RV - AULA 04 - PSI3502/2018

VR Systems

Outline

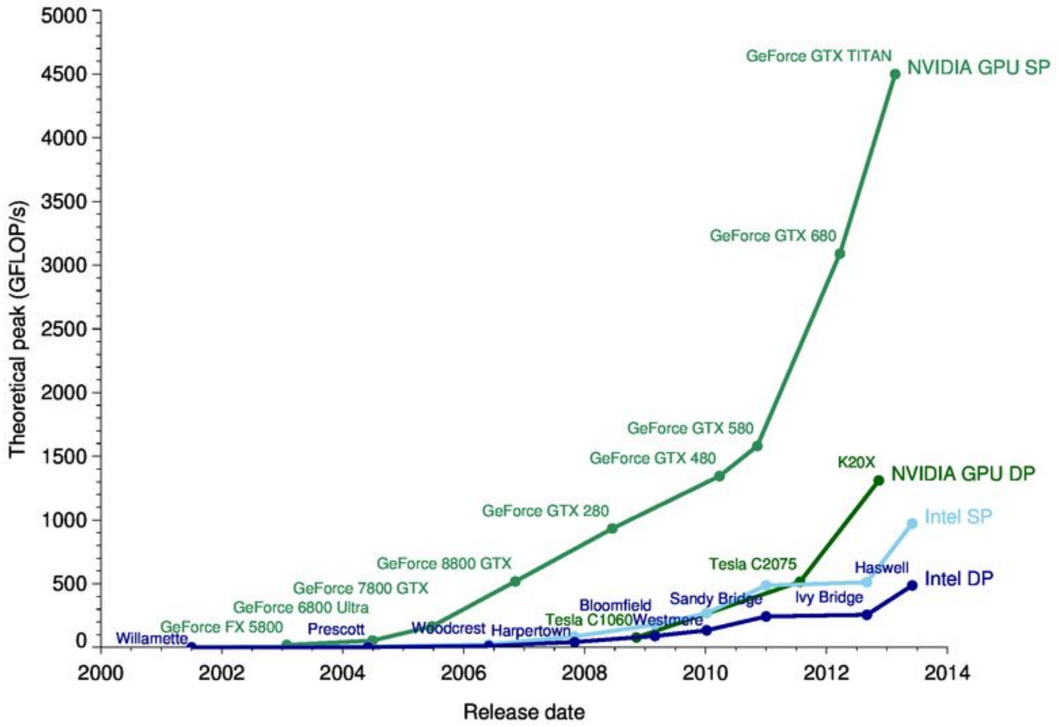
Discuss some of the major hardware and software components that can be found in most of the VR systems.

Give an overview of VR system architecture.

Examine computational platforms on which various virtual environments are deployed.

Present CAVEs and discuss some of the important software components of VR systems.

VR System Requirements



http://michaelgalloy.com/2013/06/11/cpu-vs-gpu-performance.htmll

VR System Requirements

In order to be perceived as a fluid continuous motion, a 3D imitation needs to achieve a rate of a least 25fps.

Permissible system latency in interaction between user’s input and expected feedback is less than fifty milliseconds.

An audio system needs to be able to process signal in range 20Hz to 20kHz.

