AngkorVR

Advanced Practical

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Advanced Practical – Tasks

- Virtual exploration of the Angkor Wat temple complex
- Based on **Pheakdey Nguonphan**'s Thesis called "**Computer Modeling, Analysis and Visualization of Angkor Wat Style Temples in Cambodia**"
- 3D rendering model to real time VR experience

Approach – Overview

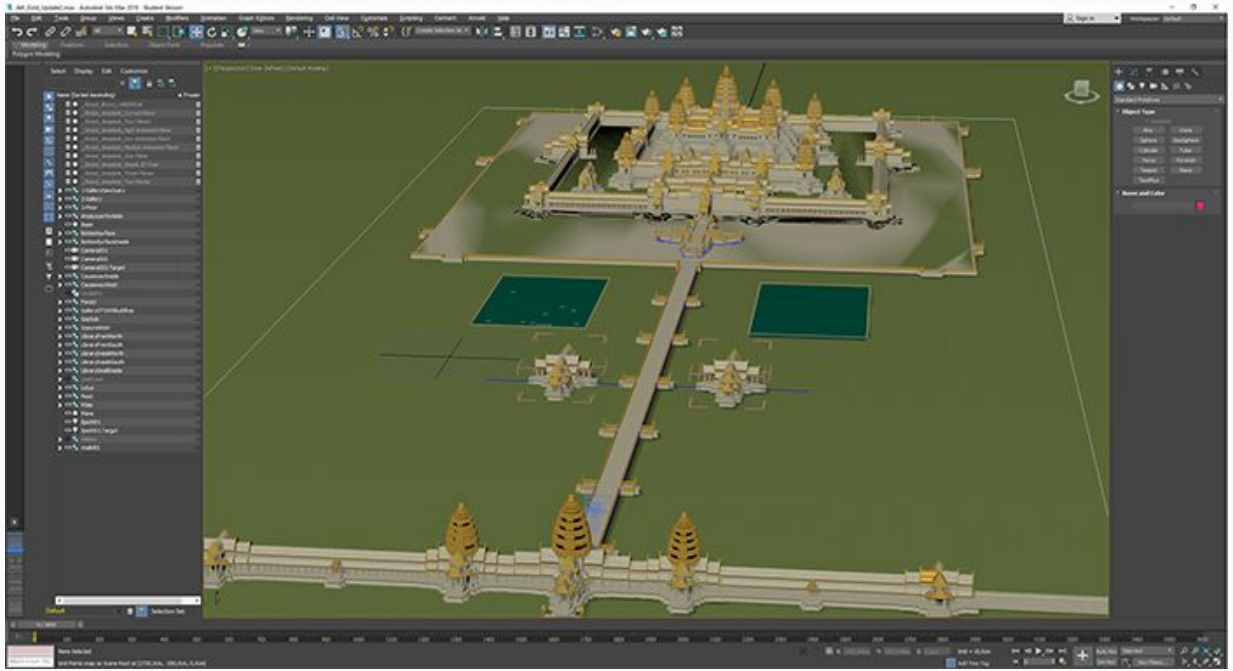
- Implementation essentials
- Model adaptation
  - Irregularities
  - Performance
  - Constraints of VR
- Implementing Controls
  - Feasibility for VR
  - Minimizing nausea
  - Navigation features
- Extras
  - Atmospheric enhancements

Approach – Implementation

- Unity game engine
  - Ease of use
  - Experience
  - VR compatibility
- Oculus Rift VR DK2 goggles
  - Full HD OLED Display
  - 960×1080 pixels per eye
  - Advanced head tracking

