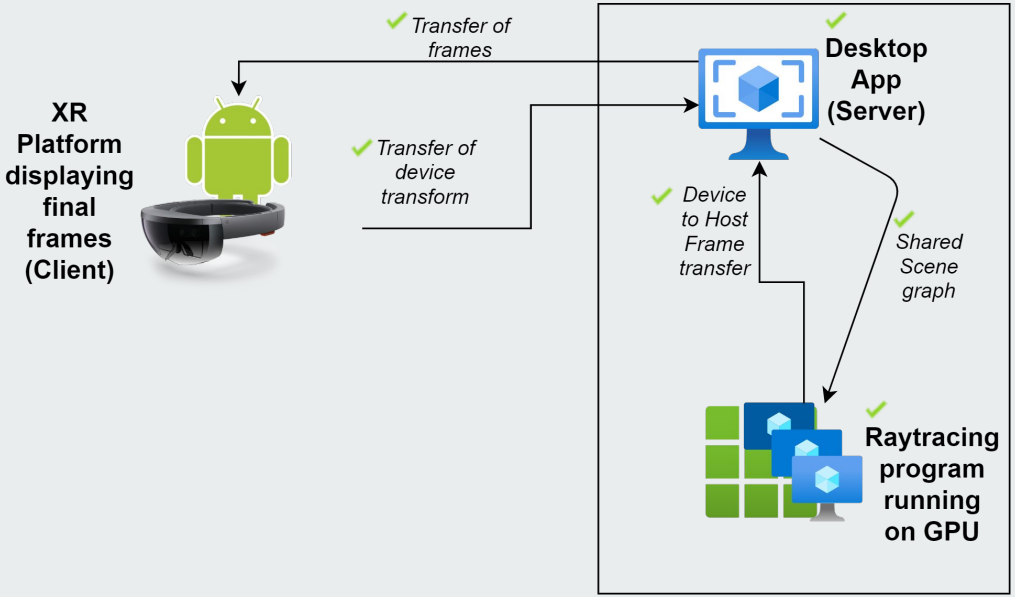
Remote Rendering for Mixed Reality

Gizem Dal, Dayu Li, Tushar Purang

