Realtime Ray Tracing & Global Illumination

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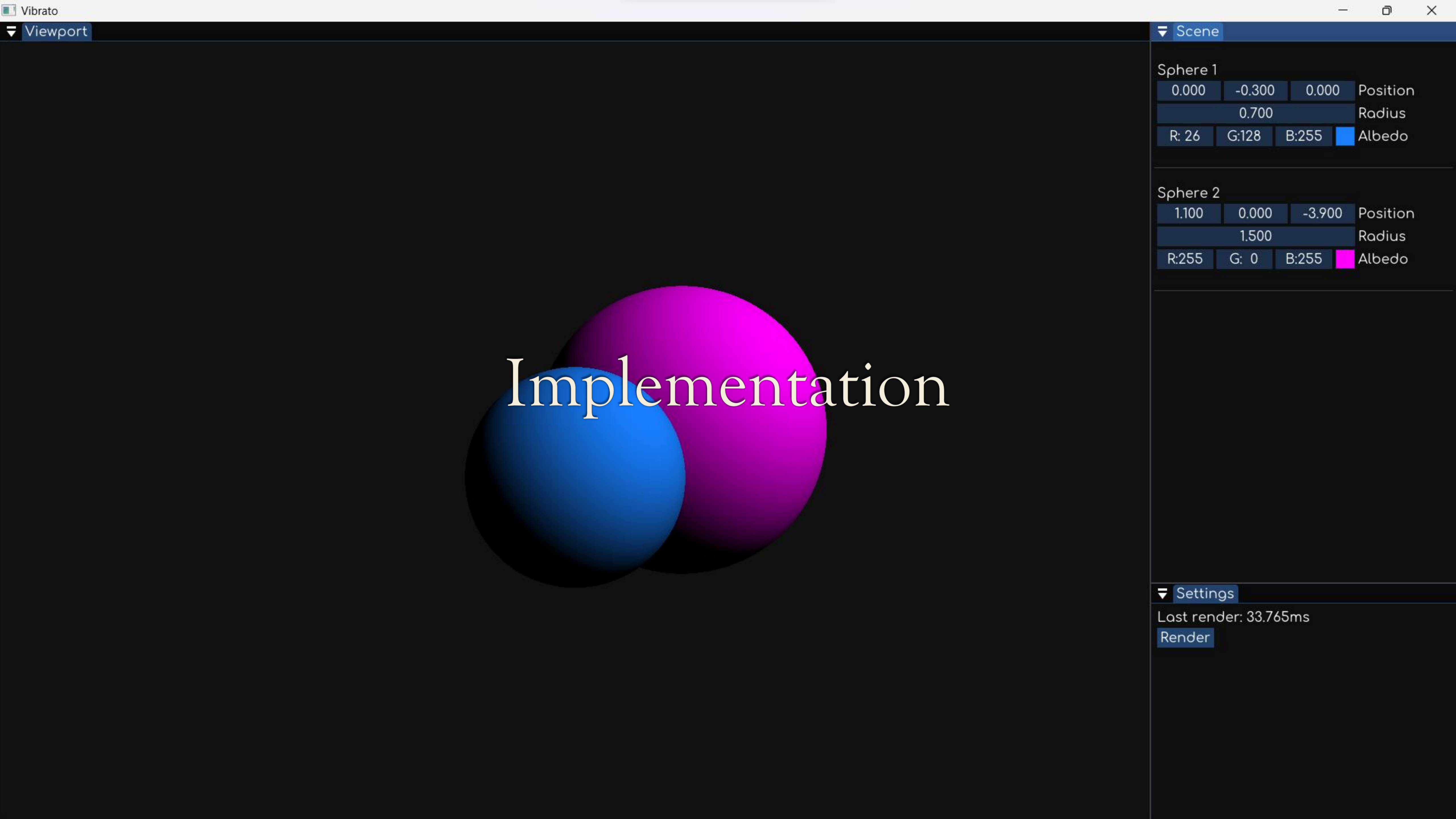
Introduction

- Computing how light will behave in real world.
- To achieve more photo realistic renders.
- Developing using C++, Premake, Vulkan, CUDA.
- Applications
  1. Gaming
  2. Light Simulations
  3. Interior Design etc

Background Review

- Rise in gaming industry.
- Everyone wants more realistic graphics.
- Ray tracing == physically based rendering.
- Unreal Engine 5
- NVIDIA Omniverse
- Games: GTA5, Cyberpunk, Portal, Minecraft

