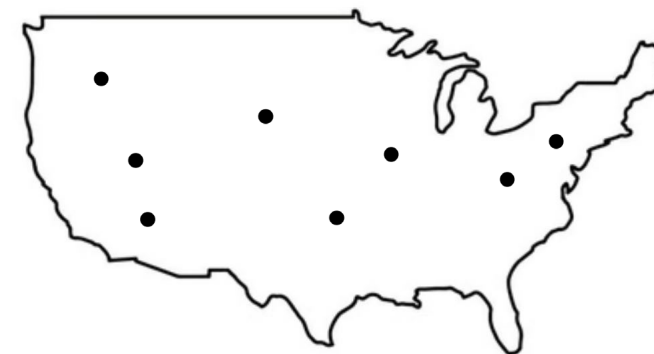
[1] Judy et al. (2013) *Neurosurgery*



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Alarming Situation

- Scarcity of Surgeons
 - 1 neurosurgeon per 66,000 people [1]
 - ~5000 neurosurgeons
- Decline in workforce
 - Productivity needs to increase by **61%** by 2030 [2]

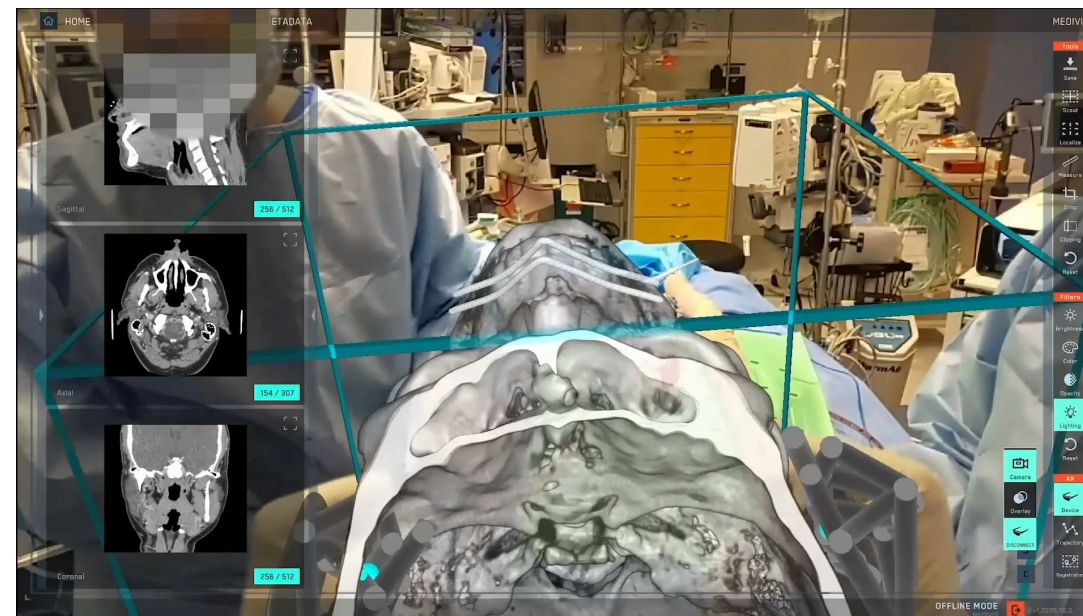
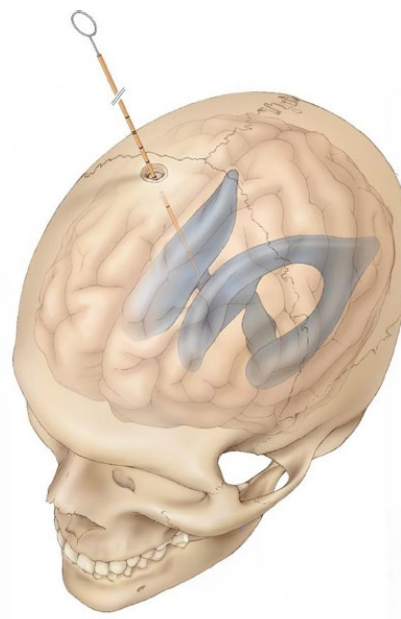