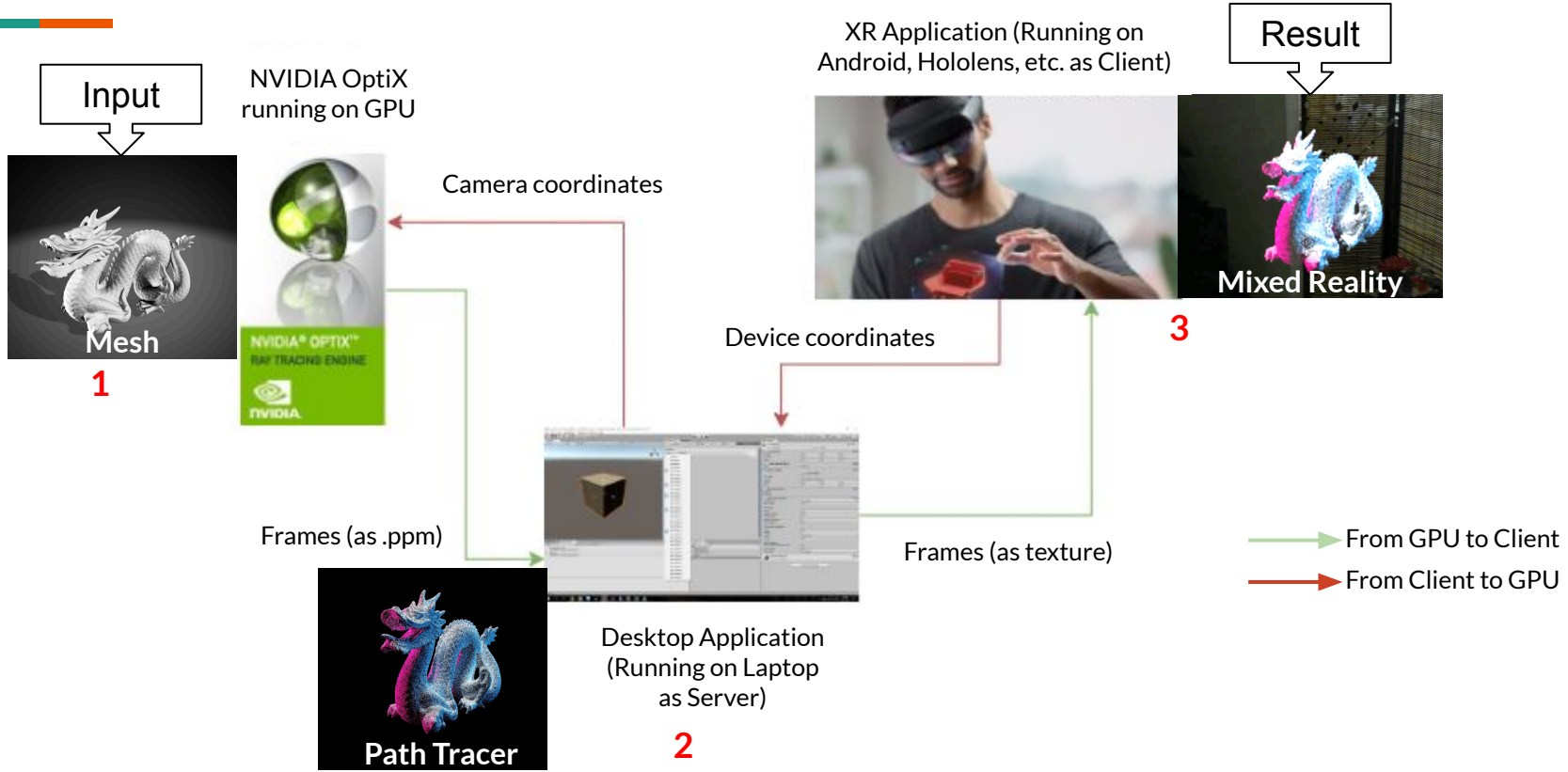
Gizem Dal (she/her/hers)
Major: *CGGT (Spring 2021)*
From: *Istanbul, Turkey*