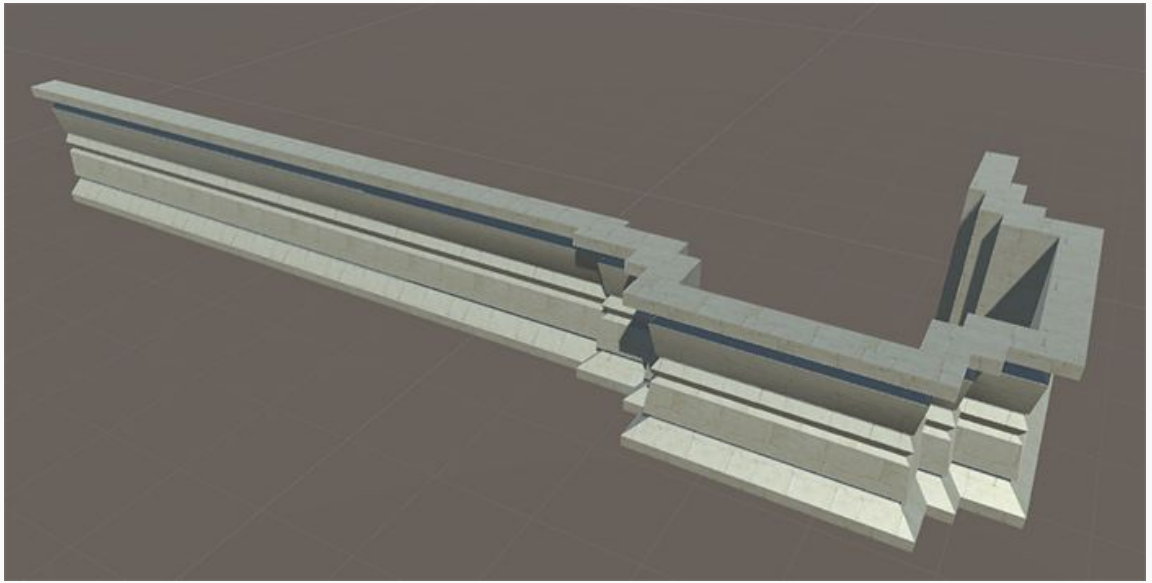
Model Adaptation

- Given model as Autodesk 3ds Max file (.max)
- Some textures missing
- Export as Autodesk FBX



Model Adaptation – Irregularities

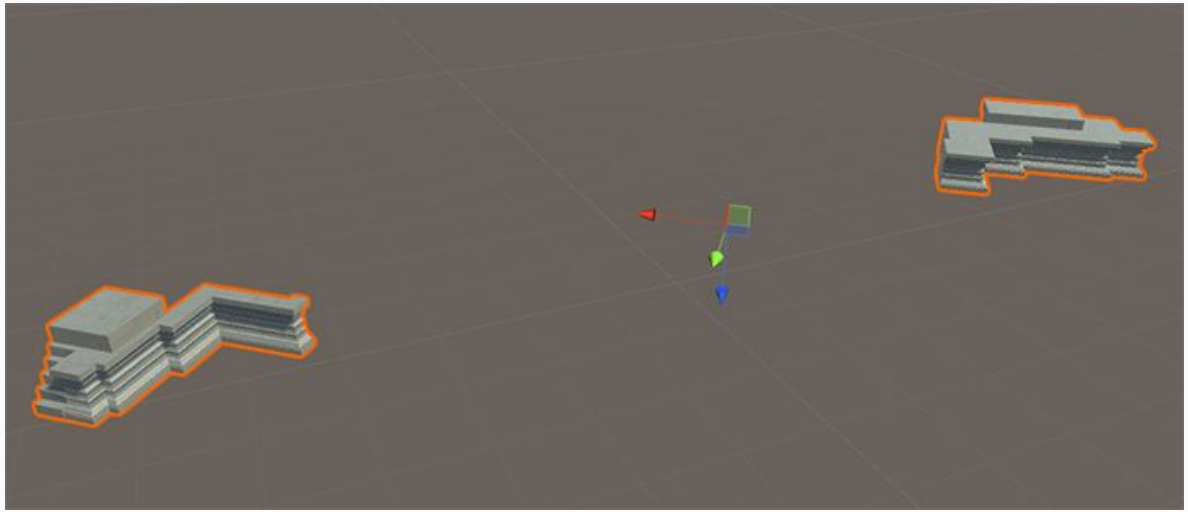
- No ordinary modelling
- Procedurally generated by mathematic formulae
- Irregular formed geometry



Single, non-divisible 3D object

Model Adaptation – Irregularities

- Some z-fighting issues could not be resolved
- Small gaps in the environment
- Partly floating objects
- Not solvable without vast amounts of remodelling



