MAR

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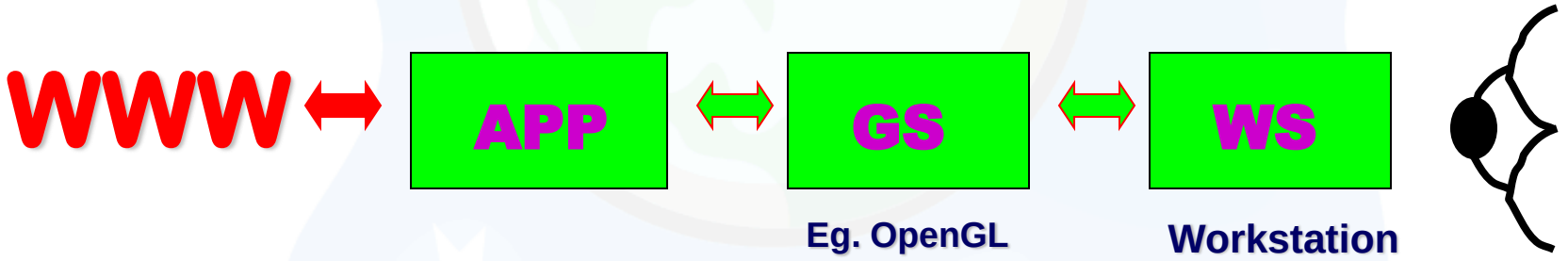
SCG 2013
Dec 9, 2020 video

Communication Interfaces

- Author - Application Programmer - GS Author - User



- What is interesting for users?
- State Exam Questions?

Five Questions

- **17. Computer Animation, Basic Concepts, Mathematical Model by Szirmay-Kalos.**
  Computer Graphics (3)
  (Coordinate systems, camera, lights, real-tme and offline animation, motion realism, 4 stages of animation creation (scenario, objects, keyframes, inbetweens), curve parameterization, ISO definition of animation, animation methods, curve parameterization).
  18. Forward Kinematics. Composition of Transformations for Articulated Structures.
  Computer Graphics (3)
  (3D scene graph, network structure, local and global transformations, their matrix expression and pros and cons, forward kinematics of articulated structures, interpolation of rotation.)
  19. Using Texture to Accelerate Rendering. Panoramas.
  Computer Graphics (3)
  (Coordinate systems, texture, surface details, procedural textures, texture processing for panoramas and facades, environment mapping, and other texture transformss, such as multipass, mipmapping, prefiltering and postfiltering.)
  20. Creating Virtual Environments. Cybercity Modeling and Rendering.
  Computer Graphics (3)
  (Coordinate systems, scene graph, LOD definitions, capturing and modeling of urban environments, terrain, georeferencing, and application of urban models.)
  21. Augmented and Mixed Reality. Reference model by Bimber and Raskar.
  Computer Graphics (3)
  (Coordinate Systems, Augmrnted Reality and its Reference Model, Three Types of Virtual Environments, Creation of either GPS Navigation, Computer Game, or Virtual Museum).

