Designing VR Systems for Semiconductor Microfabrication

WAYNE STATE
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Winter 2024

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Presentation Outline:

- Opportunity and Significance
  - Why use VR?
  - Addressing Challenges in the Semiconductor Industry
- Technical Objectives and Results
- Challenges and Future Development
  - Wayne State University
  - Opportunities for Commercialization
- Q/A?
- Sources Cited

Opportunity and Significance:

Bridging the Gap in Semiconductor Education through Virtual Reality

- Enhancing technical training and learning with VR technology.
- Addressing the semiconductor industry's skill shortage in Michigan, US.
- Using VR as a cost-effective training solution.
- Preparing a workforce for an innovating, growing sector.

[2]

What is VR? What is AR? VR Industry protocols

Advancements in personal computing and virtual reality technology have led to commercially accessible, hign. .,nbh-quality VR headsets

Why VR?

Advancements in personal computing and virtual reality technology have led to commercially accessible, high-quality VR headsets and hardware.

VR offers an immersive experience, enhances engagement and retention by simulating real-world environments.

VR training has been successfully adopted at various companies.[3]

UPS Employee completing VR work training using the HTC VIVE Pro 2 headset[4] :

Addressing Challenges in the Semiconductor Industry

High Costs of Traditional Cleanroom Training:

Traditional Cleanroom training is expensive, high cost to maintain sterile conditions and to handle sensitive materials.

- Contamination can result in costly damages, lower wafer yield, and delay production.
- Availability of cleanrooms for training is limited, may restrict the flexibility of training sessions.

VR as our Solution:

VR training modules simulate the cleanroom environment without the associated costs.

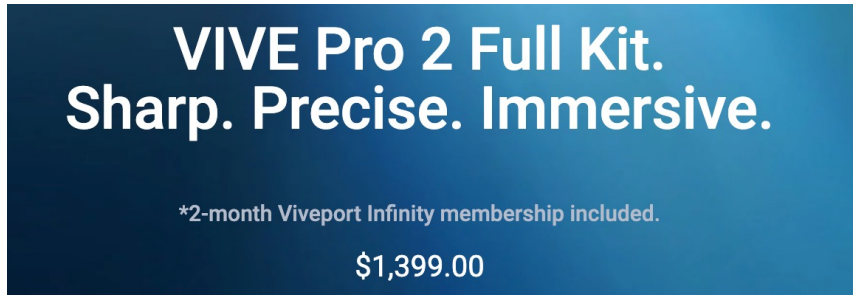
- Interactive experience that can improve learning outcomes and skill retention.

Cost-Effectiveness:

VR offers a one-time investment in hardware and software development, after which the training can be iterated and scaled to an unlimited number of participants at no additional cost.

Price of 2-day cleanroom training online course vs. price of hardware used:

[5]



Addressing Challenges in the Semiconductor Industry

By 2030, more than one million additional skilled workers will be needed to meet demand in the semiconductor industry.