Dayu Li (he/him/his)
Major: *CGGT & EE (Spring 2021)*
From: *Beijing, China*

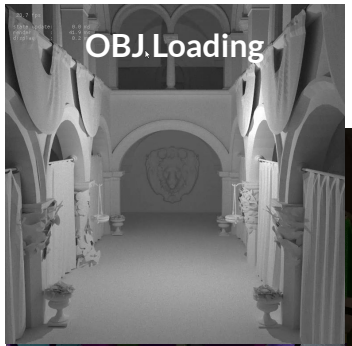
Tushar Purang
Major: *CGGT (Spring 2021)*
From: *Delhi, India*

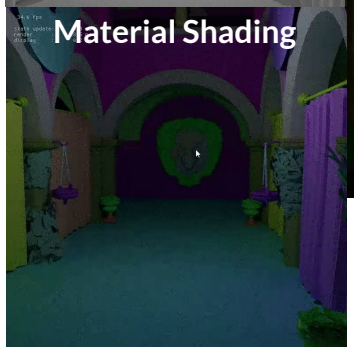


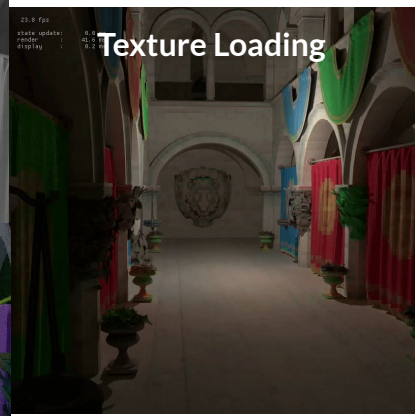
Project Overview

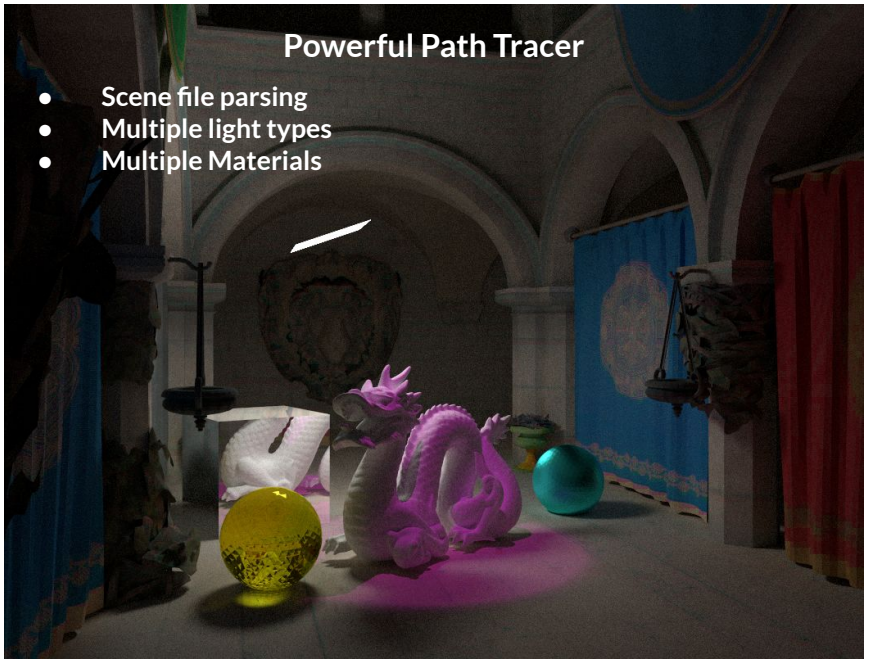


Exploring NVIDIA OptiX 7.2.0









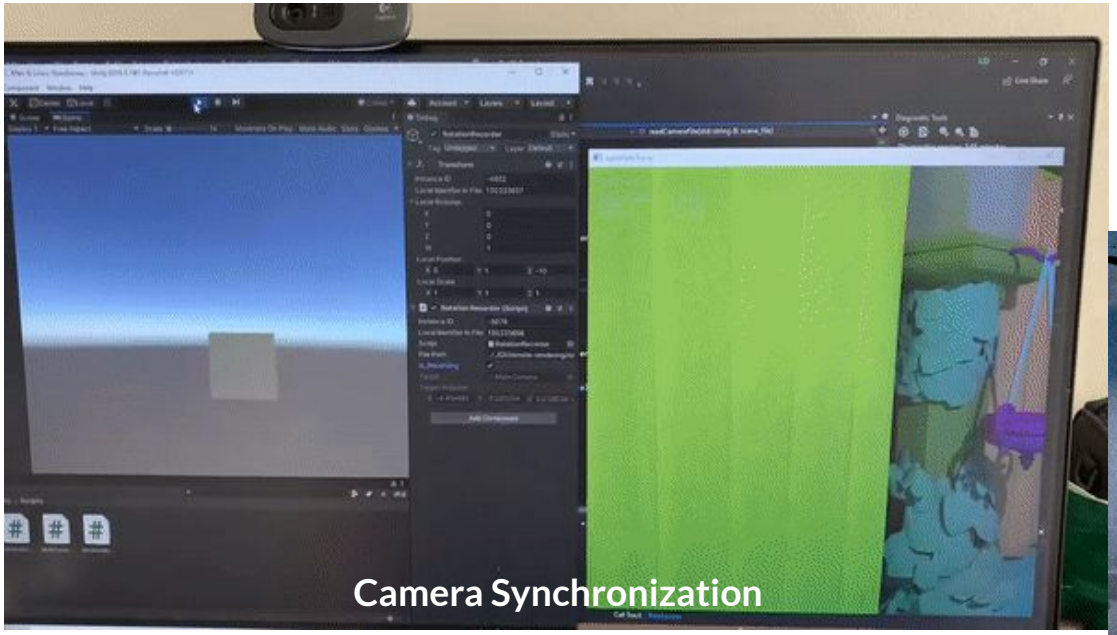
[Crytek Sponza & Dragon Mesh]

