ACM Mile High Video 2022 – Video Streaming 5

Enabling the Immersive Display A New Paradigm for Content Distribution

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Agenda

1. Evolution of display systems and paradigms
2. Market appetite for better experiences
3. Emerging advanced imaging displays: 2D forever?
4. Media formats?
5. Emerging challenges and paradigm shifts

A history of display systems and related paradigms

Display systems circa 1940's

- Number of horizontal scan lines
  - First real standards "war"
- Over the air broadcast only
- Black and white only
- 2D raster signals

Display systems circa early 1990's

- Color
- Displays used with PC's, laptops
- 2D raster signals
- Standard definition
- Start development of digital formats
- Broadcast, cable, satellite, storage-based solutions
- Start transition from analog to digital

Display systems 2000 – 2020

- UHD, HDR, HFR, deeper pixels
- Standards-based digital formats
- 2D Raster-based signals
- Broadcast, cable, satellite, cellular
- IP-based, ABR
- Interactive games

Content distribution's immutable paradigms

- Media is raster-based
- Visual media is "video"
- The scene is the frame
- Discrete and limited views (<50)
- Distribution targets the video decoder
- Standards → Renderer is "out of scope"
- Displays are homogeneous
- Displays are positioned on vertical axis.

Market appetite for better (immersive) experiences

80 years in the making

What is the “take away?”

Feature	Win?	Fail?

Feature	Win?	Fail?
COLOR TV		

Feature	Win?	Fail?
COLOR TV	✓	

Feature	Win?	Fail?
COLOR TV	✓	
Increased resolution		

Feature	Win?	Fail?
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Increased resolution	✓	

Feature	Win?	Fail?
COLOR TV	✓	
Increased resolution	✓	
High Dynamic Range		

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Larger Screen Sizes		

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Larger Screen Sizes	✓	
Mobile		

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Mobile	✓	
On-demand vs. broadcast only		

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On-demand vs. broadcast only	✓	

Feature	Win?	Fail?
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Mobile	✓	
On-demand vs. broadcast only	✓	
3D		

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High Dynamic Range	✓	
Larger Screen Sizes	✓	
Mobile	✓	
On-demand vs. broadcast only	✓	
3D		✓

Take aways from 80 years of experience

- Users want to choose when they consume the media
- Users want to create & share their own media to tell their own stories
- Users want the choice to engage with media
  - Increases user agency and emotional responses
  - Create/use personal avatars
- **Users want visual experience to be consistent with how we visually experience the real world**

What more do users want?

Why 3D has failed (so far)

READ THE PAPER

Visual cues essential for depth

Physical

- Accommodation
- Convergence
- Motion parallax
- Binocular disparity

Addressed by the DISPLAY!