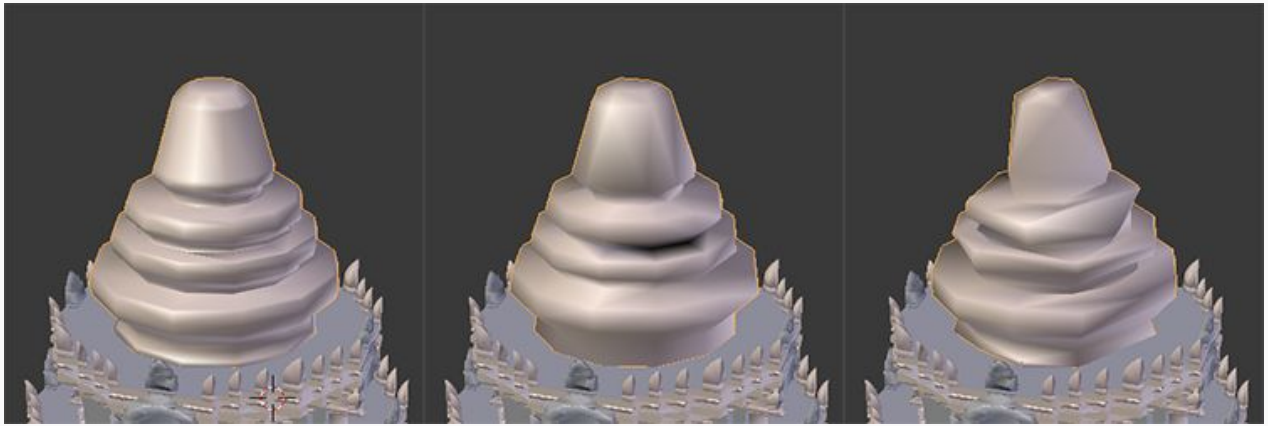
Single, non-divisible 3D object

Model Adaptation – Performance

- High resolution of model for rendering
- Thousands of vertices in even simple pieces of geometry
- High number of draw calls
- Performance dips
- Big cause of nausea

Model Adaptation – Simplify Geometry

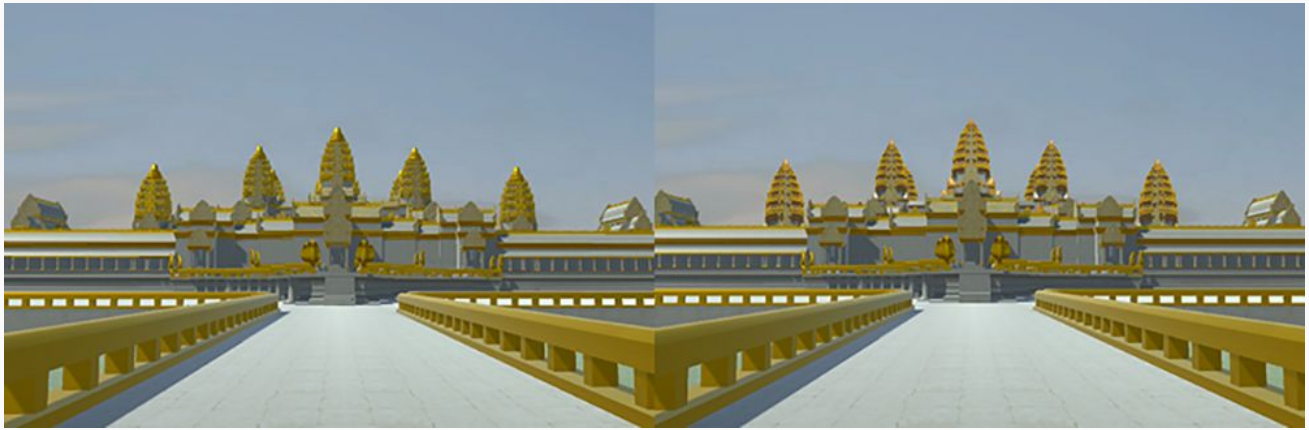
- Vertex reduction using Blender, 3ds Max, Unity script
- Not successful
- Artifacts



Blender simplification

Model Adaptation – Billboarding

- Billboarding for the 5 towers and inner walls
- Billboards are active while outside
- Get replaced by explorable geometry upon entering the temple