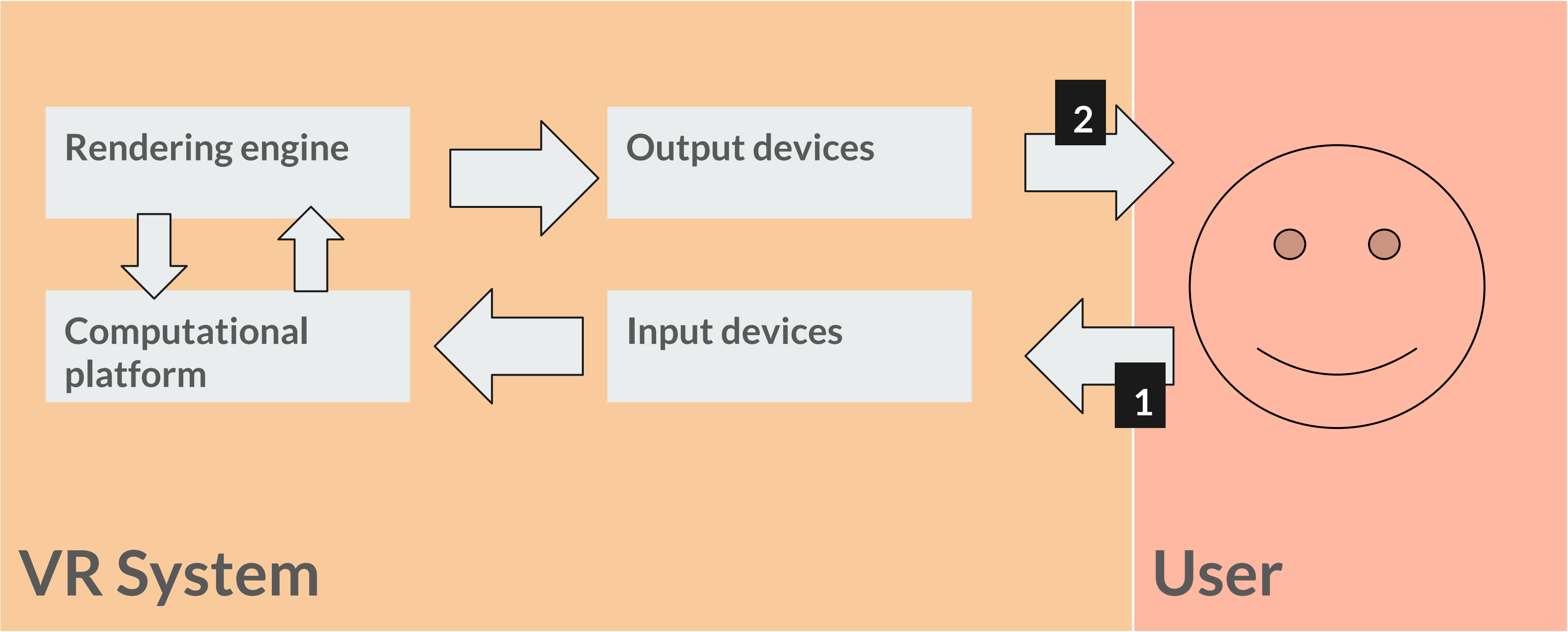
VR System Requirements

As technology advances, these technical considerations become less and less important and designers of virtual environments can focus more on the quality of user experience.

VR systems consist more and more of standard consumer grade components available in the market.

Lower cost of technology.

VR System Architecture



1) User commands
2) Artificial, computer generated stimuli

Computational Platforms

The computational platform is an underlying backbone of every VR system.

Early 80s: the geometry engine developed by Jim Clark and Marc Hannah at Stanford University at the start of the decade was the first hardware implementation of the geometry pipeline, the basic step in any 3D computer graphics system.

Computational Platforms

Silicon Graphics Indy workstation, 1993.

Computational Platforms

1994: fifth generation of game consoles.

1999: GPU device by Nvidia.

Rise of 3D gaming and popularity of computer networks, LAN and WAN.

Online virtual communities or MMOs.

Recent years: mobile devices.

World of Warcraft

PC-Based VR Systems

During the 90s, 3D gaming began to dominate the electronic entertainment market.

Development of affordable yet powerful computer graphics hardware.

GeForce 256: permitted speeds necessary for smooth animation in combination with the high resolution and high degree of realism.