Psychological

- Linear perspective
- Occlusions
- Shading
- Texture
- Prior knowledge

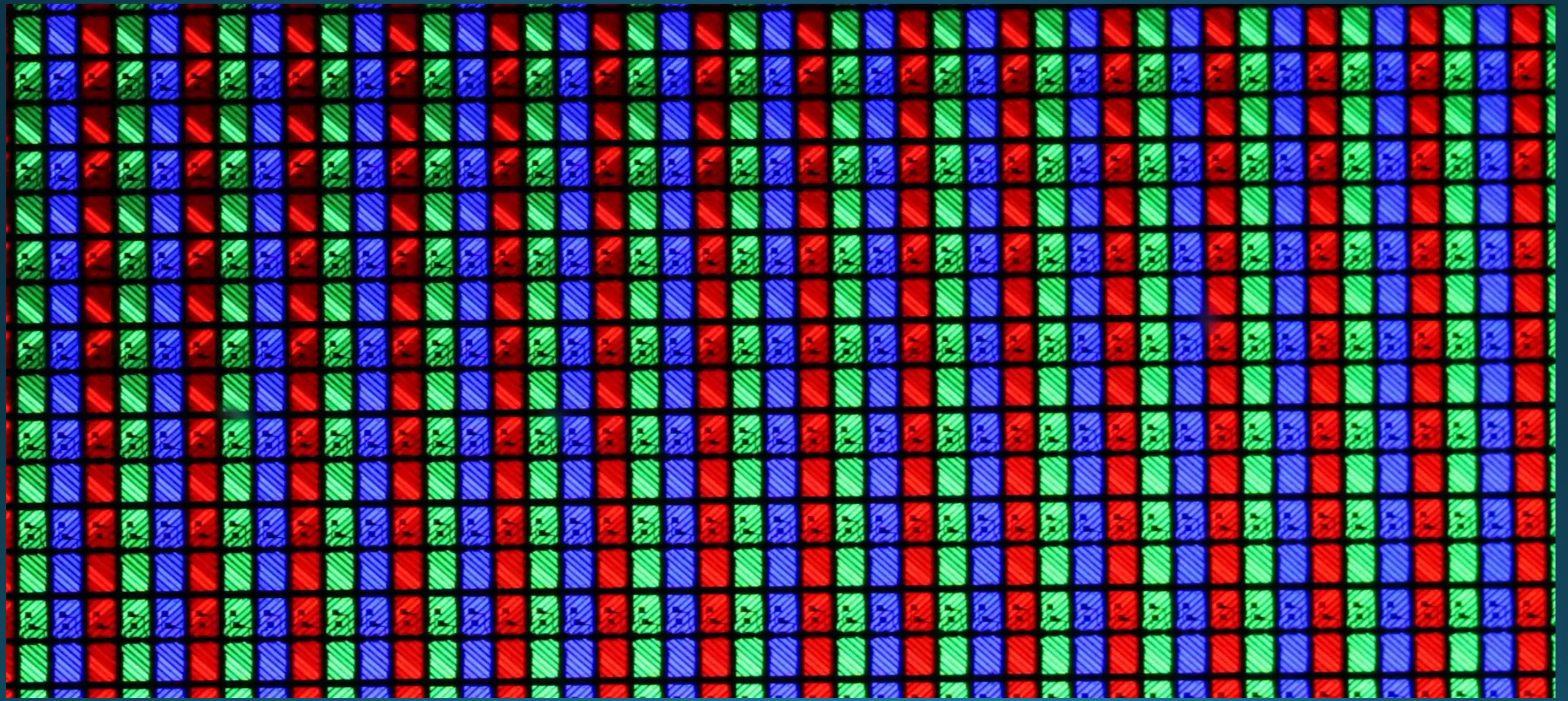
Addressed by the MEDIA!