Streaming & Network

FPS:10
Shown with
Hololens 2

Remote Rendering

More Forms of Interactions

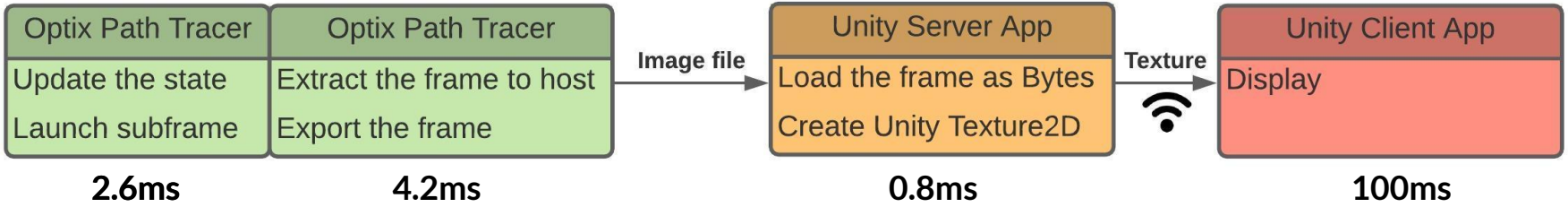


Camera Synchronization

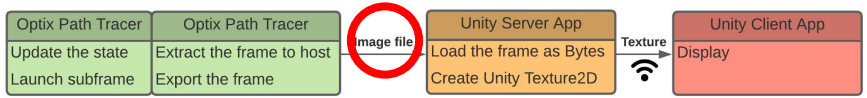
Hololens Spatial Mapping

Performance

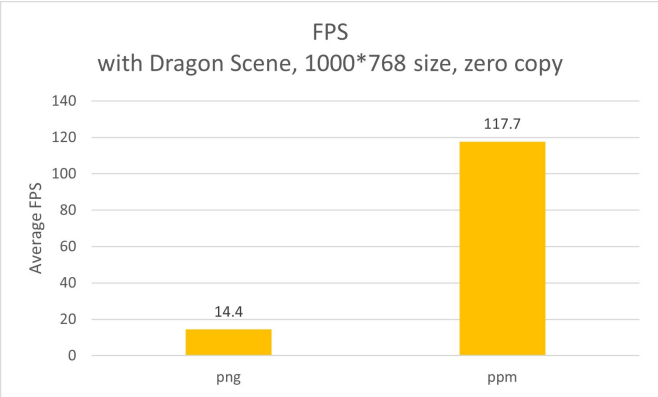
Latency Report

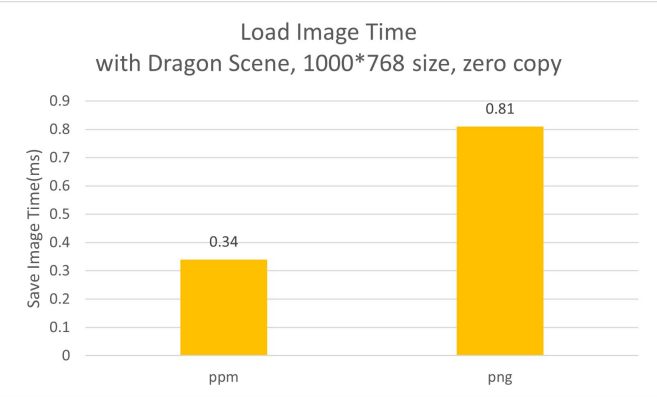


Optimization #1 : PPM Images

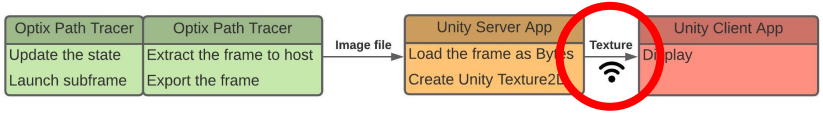


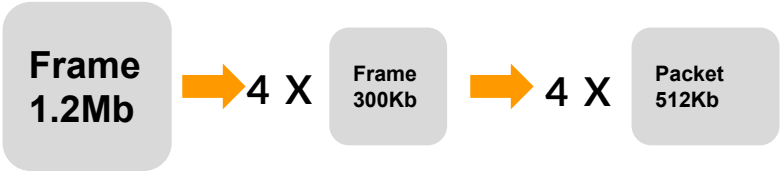
PPM → Lowest common denominator color image file format.