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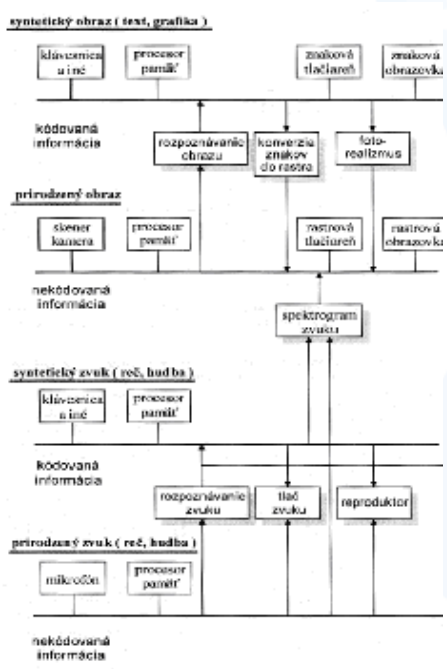
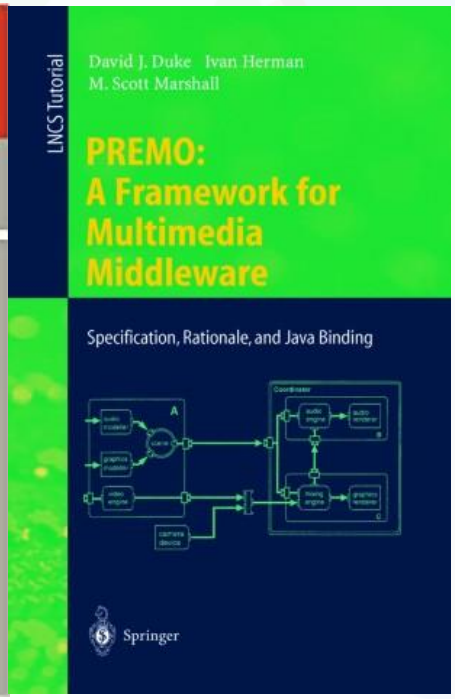
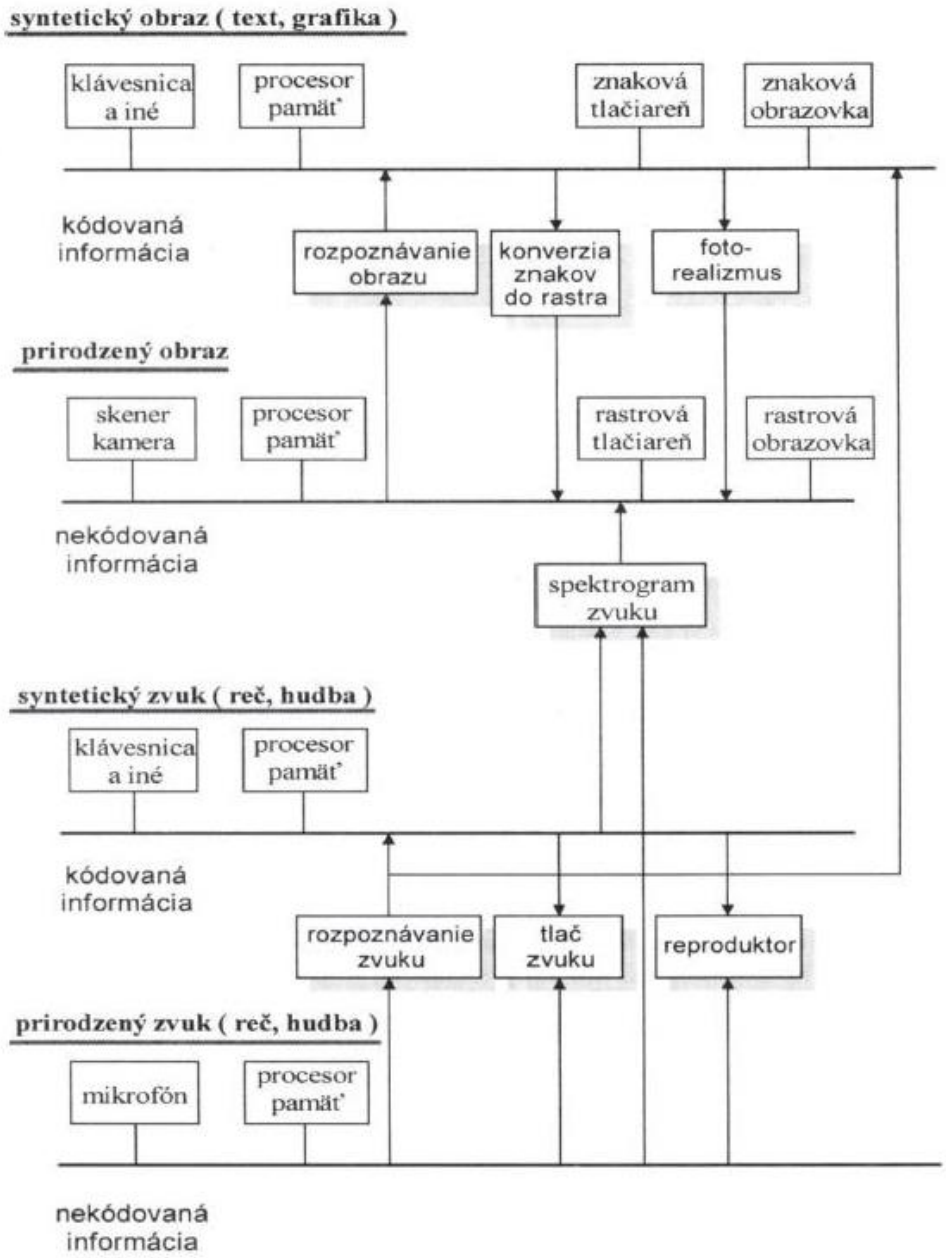