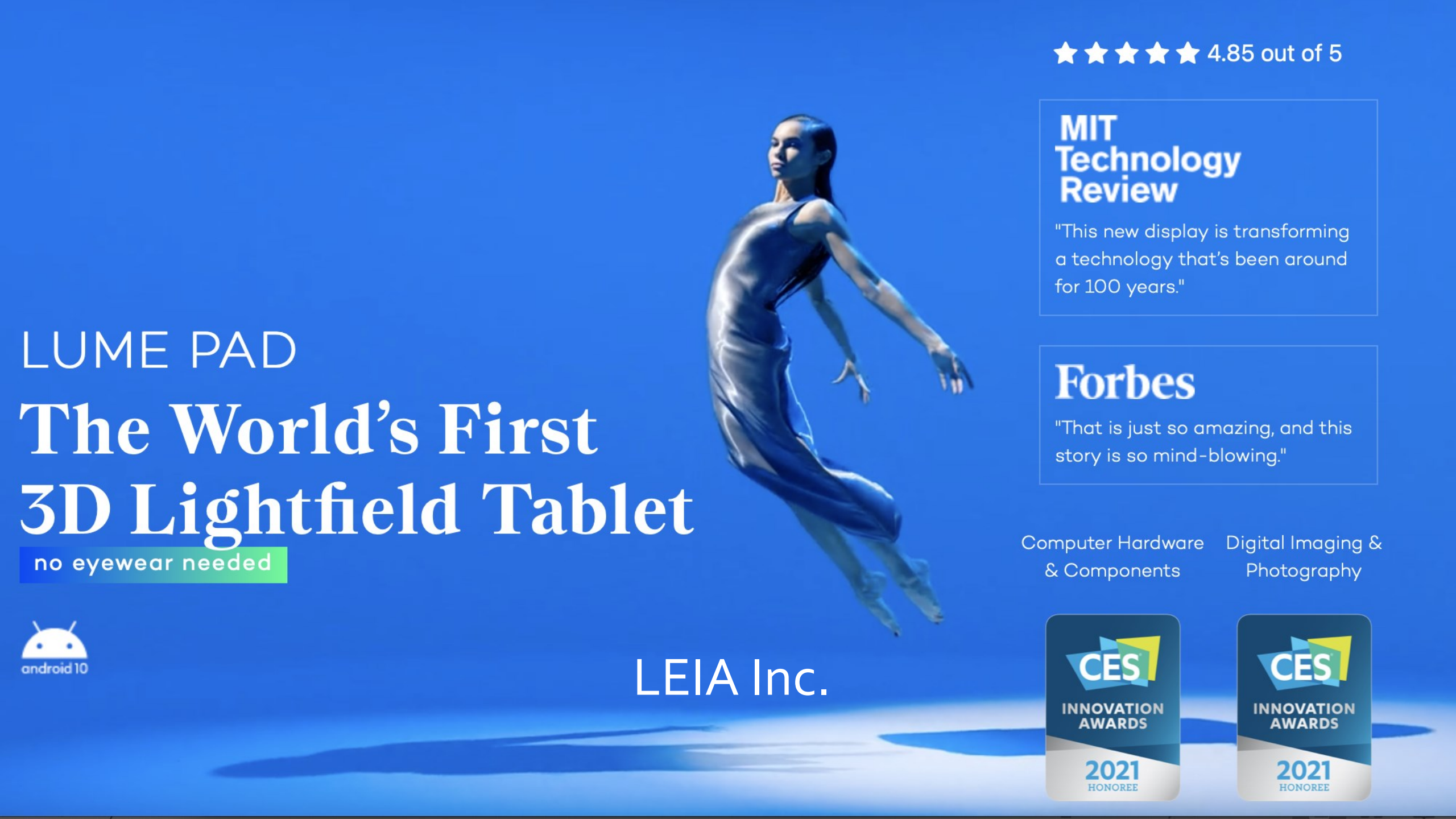
Emerging advanced imaging displays

Two essential questions

- Does the display manufacturing process use today's commercially available screens?
- How many discrete views does the display create?

Screen-based (4K or 8K) technology




4.85 out of 5
MIT Technology Review
"This new display is transforming a technology that's been around for 100 years."
Forbes
"That is just so amazing, and this story is so mind-blowing."
LUME PAD
The World's First 3D Lightfield Tablet
no eyewear needed
android 10
LEIA Inc.
Computer Hardware & Components
Digital Imaging & Photography
CES INNOVATION AWARDS 2021 HONOREE
CES INNOVATION AWARDS 2021 HONOREE

Sony Spatial Reality 3D Display

Looking Glass Factory

DIMENCO

We developed the World's Most Advanced 3D Display Technology.

Natural interaction. No Wearables required.