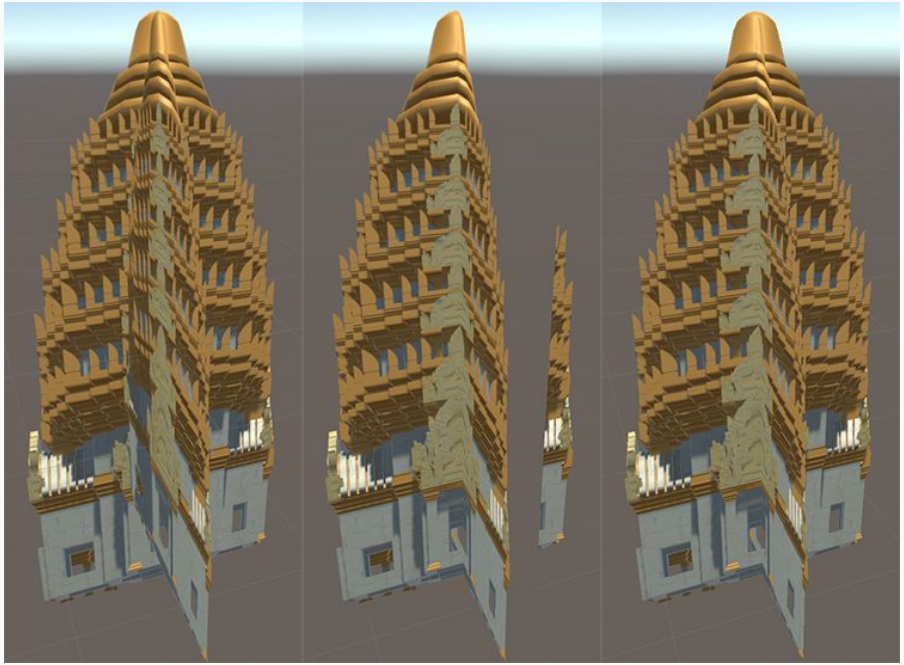


Left: Geometry
Right: Billboards

Model Adaptation – Billboard Tech

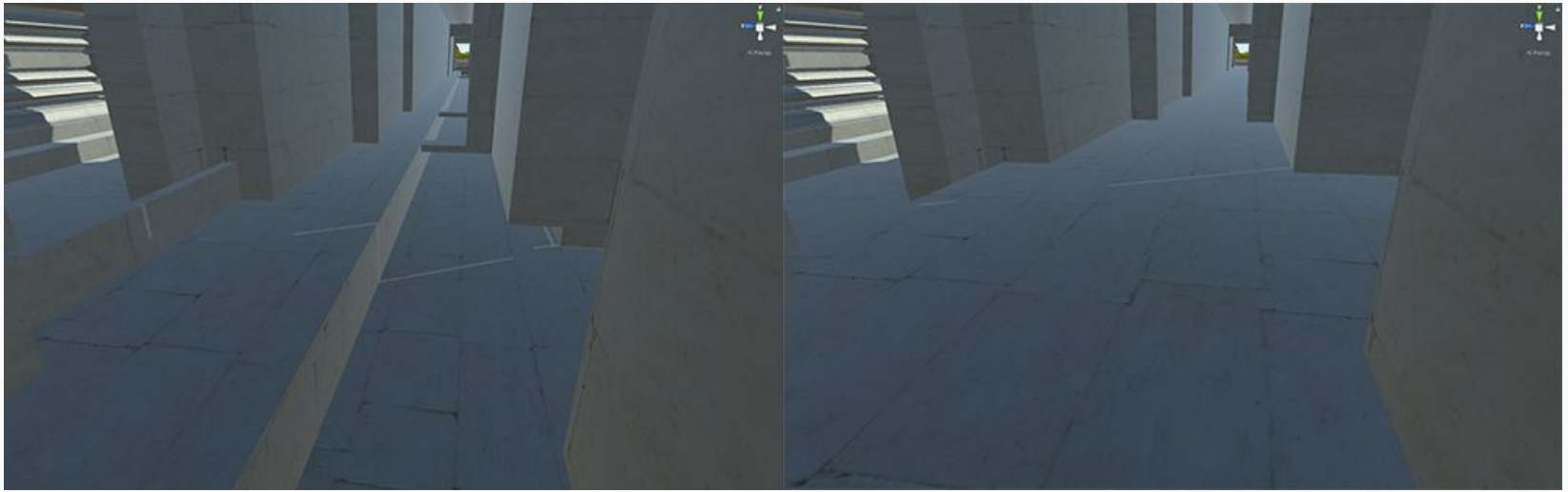
- Two unity sprites overlapping at 90° angle
- Custom vertex and fragment shader

- Left: Depth buffer issues
- Middle: alpha culling issues
- Right: Finished billboards