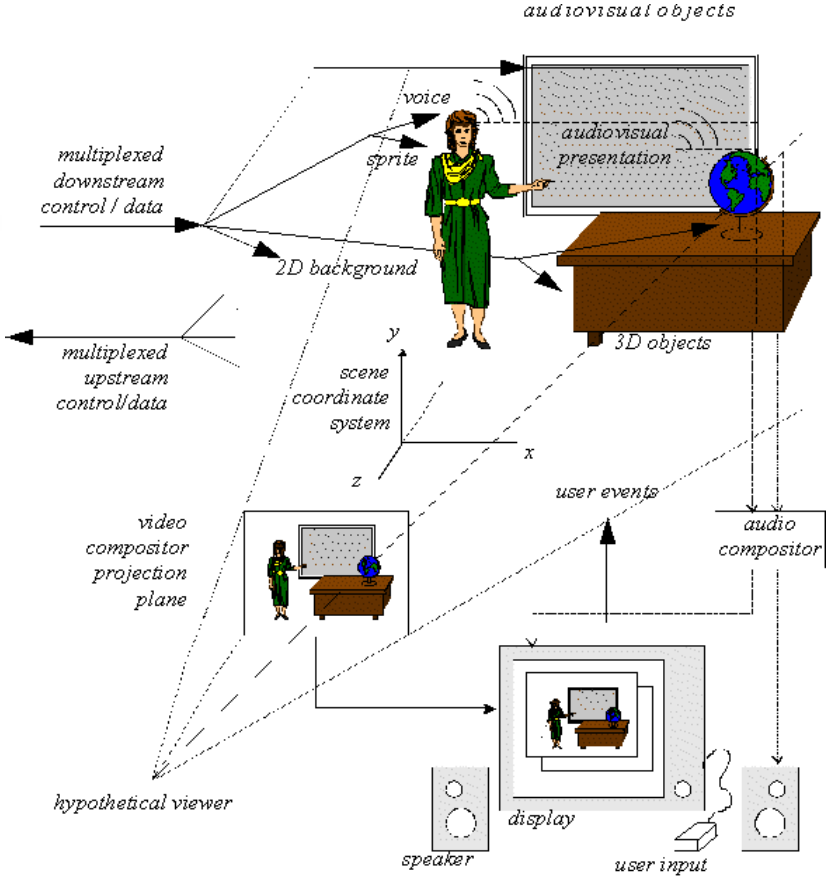
MM Architecture by Stucki 1991 >> Ruzicky 1995, kap. 20, PREMO 1998, MPEG-4 1998, MPEG-7 2004, MPEG-21 2019