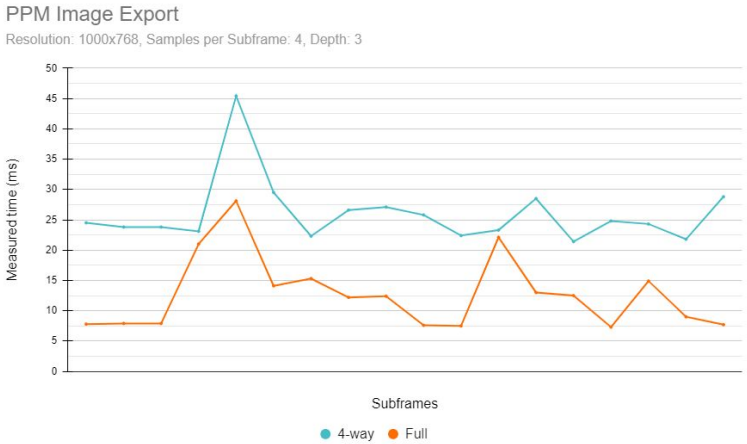


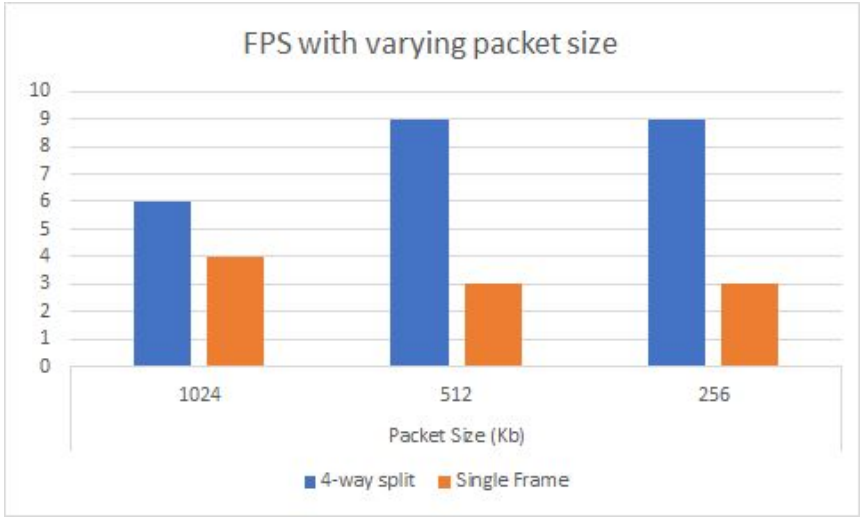


Optimization #2 : 4-Way Image Split

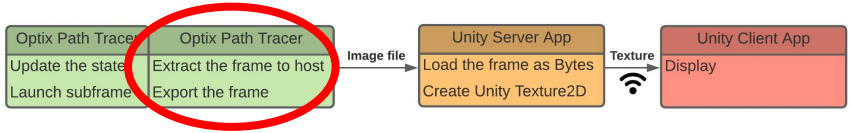


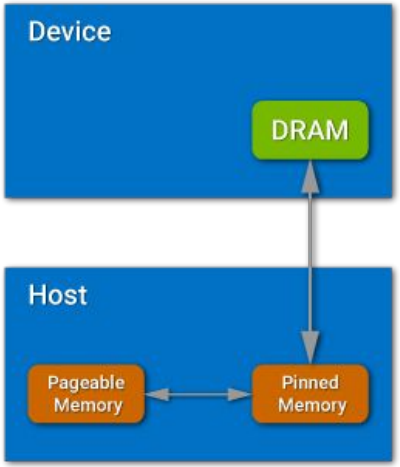


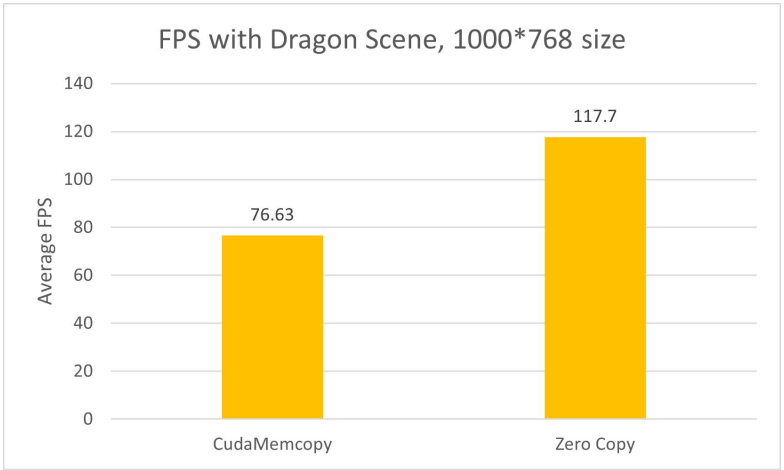


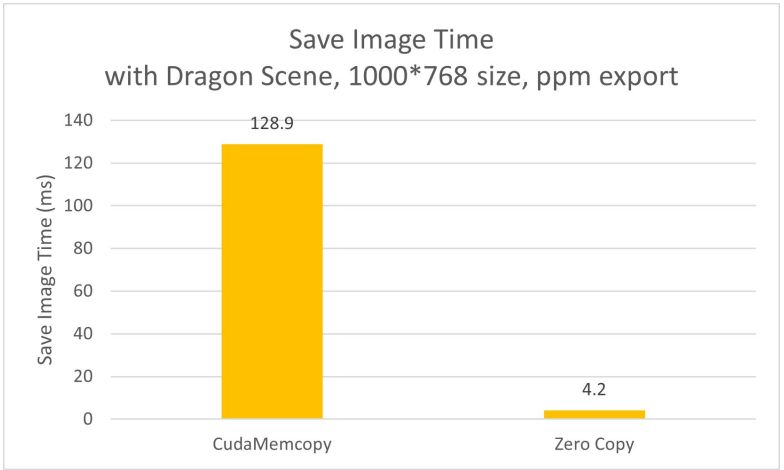


Optimization #3 : ZERO_COPY