Natural Interaction

No Wearables

For all 3D content

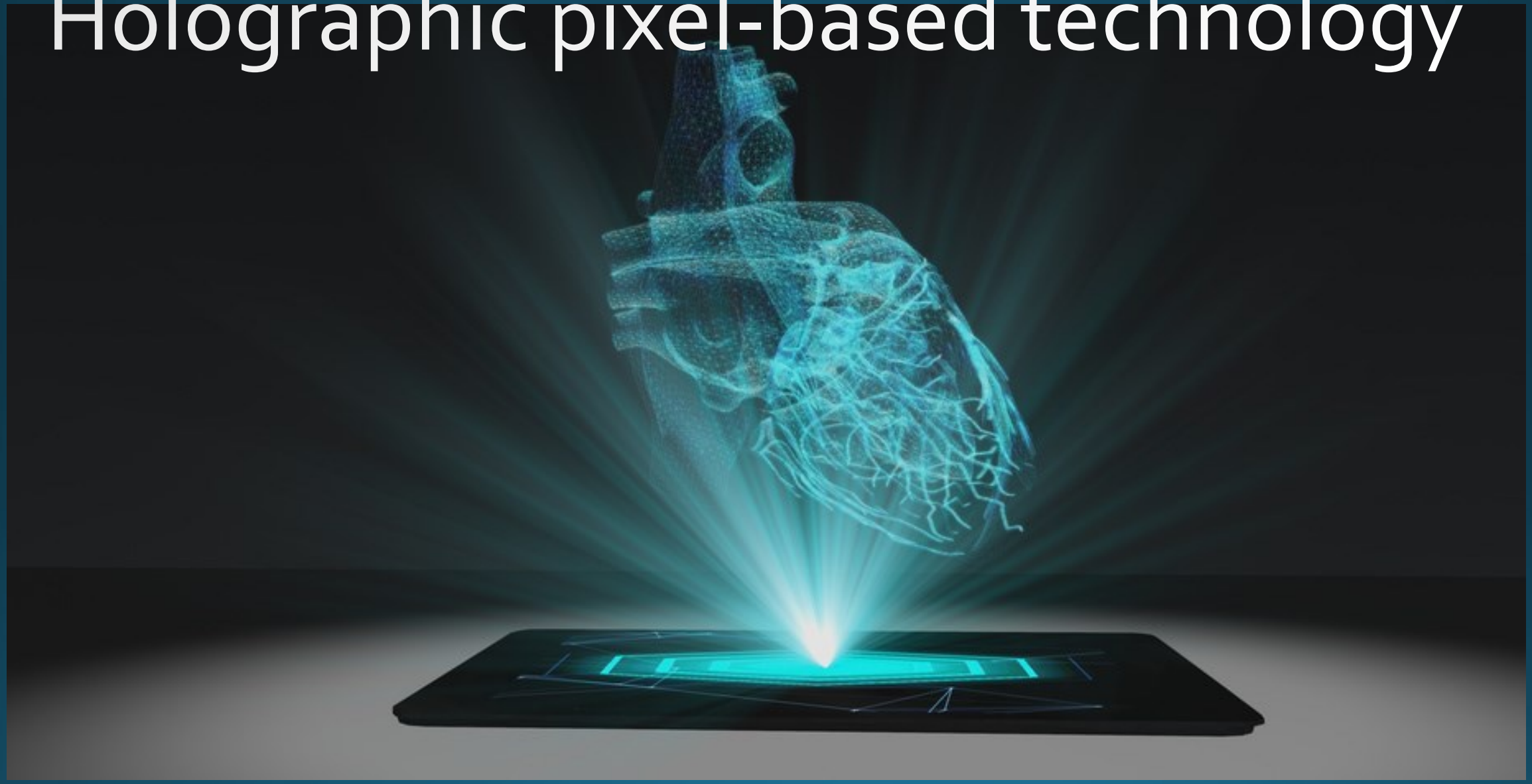
BUILT ON SR

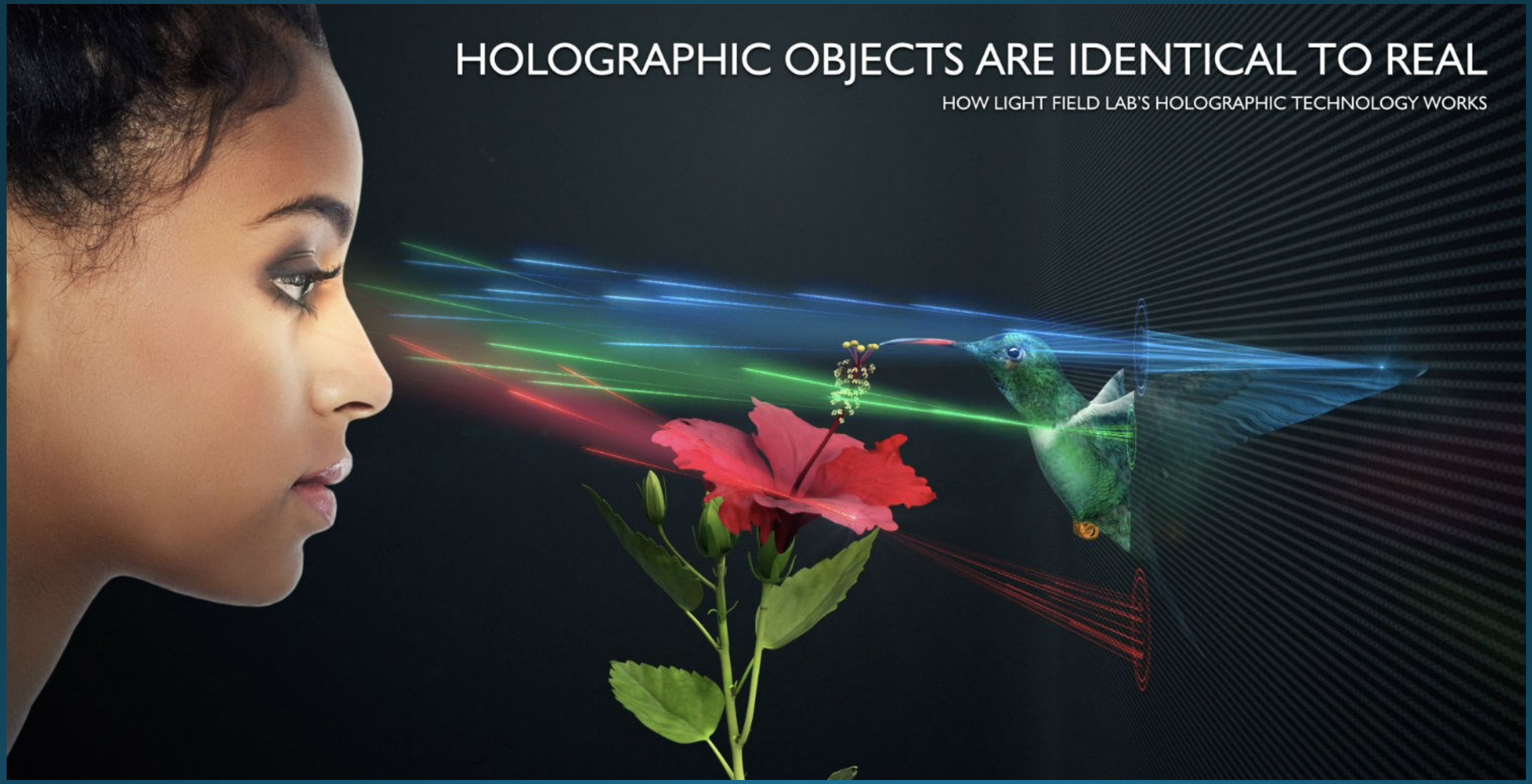
The Simulated Reality Display Module.

Fully developed Light Field 3D Display Technology ready to be implemented by Original Equipment Manufacturers. (OEM)