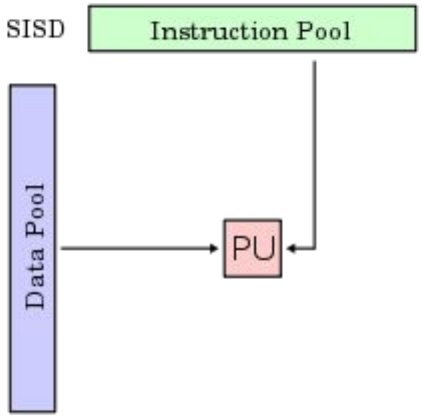
GPU

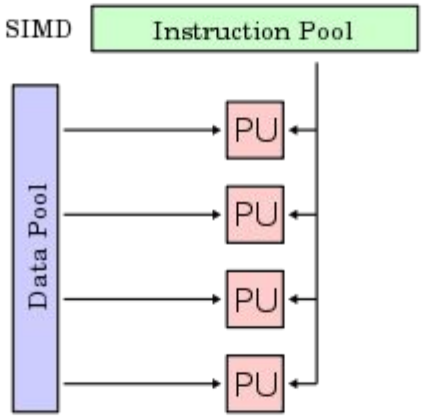
Special processing units designed for performing efficient computations needed for generating real-time 3D graphics.

Execution steps: Single Instruction Single Data (SISD) architecture.

CPU X GPU: CPUs can have multiple cores, GPUs can have hundreds of processing units.

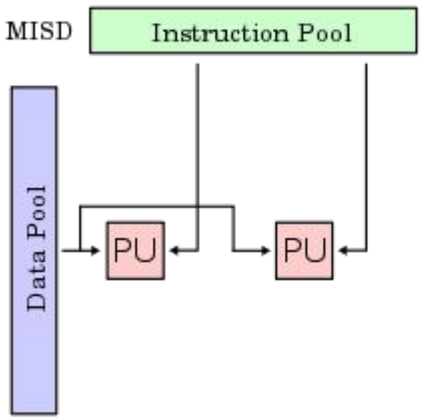
GPU

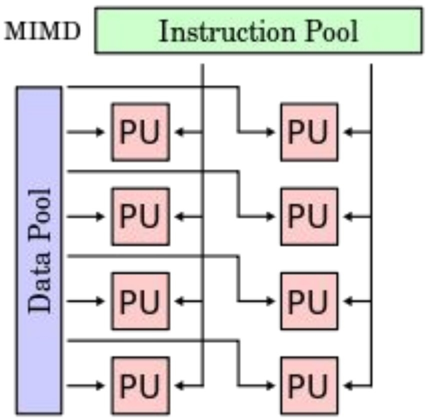




http://thedestination-vaibhav.blogspot.com/2010/05/parallel-processing-sisdsimdmimdmisd.html

GPU





http://thedestination-vaibhav.blogspot.com/2010/05/parallel-processing-sisdsimdmimdmisd.html