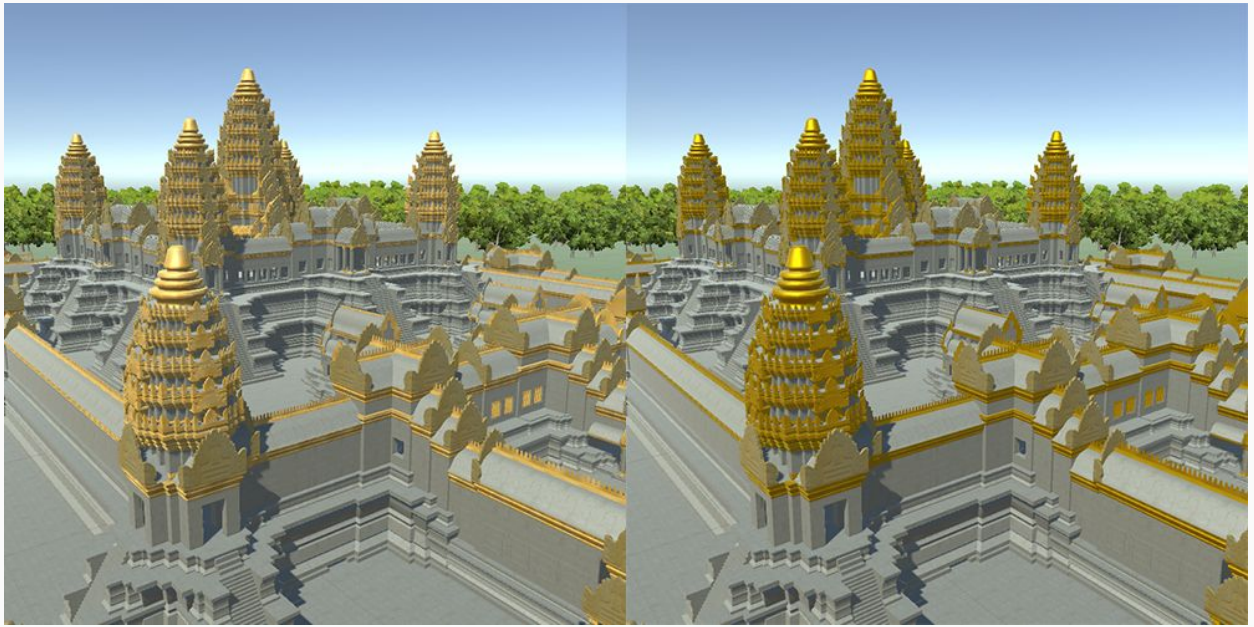
Model Adaptation – Remodelling

- Accessibility requires colliders
- Adding floors and stairs



Model Adaptation – Textures

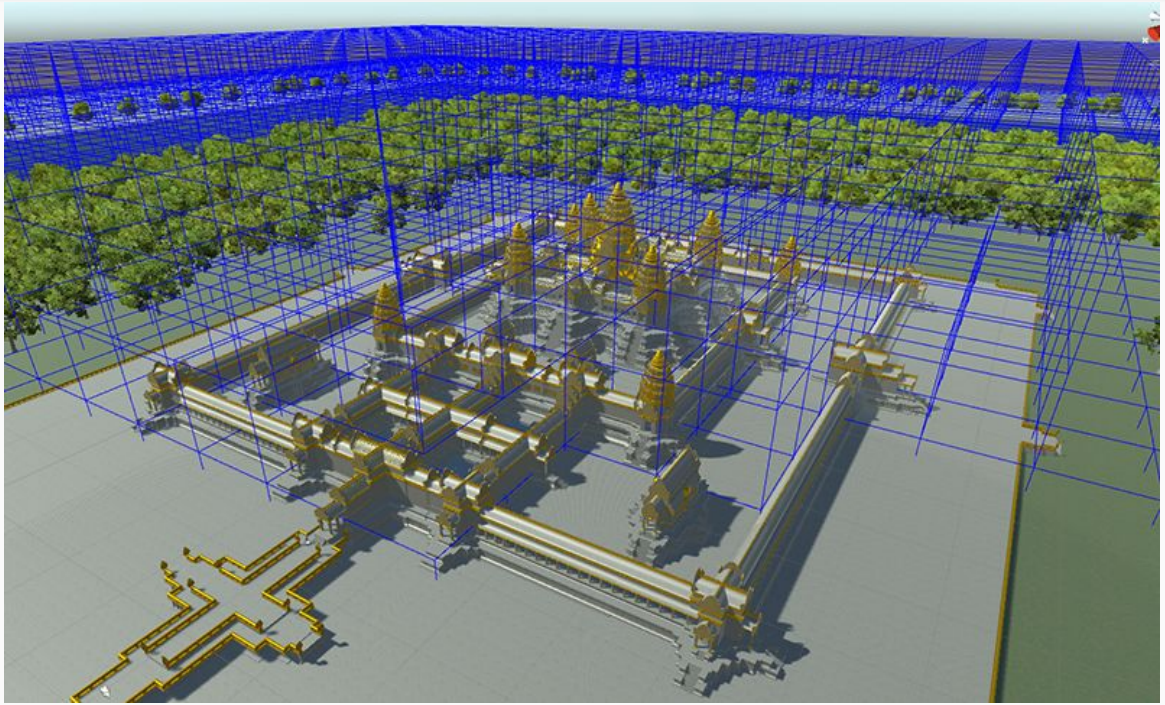
- Replacement of missing textures
- Improving existing textures