Get the latest updates and find out what's possible in Simulated Reality 3D display technology.

Holographic pixel-based technology





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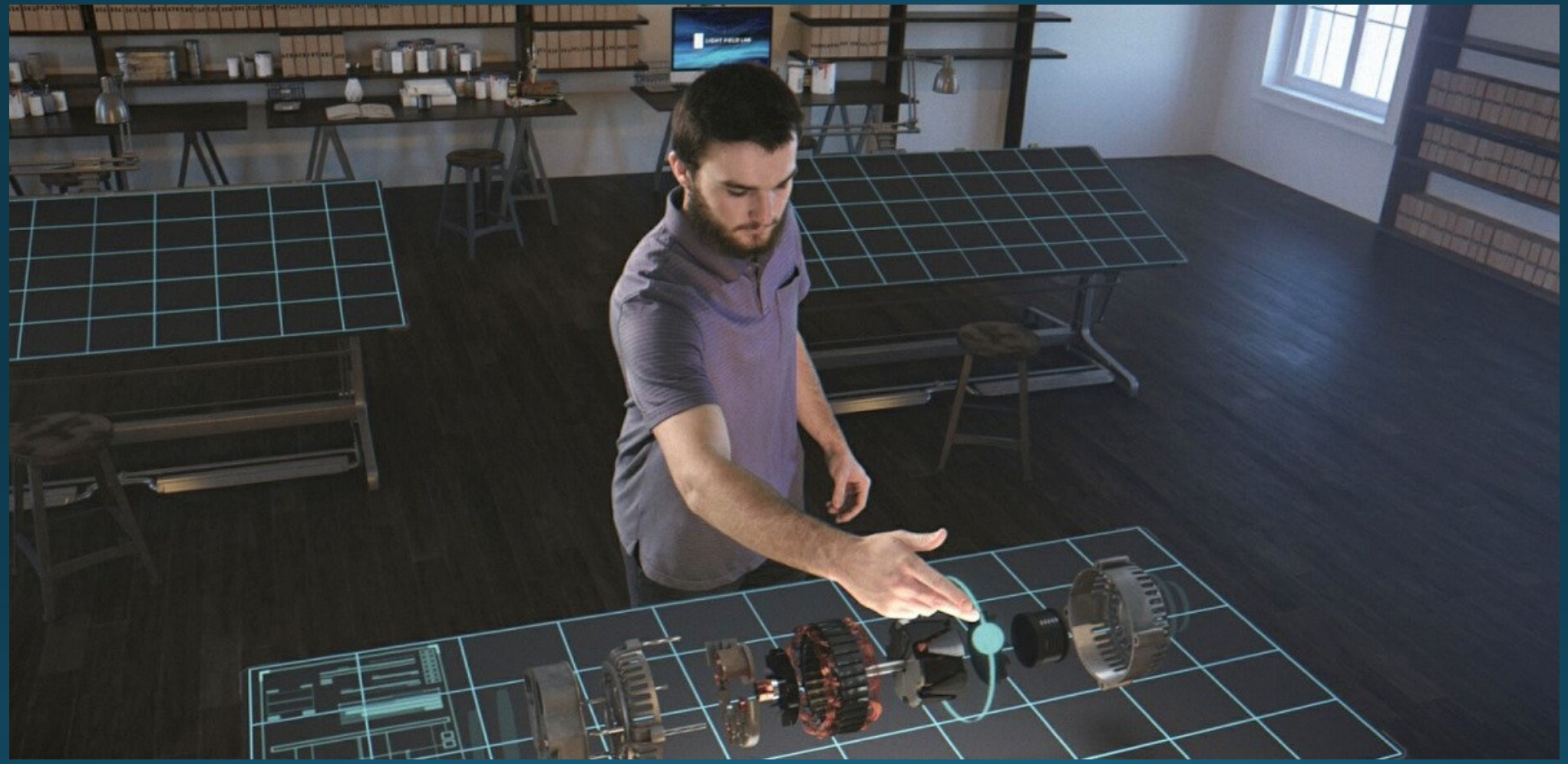