Obr. 20.1 Architektúra multimediálneho systému

Imaging by CGRM

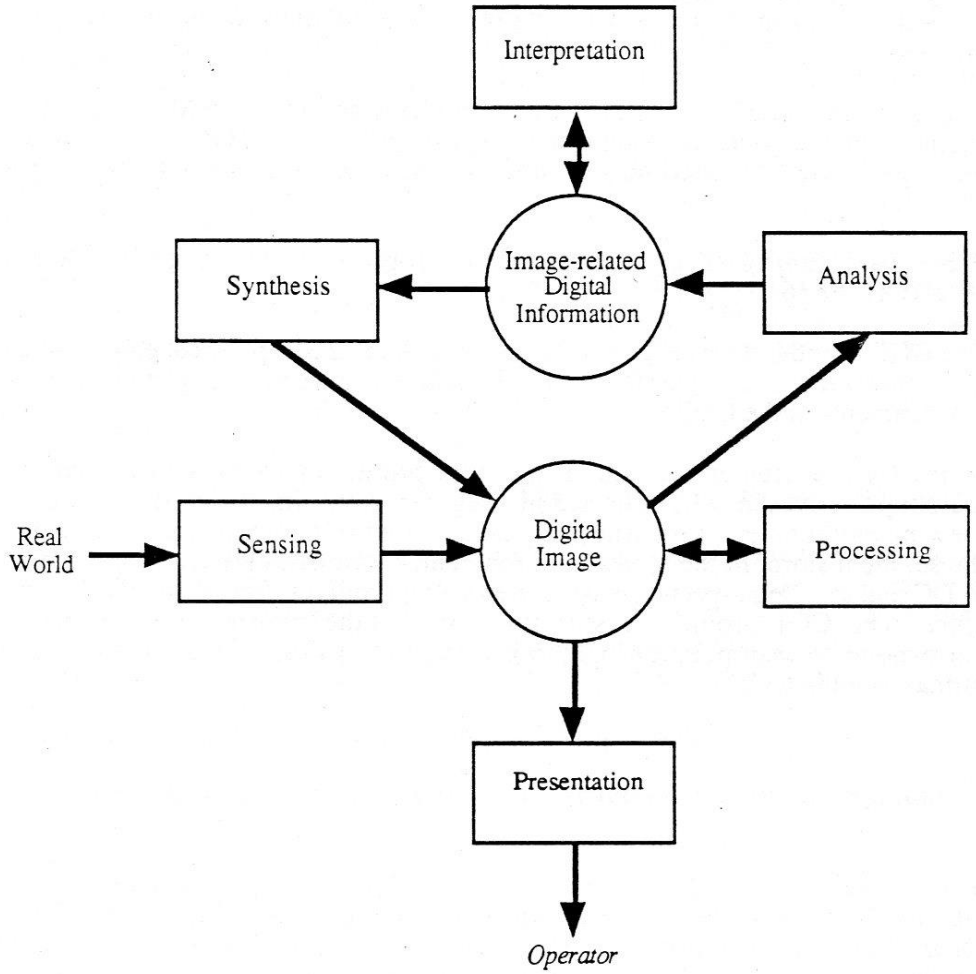


Figure B.1 – Computer imaging model

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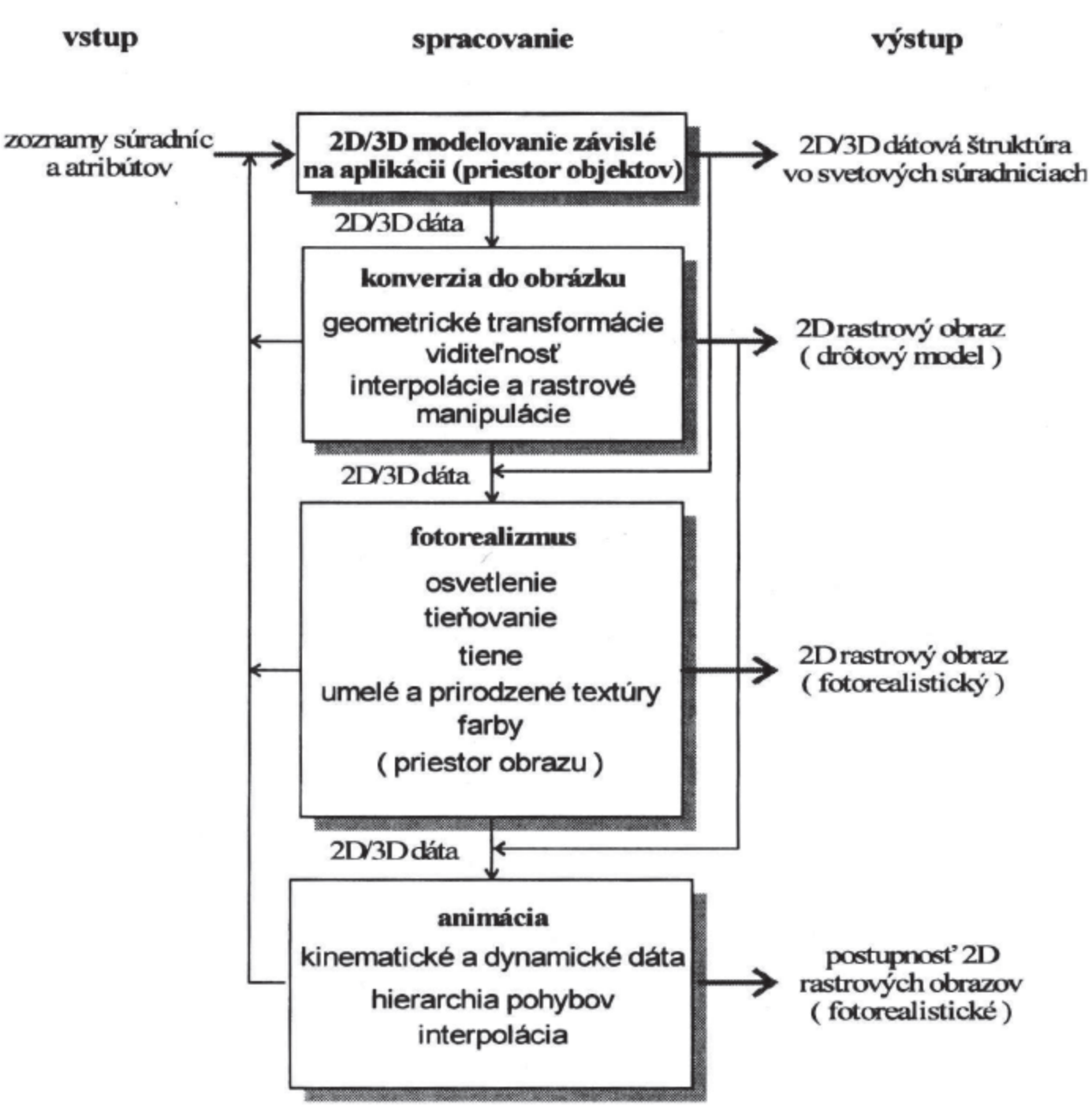
vstup
spracovanie
výstup
zoznamy súradníc a atribútov
2D/3D modelovanie závislé na aplikácii (priestor objektov)
2D/3D dátová štruktúra vo svetových súradniciach
2D/3D dáta
konverzia do obrázku
geometrické transformácie
viditeľnosť
interpolácie a rastrové manipulácie
2D rastrový obraz (drôtový model)
2D/3D dáta
fotorealizmus
osvetlenie
tieňovanie
tiene
umelé a prirodzené textúry
farby
(priestor obrazu)
2D rastrový obraz (fotorealistický)
2D/3D dáta
animácia
kinematické a dynamické dáta
hierarchia pohybov
interpolácia
postupnosť 2D rastrových obrazov (fotorealistické)