Optimization #4 : Compressed Color

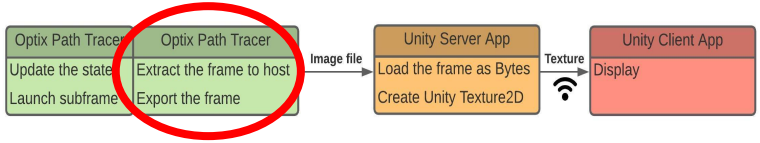


Image Source

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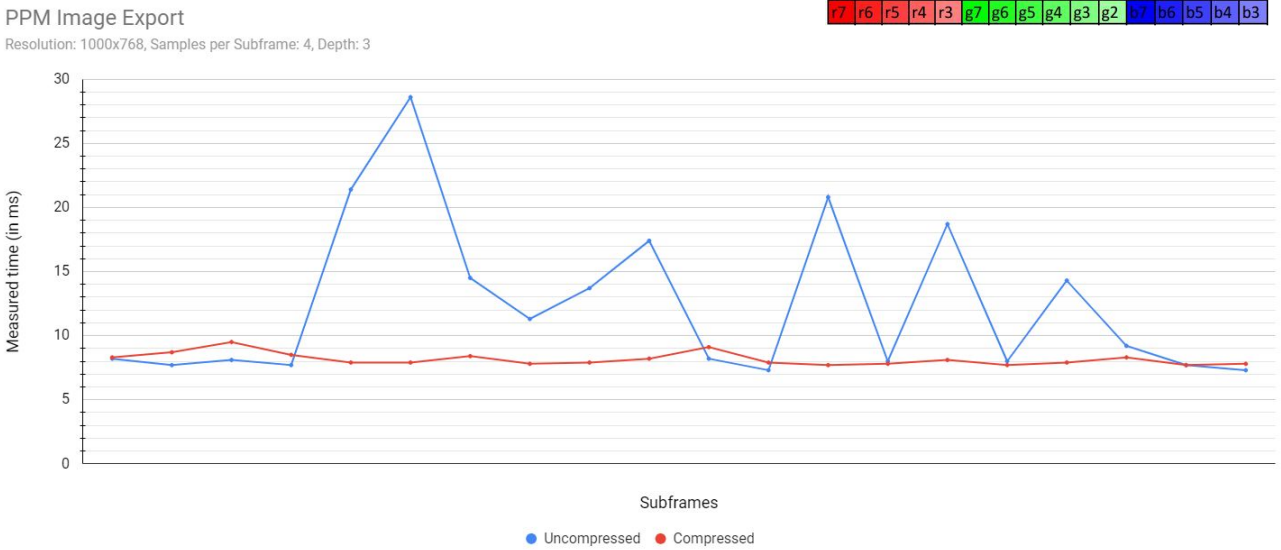
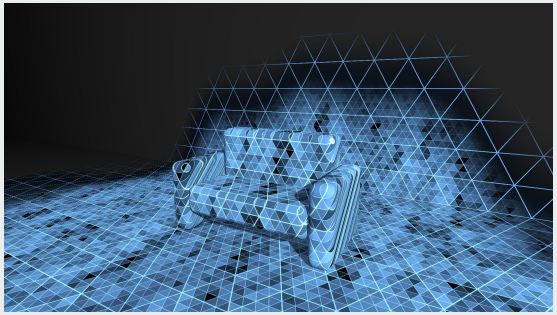
r7	r6	r5	r4	r3	r2	r1	r0	g7	g6	g5	g4	g3	g2	g1	g0	b7	b6	b5	b4	b3	b2	b1	b0