Implementation



Vibrato

Viewport

Scene

Sphere 1
0.000 -0.300 0.000 Position
0.700 Radius
R: 26 G:128 B:255 🟦 Albedo

Sphere 2
1.100 0.000 -3.900 Position
1.500 Radius
R:255 G: 0 B:255 🟪 Albedo

Settings
Last render: 33.765ms
Render

Project Architecture

01

APPLICATION FRAMEWORK

- CLEF
- VULKAN, IMGUI

02

RAY TRACING MODULE

- VIBRATO
- ALGORITHMS

03

RENDERER SOFTWARE

- CLEF APP

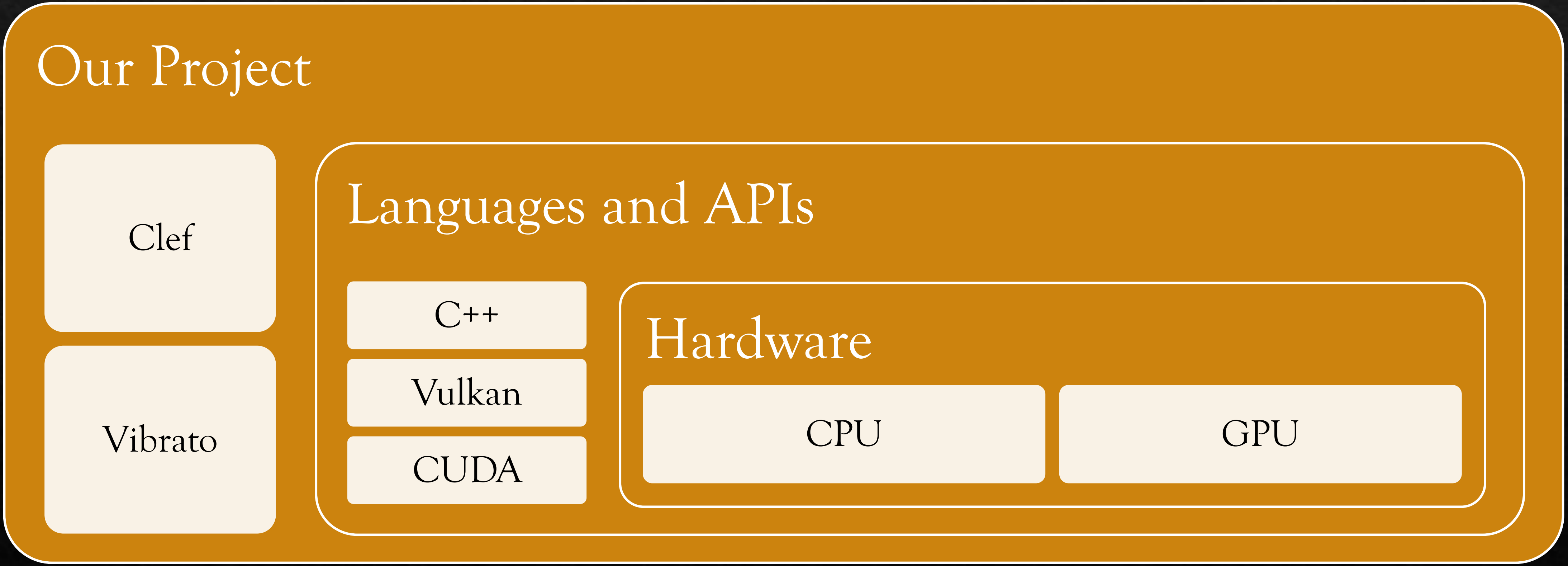
Clef

- A simple application framework.
- Built with Dear ImGui and designed to be used with Vulkan.
- Seemlessly blend real-time Vulkan rendering with a great UI library to build desktop applications.
- The plan is to expand Clef to include common utilities to make immediate-mode desktop apps and simple Vulkan applications.

Vibrato

- Ray Tracing Methods
- Mathematics
- Different Approaches
  - Brute Force Approach (implemented)
- Optimizations
- GPU Acceleration

Architecture



Progress and Findings

- Application framework (Week 1)
- Ray tracing pipeline (Week 2)
- Brute force approach (Week 3)
- Polygons, Textures and Materials (In Progress)

- Ensuring 60fps output requires powerful computations. Some way of parallel processing is must for realtime renders.

Future Plans and Research

- Implement different raytracing methods:
  - Monte Carlo, bi-directional, metropolis, photon mapping methods
- GPU Acceleration using CUDA or Vulkan.
- Attempt to devise an improved method:
  - Faster Calculation or Better Results

References

- “Vulkan Tutorial”
  https://vulkan-tutorial.com/
- “Dear ImGUI”
  https://github.com/ocornut/imgui
- “Ray Tracing in One Weekend.”
  raytracing.github.io/books/RayTracingInOneWeekend.html
- “Ray Tracing Series by The Cherno”
  https://youtube.com/playlist?list=PLlrATfBNZ98edc5GshdBtREv5asFW3yXl