Architecture of VE

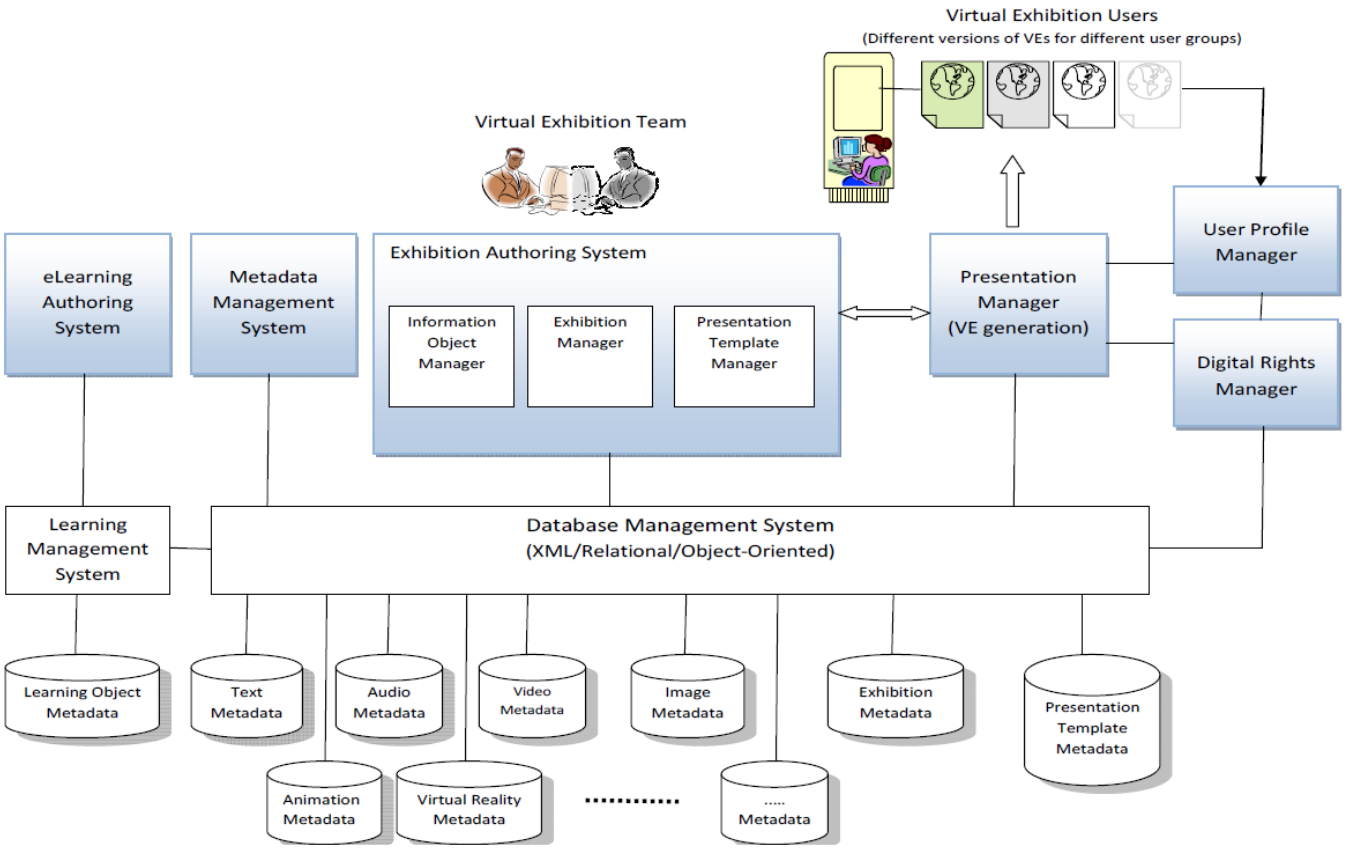

Figure 2. Generic system architecture for VE development

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Spatial by CIDOC CRM