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r7	r6	r5	r4	r3	g7	g6	g5	g4	g3	g2	b7	b6	b5	b4	b3



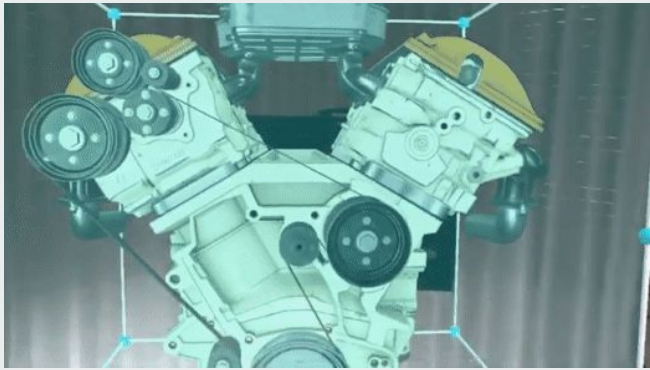
Future Improvements & Features

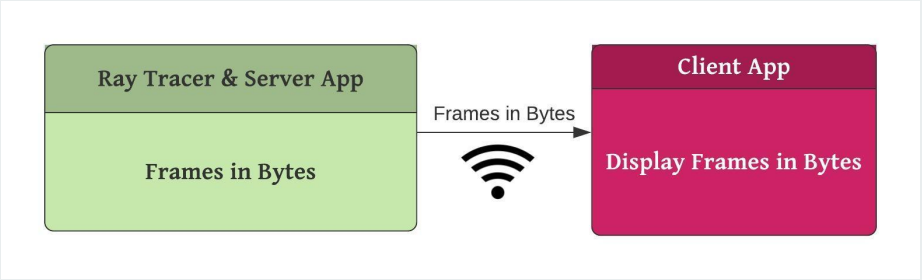
- Better utilize Hololens spatial mapping
  - Split objects from the entire spatial mapping
- Hololens gesture recognition
  - Manipulate the scene with hand gestures
- Implement independent client App in Hololens without using Unity



Source: Rebuilding Scanning

Source: Azure Remote Rendering





Resources

Check out our Remote Rendering for XR GitHub repository for more details!

- NVIDIA OptiX 7.2.0 SDK & Samples
- NVIDIA OptiX 7 SIGGRAPH Course Samples by Ingo Wald
- McGuire Computer Graphics Archive Meshes
- A Streaming-Based Solution for Remote Visualization of 3D Graphics on Mobile Devices
- Physically Based Rendering: From Theory to Implementation Online Textbook
- About Azure Remote Rendering
- High-Quality Real-Time Global Illumination in Augmented Reality
- RGB565 Color Picker - Barth Development
- Tinyobjloader
- Parsing a ppm format
- Advanced Topics in CUDA

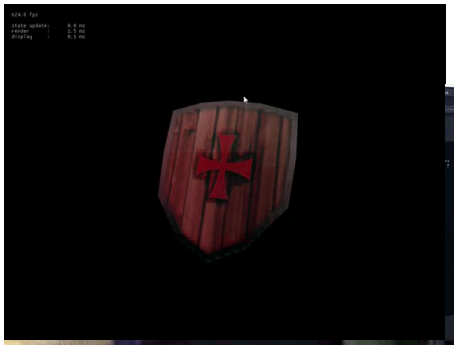
Acknowledgements & Gratitude

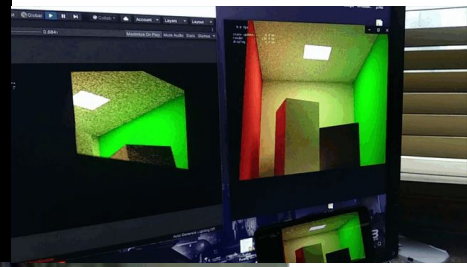
- Our Shadow Team (Janine Liu, Helen Liu, Spencer Webster-Bass)
- Prof. Stephen. H. Lane for the access to Hololens devices
- Ingo Wald and Steven G Parker, NVIDIA for the OptiX7 course and sample