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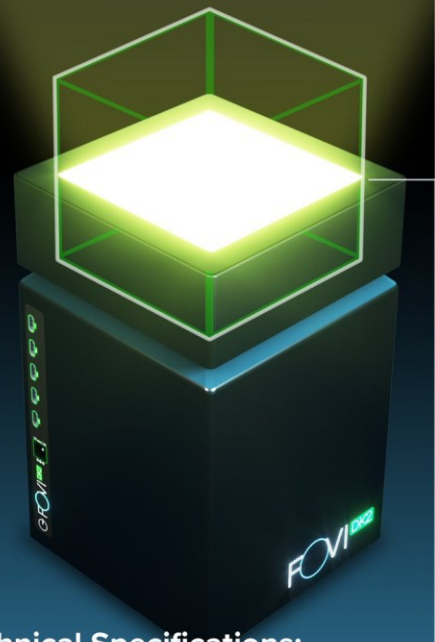
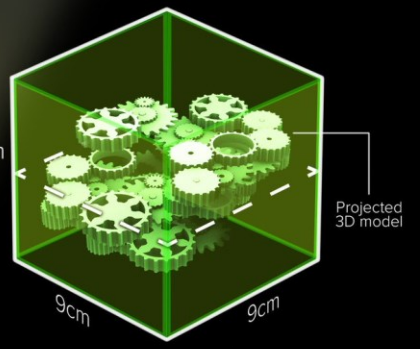
Light Field Displays

Image Credit: Avalon Holographics, Inc.

FOVI3D

DevKit 2 Final Lens Design





729 cubic centimeters of active 3D light field display volume projection

60° FOV

Wide hogel field of view with high angular resolution projects 3D scene

Hogel
3D pixel

0.5mm hogel diameter
180 x 180 hogel display
50 x 50 views per hogel

Technical Specifications:

- Enclosure dimensions
  W: 15.5cm H: 22cm D: 15.5cm
- Display Interface:
  - Raw hogel stream API
  - ObjGL with FoVI3D renderer
- 9cm x 9cm x 9cm active light field volume
- 60° field of view
- 0.5mm hogel diameter
- 180 x 180 hogel display
- 50 x 50 views per hogel
- Five USB 3.1 Gen2
- Power: 120/240Vac, 75W

Number of unique views?