Examples

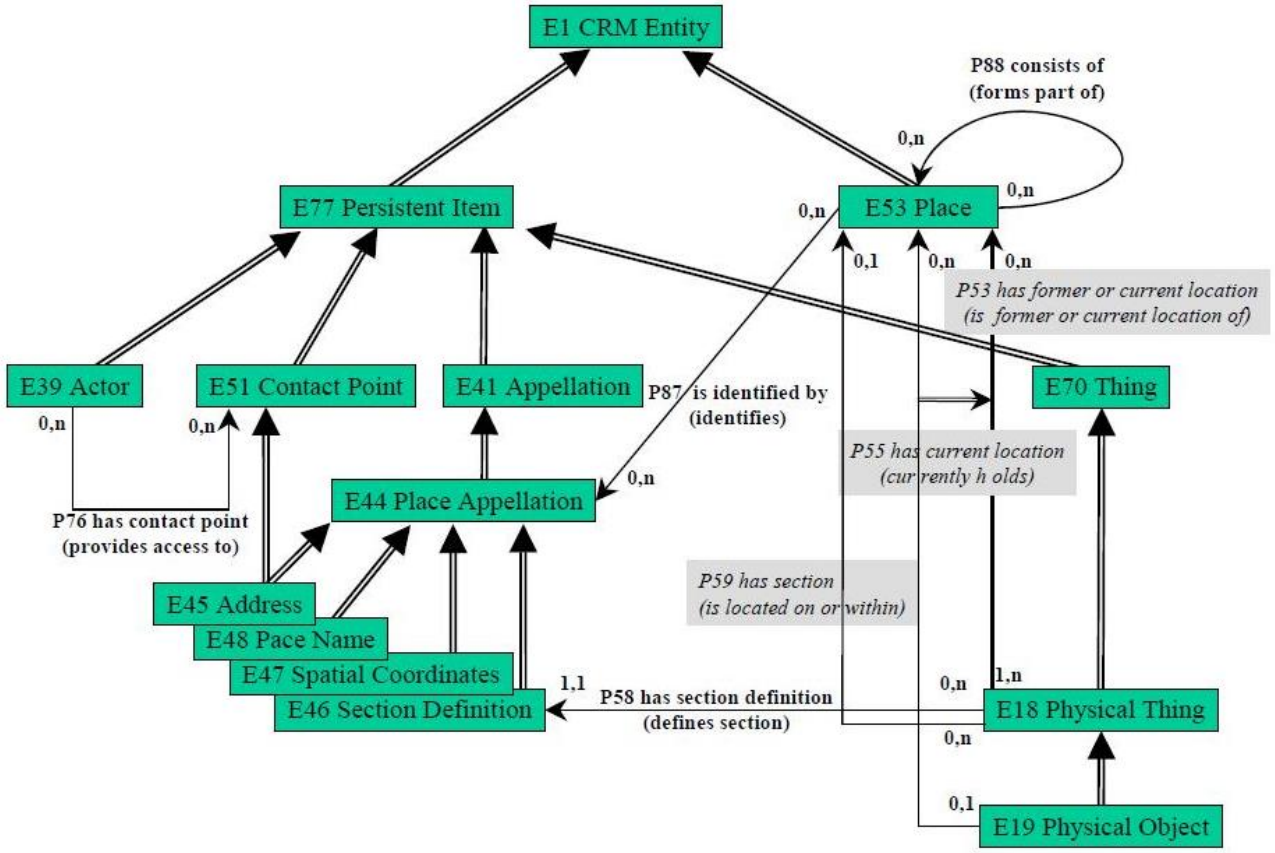

fig. 1 reasoning about spatial information

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Temporal by CIDOC CRM