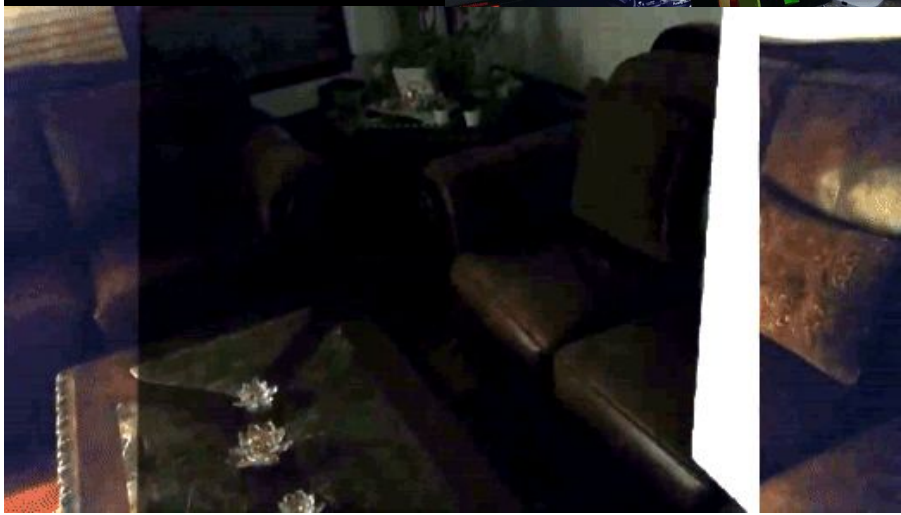
Thank You!

Let’s stay in touch:

- Gizem Dal
  - gizemdal1997@gmail.com
  - Portfolio, LinkedIn, GitHub
- Dayu Li
  - universeldy@gmail.com
  - LinkedIn, GitHub
- Tushar Purang
  - purangt@gmail.com
  - Portfolio, LinkedIn, GitHub

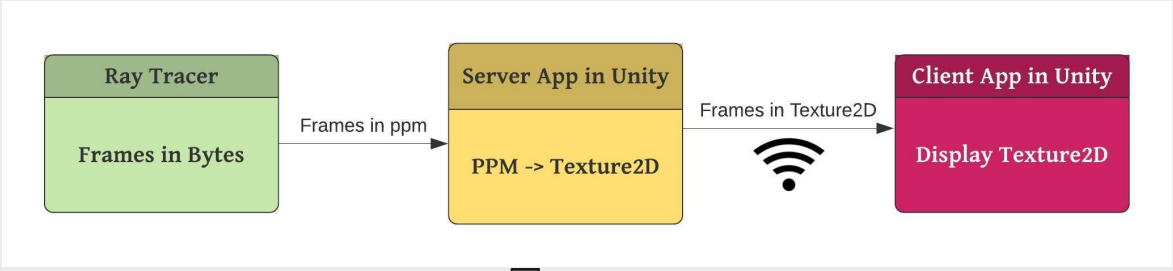




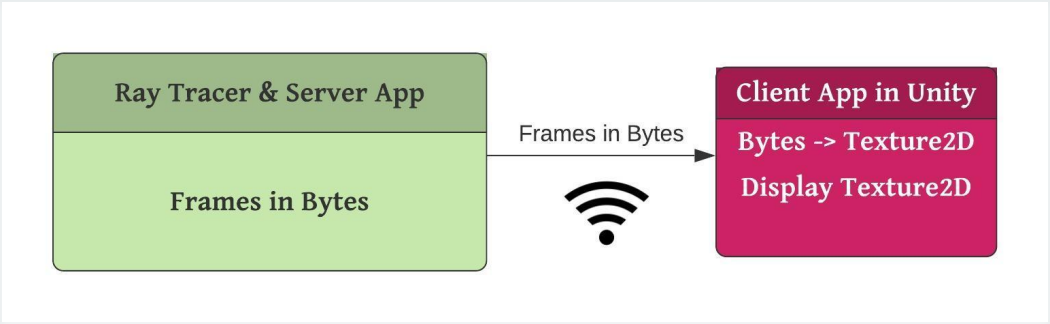


Appendix

Sending Raw Data to Hololens?



Latencies in export/import frames in ppm format.



Need to do the Bytes->Texture calculations in Hololens with a weaker processor

VERY TIME CONSUMING!!!

Challenges for GPU Programming with Hololens

- Wireless Transfer (Wifi, BlueTooth, etc) is time consuming, bring the server to cloud if allowed!
- The users of Hololens won't have the access to it's lower level APIs, including the graphics processor. This would make computations in Hololens much slower than you expected!
- Any features that takes hardware accelerations like the late stage reprojections is hard to be effective without the lower level access.