- Left: Old gold texture
- Right: New, shiny texture

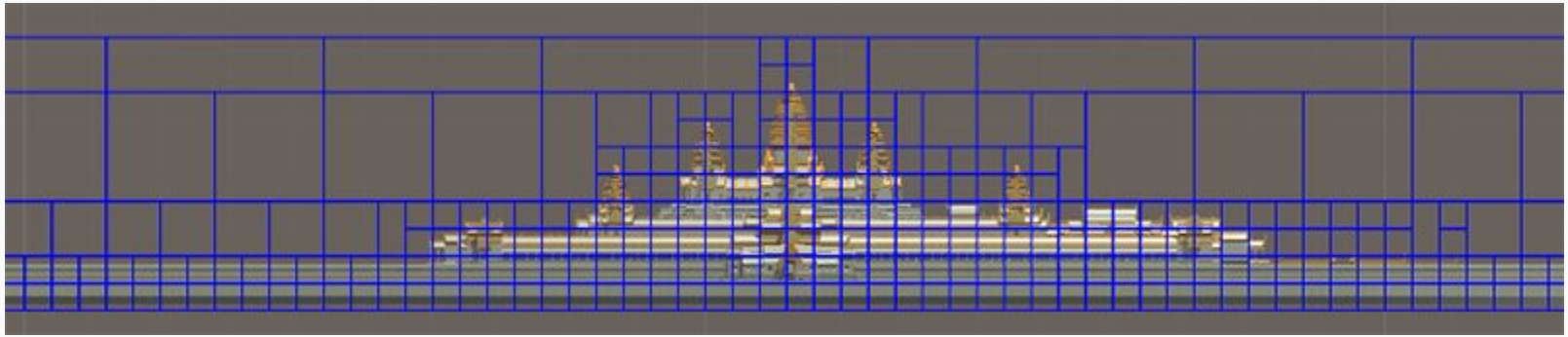
Model Adaptation – Occlusion Culling

- Unity occlusion culling
- Large volumes in empty areas
- More refined cull boxes for more complex geometry



Model Adaptation – Results

- Completely accessible, nice looking model
- High performance with 60 FPS and above
- Tested on different systems with Oculus and WQHD monitors