[1] Judy et al. (2013) *Neurosurgery*
[2] Oslock et al. (2022) *AJS*



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MR in the OR: Image Guidance





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MR in the OR: Holographic Displays





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Limited Real-world Evaluation

- Contrived lab studies

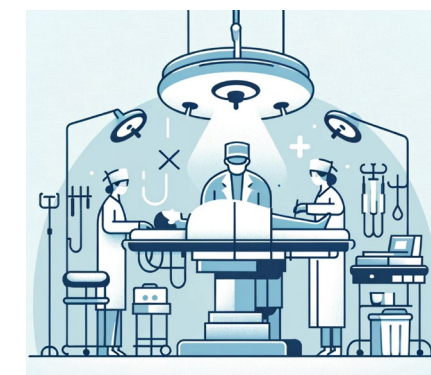




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Limited Real-world Evaluation

- Contrived lab studies
- Lack of clinical trials





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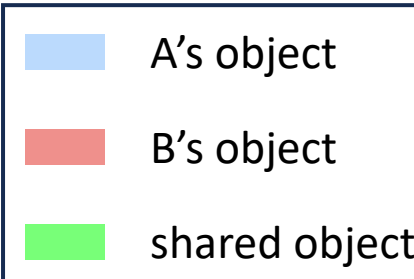
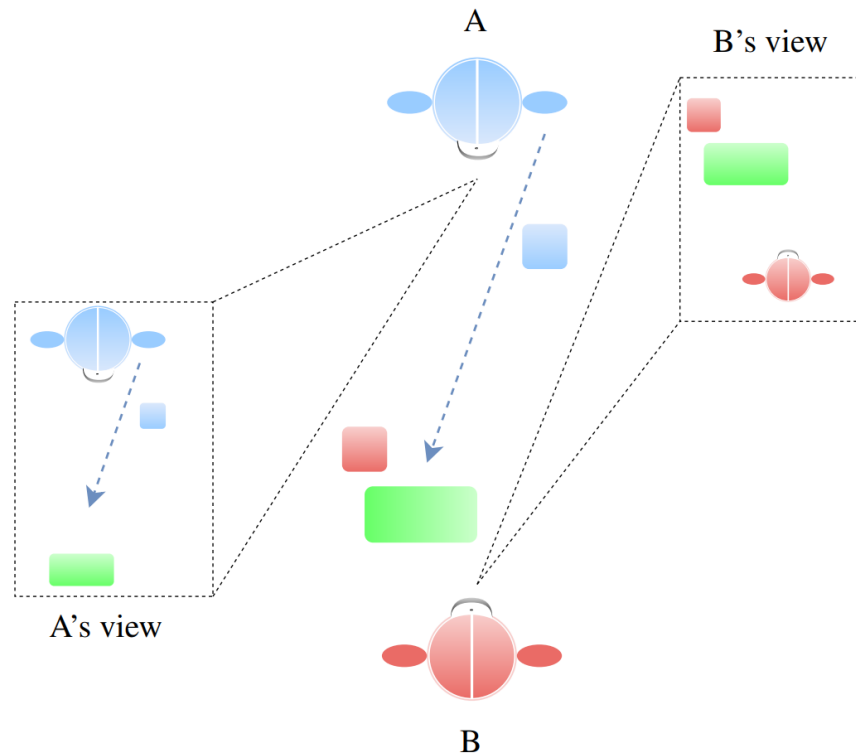
Hardware Limitations

- Gap of several orders of magnitude

Metric	Varjo XR-4	Ideal VR	HoloLens 2	Ideal AR
Weight (grams)	1011	100 – 200	566	10's
Field-of-view (degrees)	120 x 105	165 x 175	52 diagonal	165 x 175
Power (W)	N/A	1-2	> 7	0.1 – 0.2
Resolution (MPixels)	15.7	200	4.4	200

[1] Huzaifa et al. (2022) *IEEE Micro*

Affordances and Caveats: Establishing Awareness





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What's the future?

- Potential to revolutionize current surgical practice



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What's the future?

- Potential to revolutionize current surgical practice
- Small incremental steps



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What's the future?

- Potential to revolutionize current surgical practice
- Small incremental steps
- Must act quick

Thank you!



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