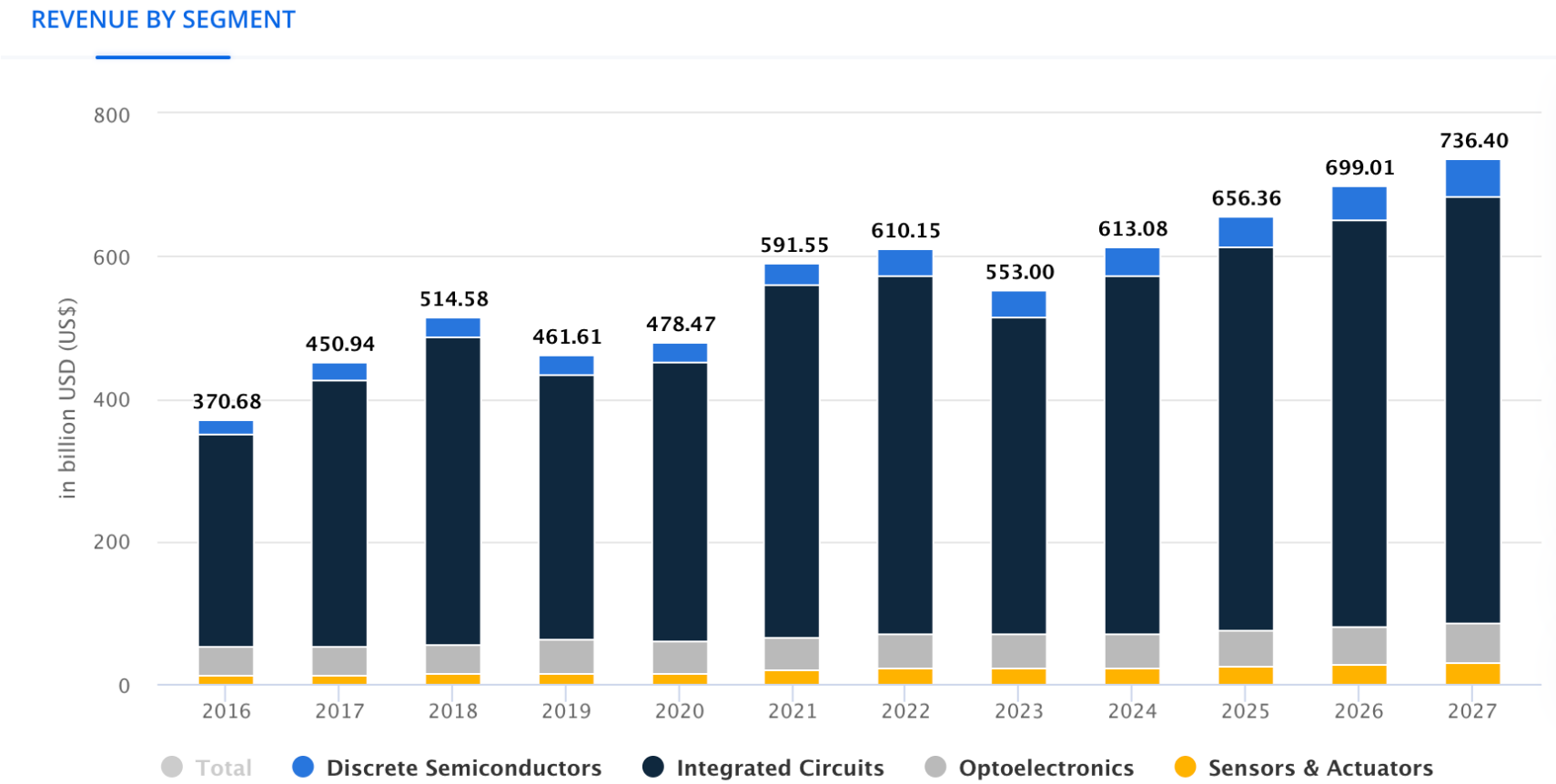
- Michigan's projected growth in semiconductor fabrication will require a well-trained workforce.

Michigan's semiconductor workforce ranks among the top ten in the nation, with job growth projected to grow by at least 11% in the next five years. [6]

CHIPS Act:
"Bolster U.S. leadership in semiconductors. The CHIPS and Science Act provides $52.7 billion for American semiconductor research, development, manufacturing, and workforce development. This includes $39 billion in manufacturing incentives." [7]

Addressing Challenges in the Semiconductor Industry

Growth trends and projections for the global semiconductor industry:



Notes: Data shown is using current exchange rates and reflects market impacts of the Russia-Ukraine war.