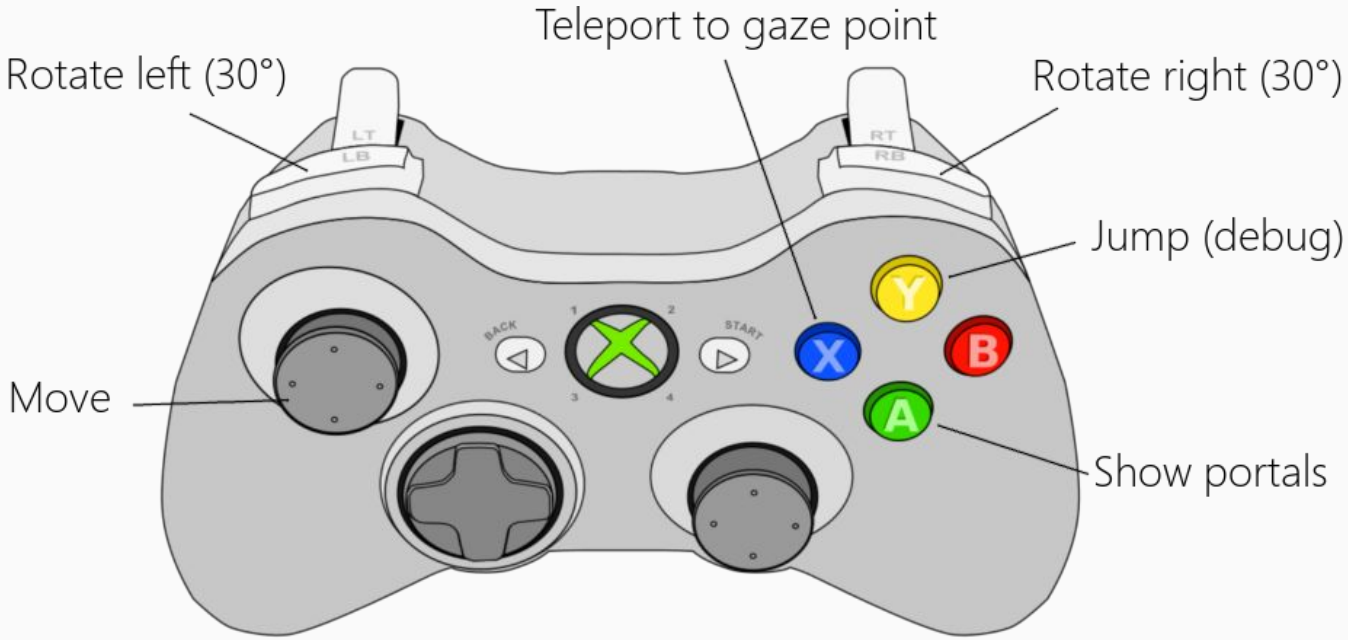
Occlusion Culling in 2D

Controls – Overview

- Control Scheme
- Nausea minimization
- Environment interaction
- Teleportation System
- Camera blinking effect

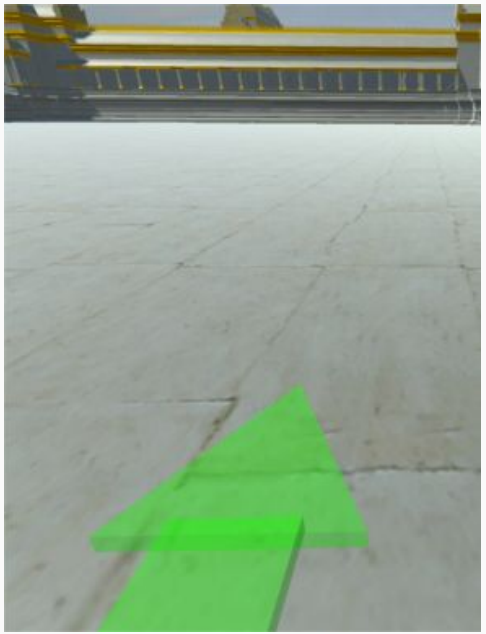
Controls – Scheme

- Keyboard and Mouse controls for development
- Controller support with head tracking for VR



Controls – Nausea Minimization

- Rotation with analog stick very nauseating
- Fixed rotation with trigger buttons
- No head bobbing
- Jumping for experienced users only
- Facing direction indicator

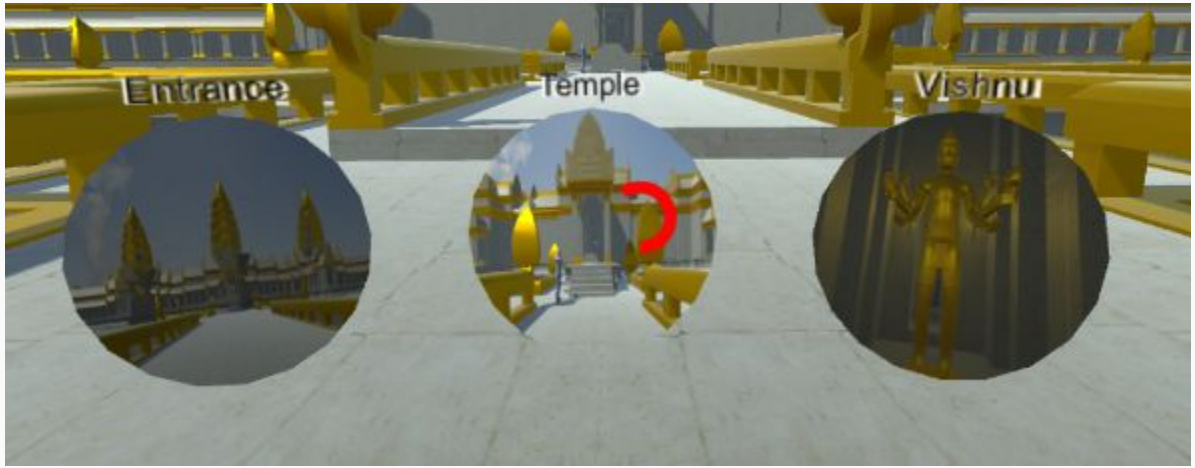


Controls – Environment Interaction

- Gazing mechanism
- Looking at an interactive object spawns a circle
- Circle fills up while looking at the object
- When the circle is full, the object will be activated