Distributed VR Systems

Deployed over some kind of a computer network, i.e. LAN or WAN

LAN-based systems: peer-2-peer architecture

WAN-based systems: servers

Mobile Devices and VE

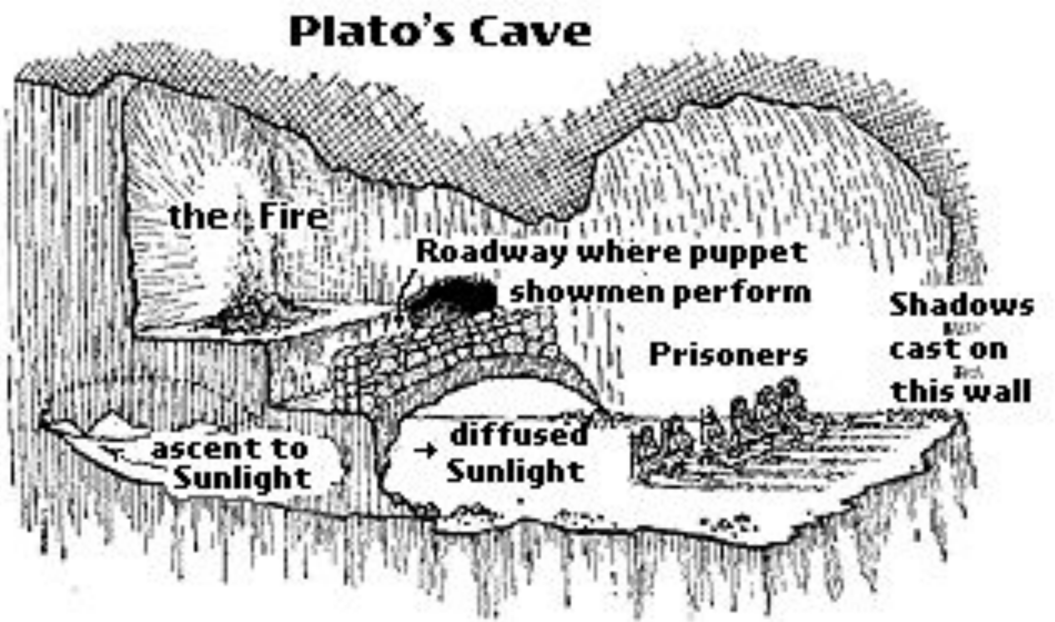
I/O Devices-Standard | I/O Devices-VR Specific