2D panel	One single view
VR HMD	Two views (left & right eyes)
Leia tablet	Four separate views
AR glasses	Six to eight views
Looking Glass Factory 8K display	45 separate views
Looking Glass Factory Portrait	45 to 100 separate views
Avalon Holographic Display	Several thousands+ of views
Light field lab display	Several thousands+ of views

How many unique views can raster support?

Raster media

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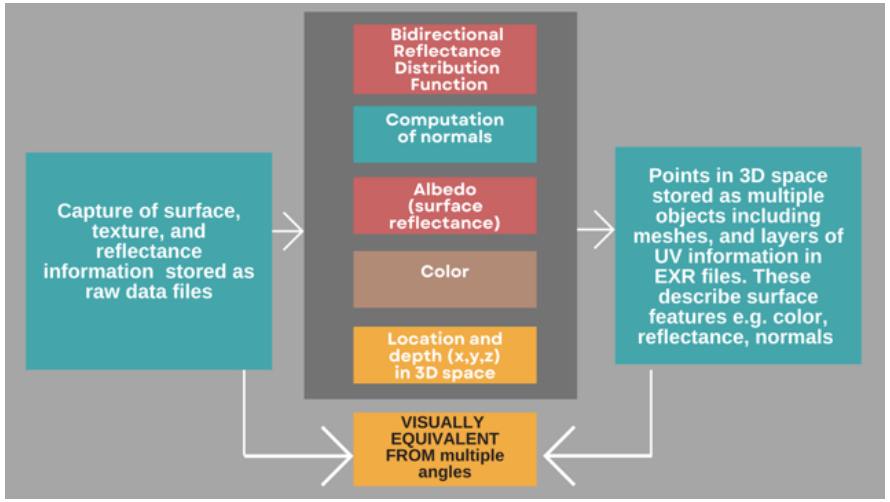
Synthetic media

Synthetic media

CGI-based



- TARGET the renderer!
- Segment the objects from the scene
- Use a ROBUST scene graph
- ALL popular 3D media types
- EXPLICIT geometry for each object
- Surface properties of each object
- Material properties of each object

ITMF approach

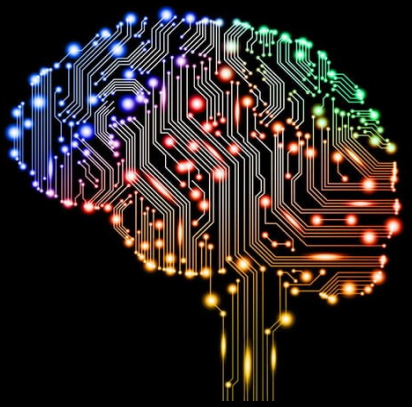
ITMF aims to address these requirements

Computer Graphics

Volumetric

Light Field Array

AI and Computational Photography



Immersive Technology Media Format

Display-Agnostic Approach

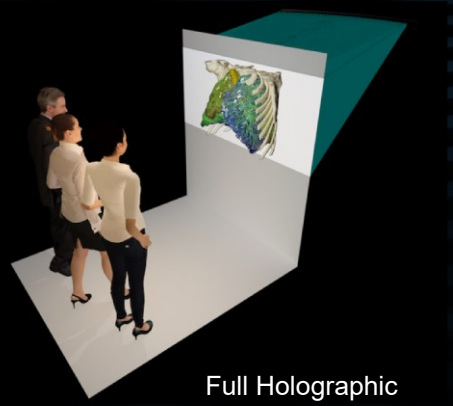
IMMERSIVE DIGITAL EXPERIENCES ALLIANCE

IDEA's vision:

Immersive
Technology
Media Format

ITMF
Scene Graph
File or Stream

Media-Aware Network + Display-Specific Renderer



Full Holographic Light Field Display

Multifocal head-mounted Display

VR head-mounted Display

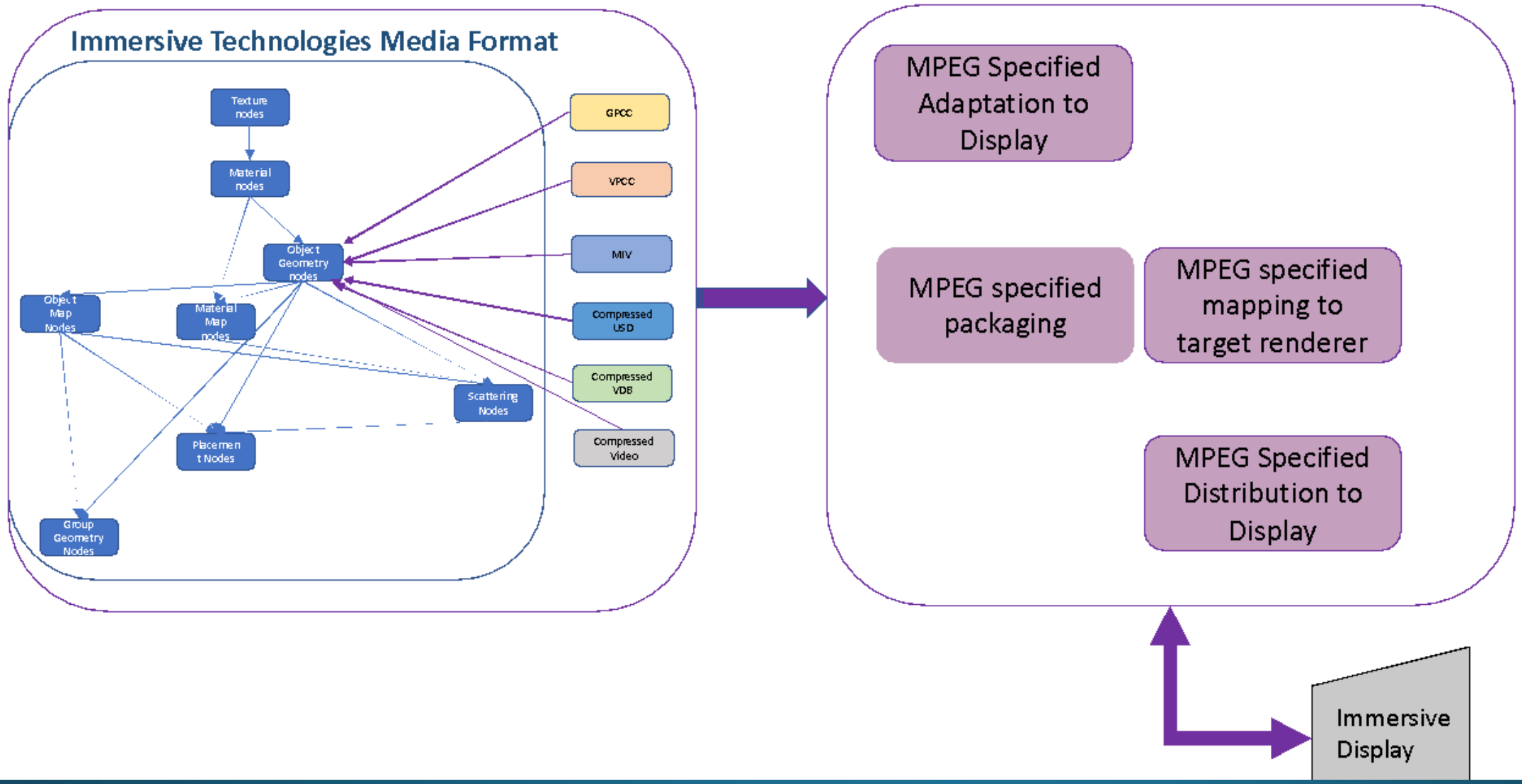
3D Stereo Display

Legacy 2D Displays

MPEG-render group + IDEA ITMF

- **ALL emerging immersive displays support Unity or Unreal Engine**
- Build standards to stream directly to Unity or Unreal Engine
- **TARGET the renderer**
- MPEG-I Part 28 maps ITMF to Unreal Engine
- Unreal Engine recommended as starting point by studios.

Immersive Technologies Media Format + MPEG specified extensions



Conclusions

- Paradigm shifts to support immersive displays
- Emerging displays are no longer homogeneous
- MPEG and IDEA collaborating to build MPEG standards
- ITMF supports ALL popular 3D formats
- MPEG-I Part 28 the first of several standards to stream media directly to Unreal Engine and Unity
- Continue to send “video” to “legacy” displays.
- Raster formats less efficient than sending synthetic formats (read the paper)

Call to Action

- Join MPEG
- Join MPEG-render Ad hoc Group
- Join IDEA

Thank you
Questions?