Controls – Teleportation System – Portals

- Fast movement over long distances can be nauseating and inconvenient
- Portals to key areas in the environment



Controls – Teleportation System – Freely

- Teleportation in viewing direction
- Target feasibility check via surface normal vector
- Launched by pressing and holding the respective button
- Releasing the button initiates the teleportation

Controls – Camera blinking

- Abrupt changes in camera position are nauseating
- Blinking effect added
- Closing planes represent eyelid
- As soon as eyelids are closed, position will be changed
- Eyelids open at new location

Extras – Overview

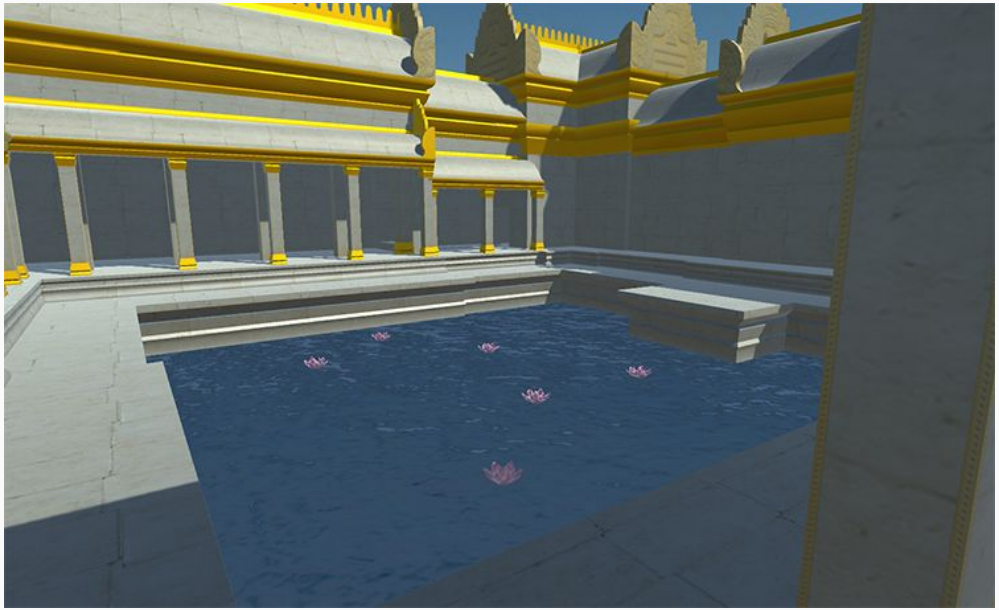
- Real-time optimized trees
- Realistic water effects
- Skybox
- Torches for mood lighting
- Animated guide with speech interaction

Extras – Trees

- Render optimized trees do not work in real time environments
- Replacement with SpeedTrees
- Included level of Detail and billboarding for performance

Extras – Water

- Ponds with animated water
- Floating sea roses



Extras – Skybox

- Helps disguise the borders of the map
- More realistic feeling

Extras – Torches and Vishnu

- Central point of the temple
- Torches help illuminate the gold texture
- Example on how to make the world in VR more interesting and lifelike

Extras – Animated Guide

- Located at the entrance
- Helps discovering the temple
- Text-to-speech can be used to inform the user about the temple and its history
- Traverses predefined waypoints

Results and Conclusion

- Transition from render optimized model to interactive, real time experience
- Various optimizations for high framerates
- Customized control scheme
- Nausea minimization techniques
- Convenience features including teleportation and a guide

Documentation at http://pille.iwr.uni-heidelberg.de/~oculus04/

Future Work

- Additional speech information for the guide
- Recreate tall palm trees
- Atmospheric improvements
  - Grass
  - Particle effects
  - More variety in textures
- Acquisition of new VR interfaces
  - End user version of Oculus Rift
  - HTC Vive for room scale VR