CAVEs

CAVE: Automatic Virtual Environment

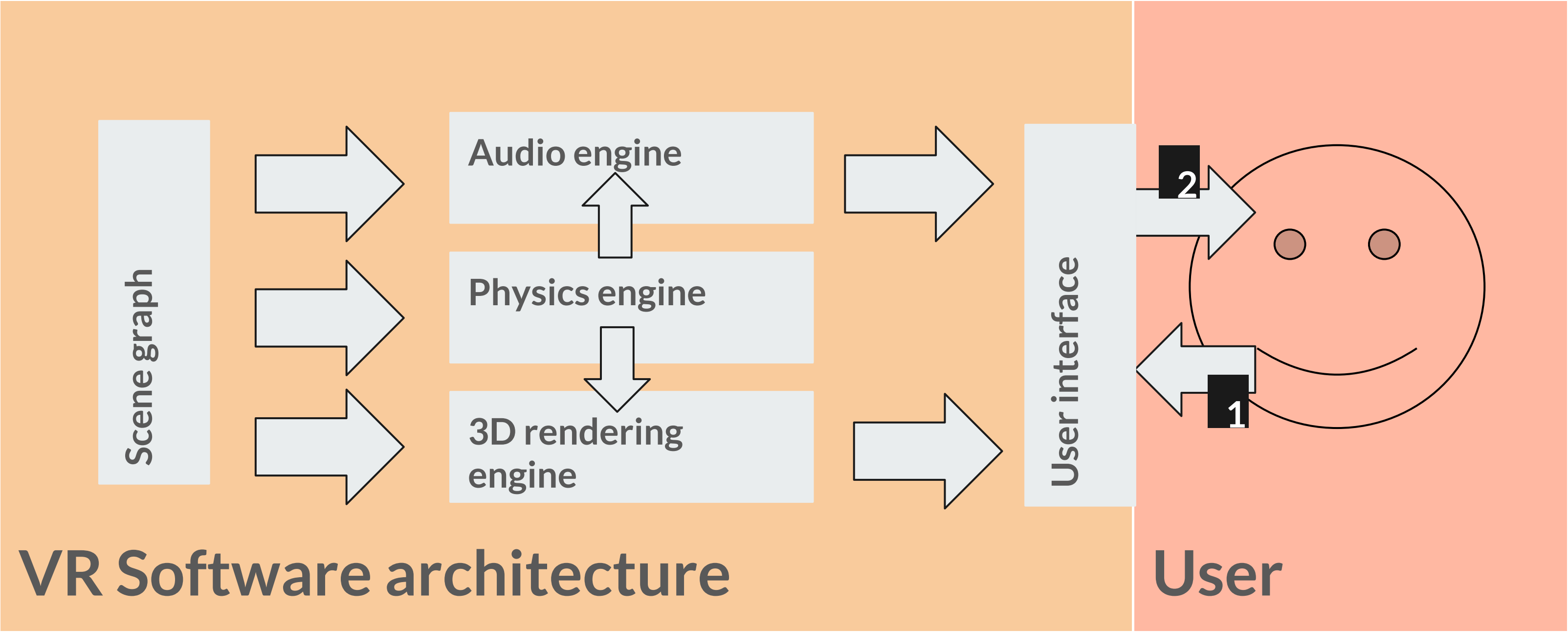
Platonic Allegory of the cave

Attempt of creating a fully immersive VE



https://faculty.washington.edu/smcohen/320/cave.htm

VR Software



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Scene Graph

Abstract representation of the VE

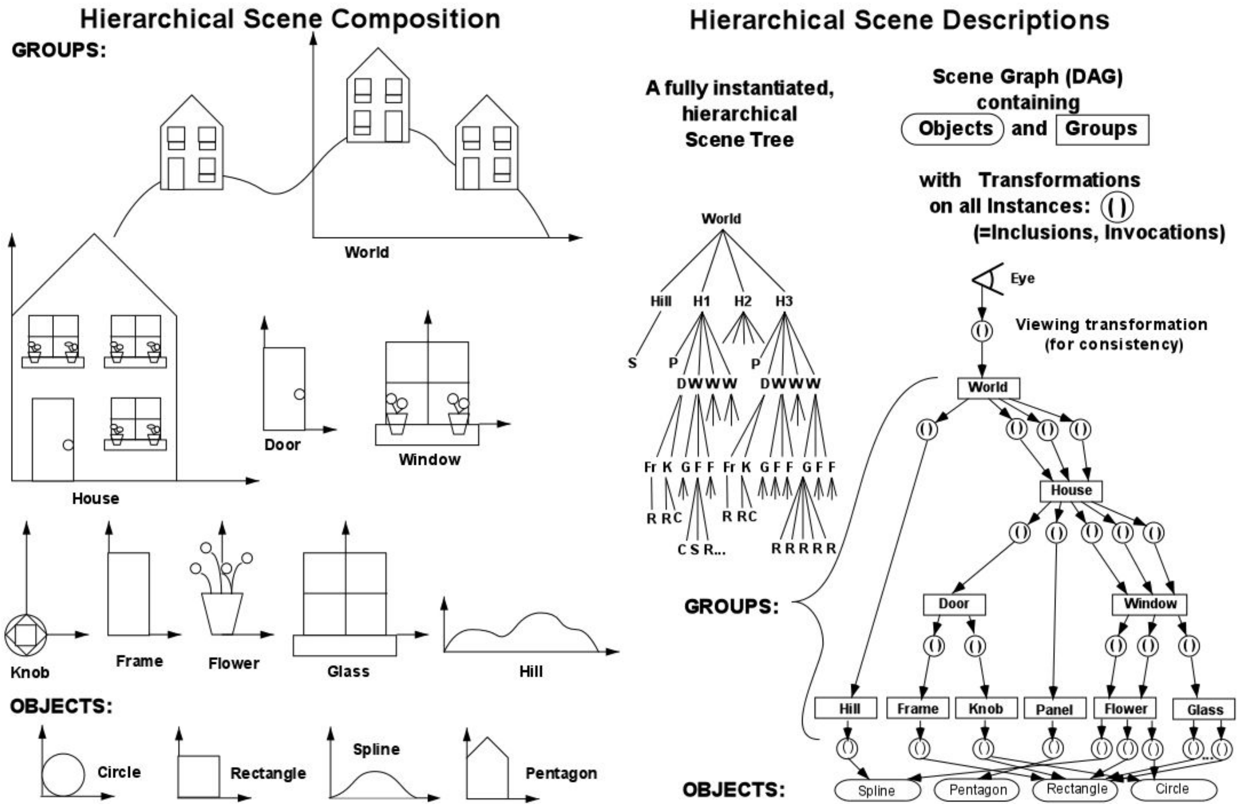
Complex data structure

Usually contains the links to geometric representation of virtual 3D objects

Information about position, orientation and scale

Visual appearance in form of shaders or snippets of code

Scene Graph



Tree-like structure

https://manek.tech/project/pysg/

3D Rendering Engines and 3D Rendering

FPS, pixels, displays, etc.

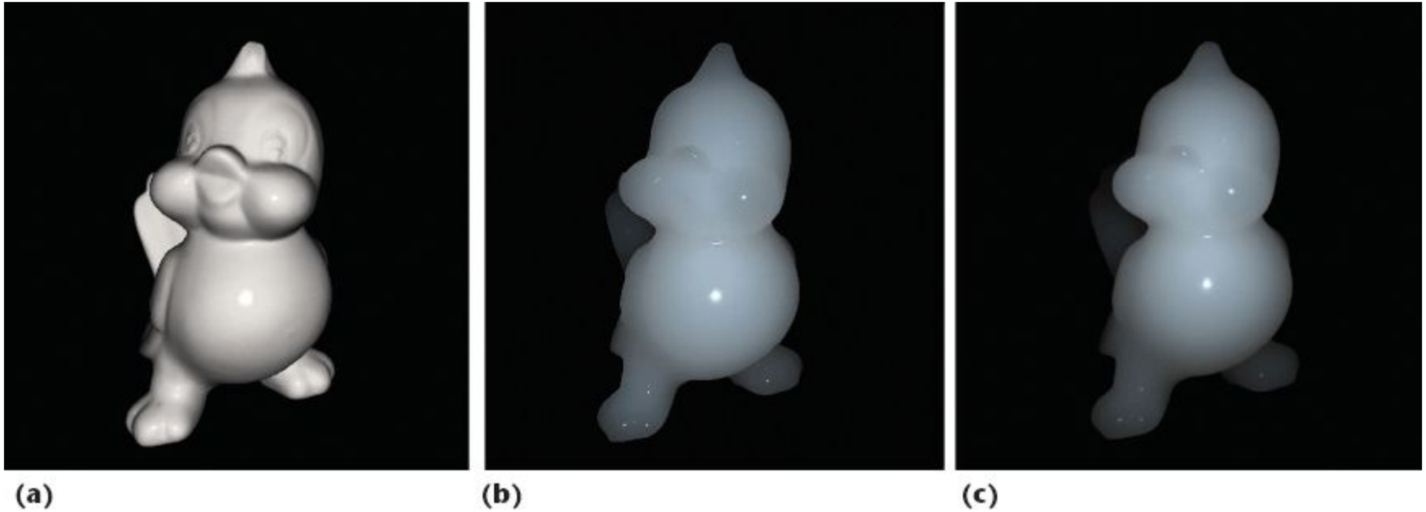
Rendering is a process of transforming the abstract representation of a 3D scene in a 2D image that is displayed to the user.

Rendering equation: mathematical model of light transfer at any given point in the 3D space.

Render algorithms: Lambertian shading, Phong shading, ray tracing, ray casting, radiosity

Rendering engine: geometry of the virtual object. Mesh.

3D Rendering Engines and 3D Rendering



https://www.computer.org/csdl/mags/cg/2009/01/mcg2009010066.html

Physics engine

Physics engines typically simulate:

1) Rigid body mechanics-collisions of bodies that do not change their geometries;

2) Soft body mechanics-collision of objects that can be deformed;

3) Rope mechanics-behavior of things like chains, ropes, etc;

4) Cloth physics-simulations of dynamic behavior of soft two-dimensional surfaces.

Referências

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