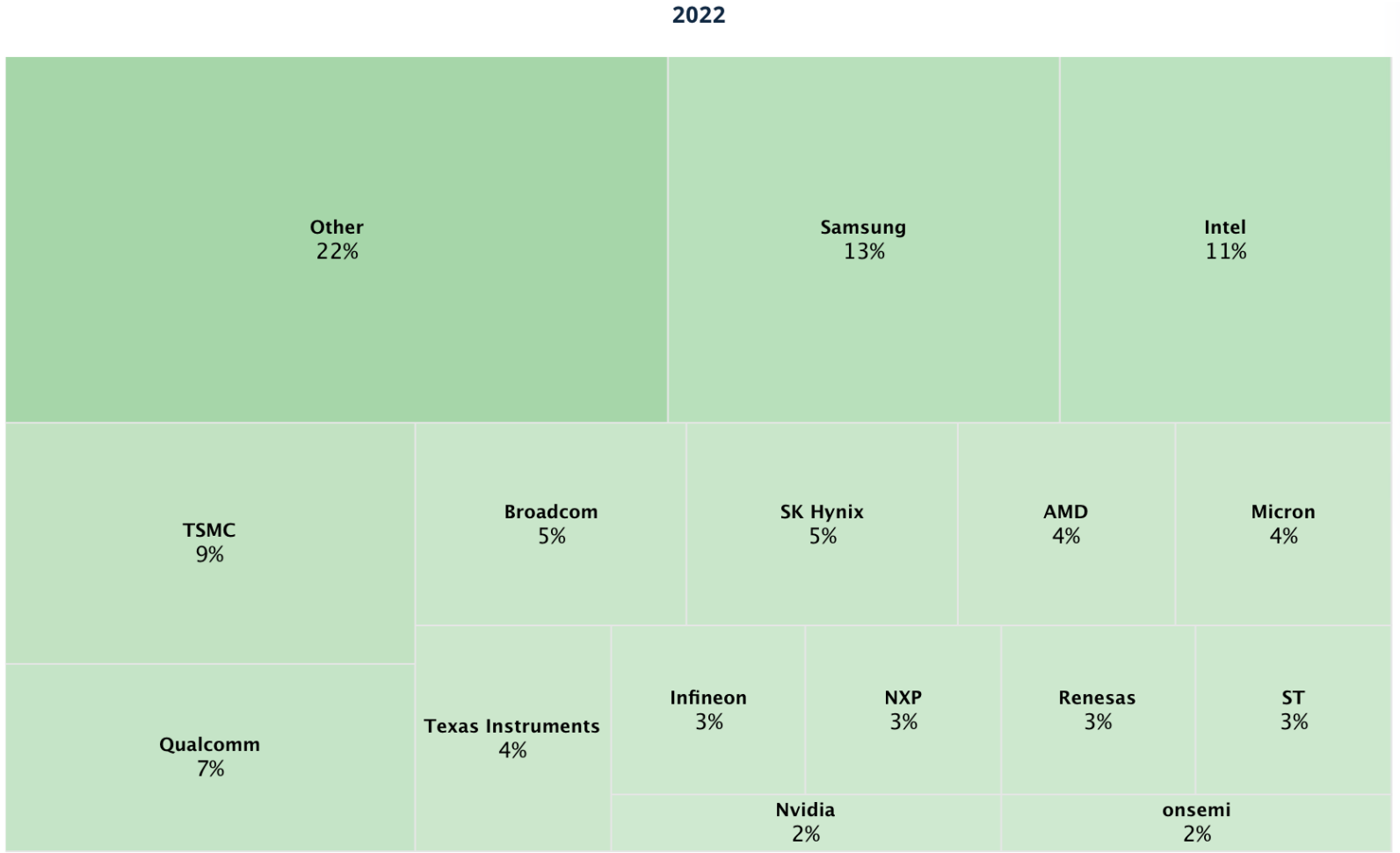
Most recent update: Aug 2023

Source: Statista Market Insights

[8]

Addressing Challenges in the Semiconductor Industry

Market Control of Major global foundries:



Most recent update: Nov 2023

Source: Statista Market Insights

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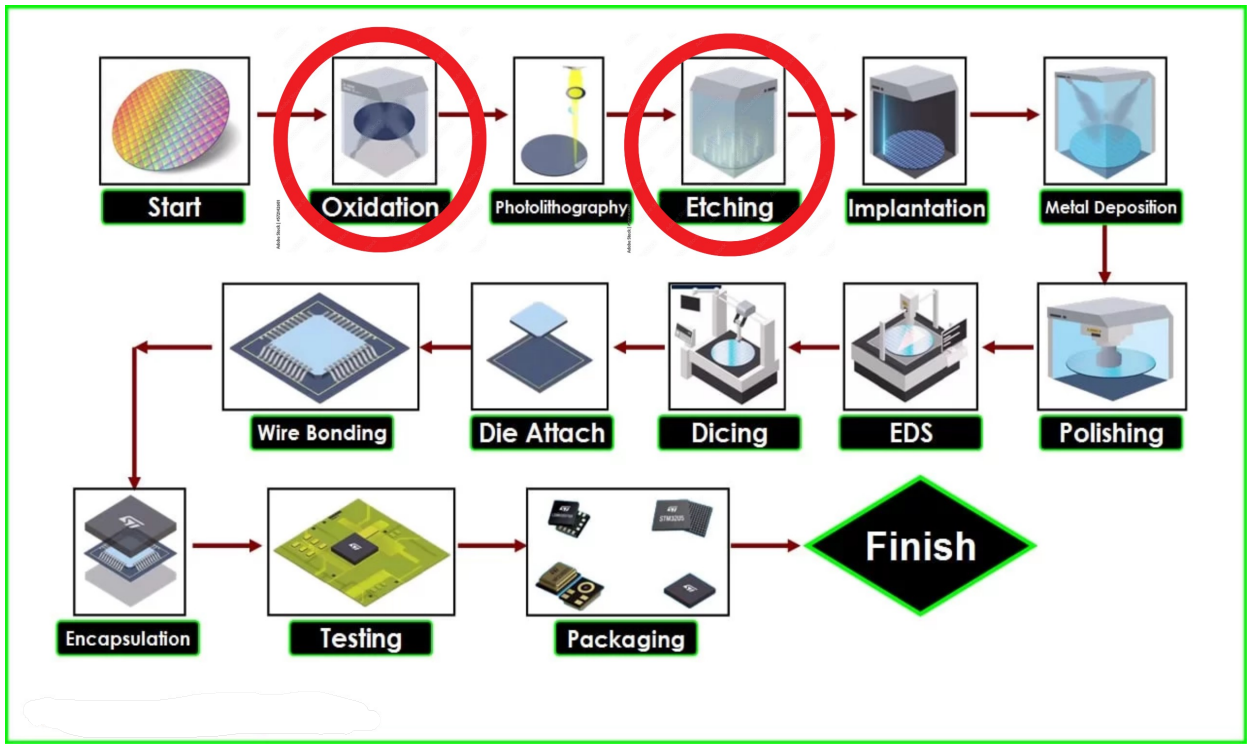
Technical Objectives & Methodology

<u>Our Starting Goal:</u>
Create a VR environment that simulates certain steps in the overall silicon microfabrication process, and closely mirrors what could be achieved at WSU facilities.

<u>Specifying Our Focus:</u>
Our end-product accomplishes the following four processes:

- Cleanroom gowning procedure
- SiO_2 oxidation
- BHF wet etching
- Dry etching



Components and Tools Used:

- VIVE Pro 2 Full Kit (Controllers, Sensors, pictured)
- A strong computer/GPU!
- Unity 2019 Game Engine Software Development Tools
- Open-Source Development packages:
  - SteamVR and OpenXR

Unity

STEAMVR™

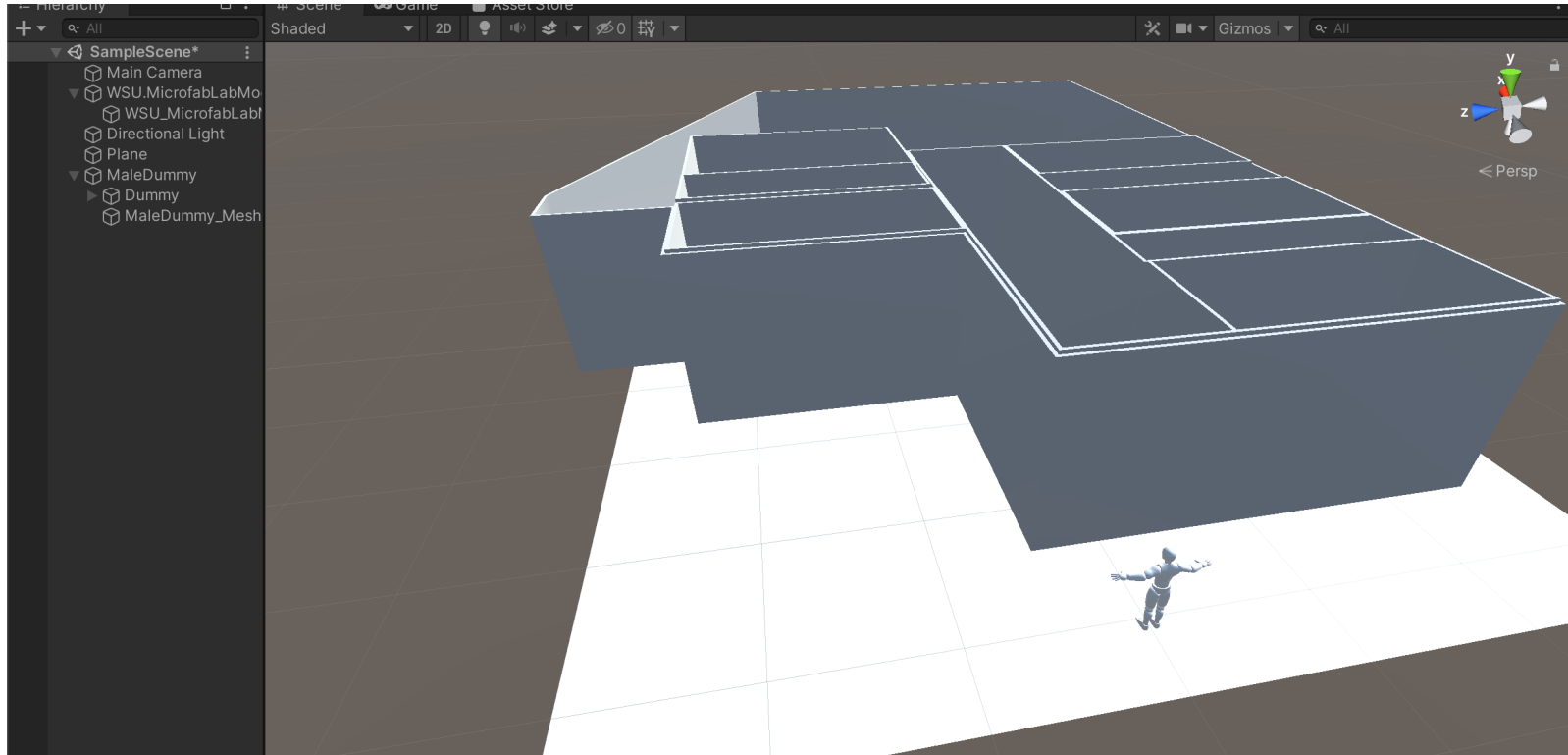
Modeling Wayne State's microfabrication lab:

nFab: 5000 sqft clean room for micro and nanofabrication

- **Wet Etching Bay**
  - Wet chemical etching Bays
  - Wafer cleaning
- **Metal Deposition Bay**
  - 2 Thin film E-beam evaporators
  - 1 Magnetron Sputter coater
- **Gowning area**
- **Large storage area**

- **Photolithography Bay:**
  - EVG 620 Mask Aligner
  - Photoresist spin coaters
  - Developer bays
  - Ovens

Creating 3D floor plan in Unity:



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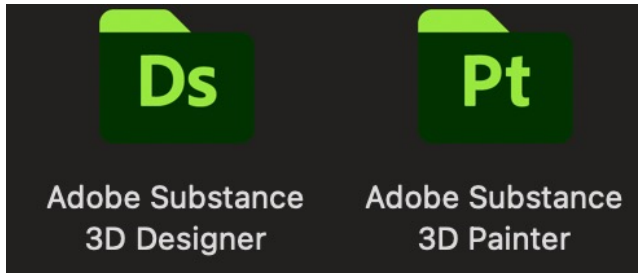
Results:

Results-Creating Prefabs:

Throw in cool prefabs we made! Maybe screenshots of blender too?



Results - VR Integration:

Challenges:

Learning curve oof

Mention leapmotion challenges/opportunities to expand

Integrating work with Team 1? Maybe not mention that

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