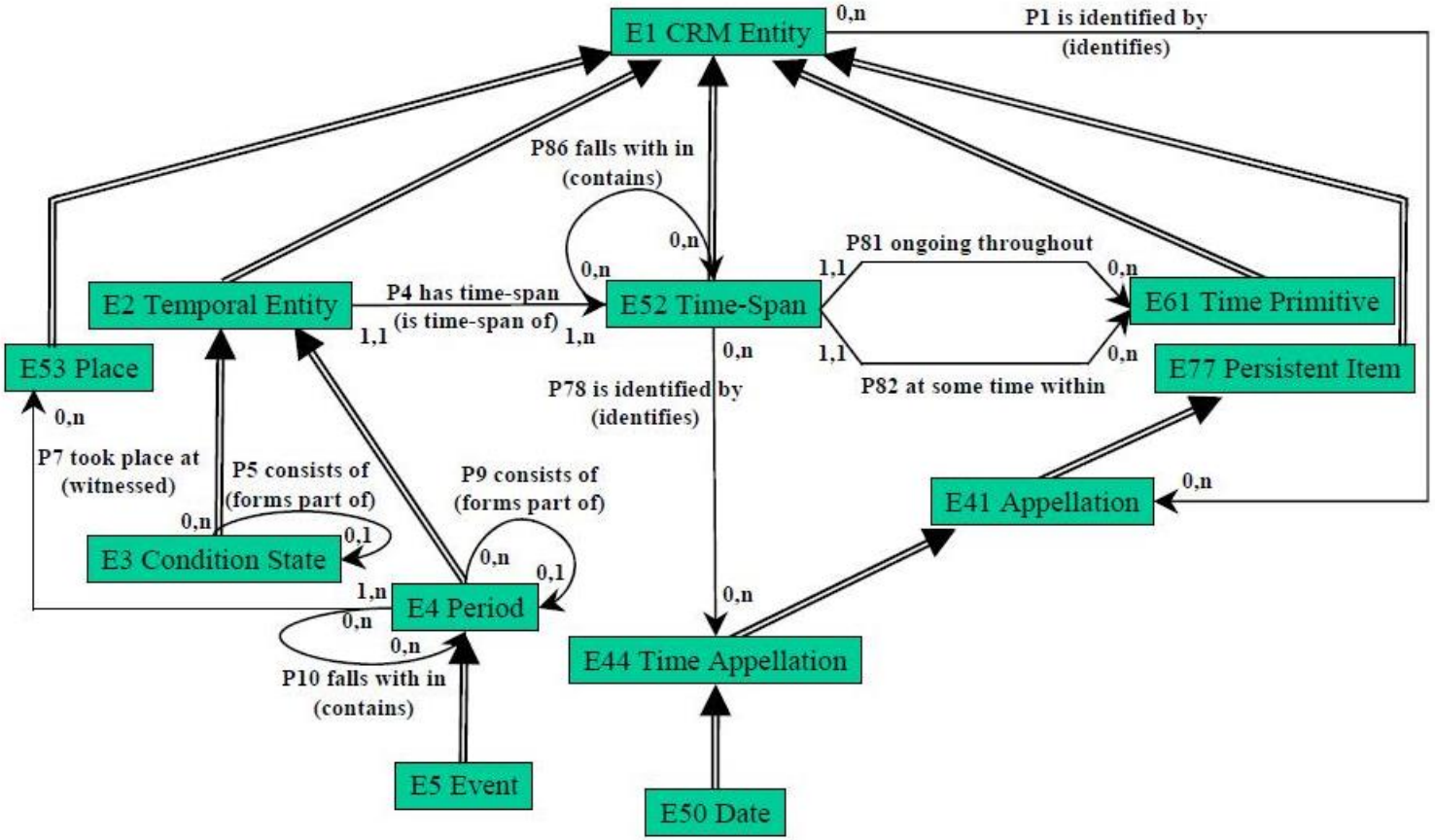

fig. 2 reasoning about temporal information

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Interfaces by CGRM

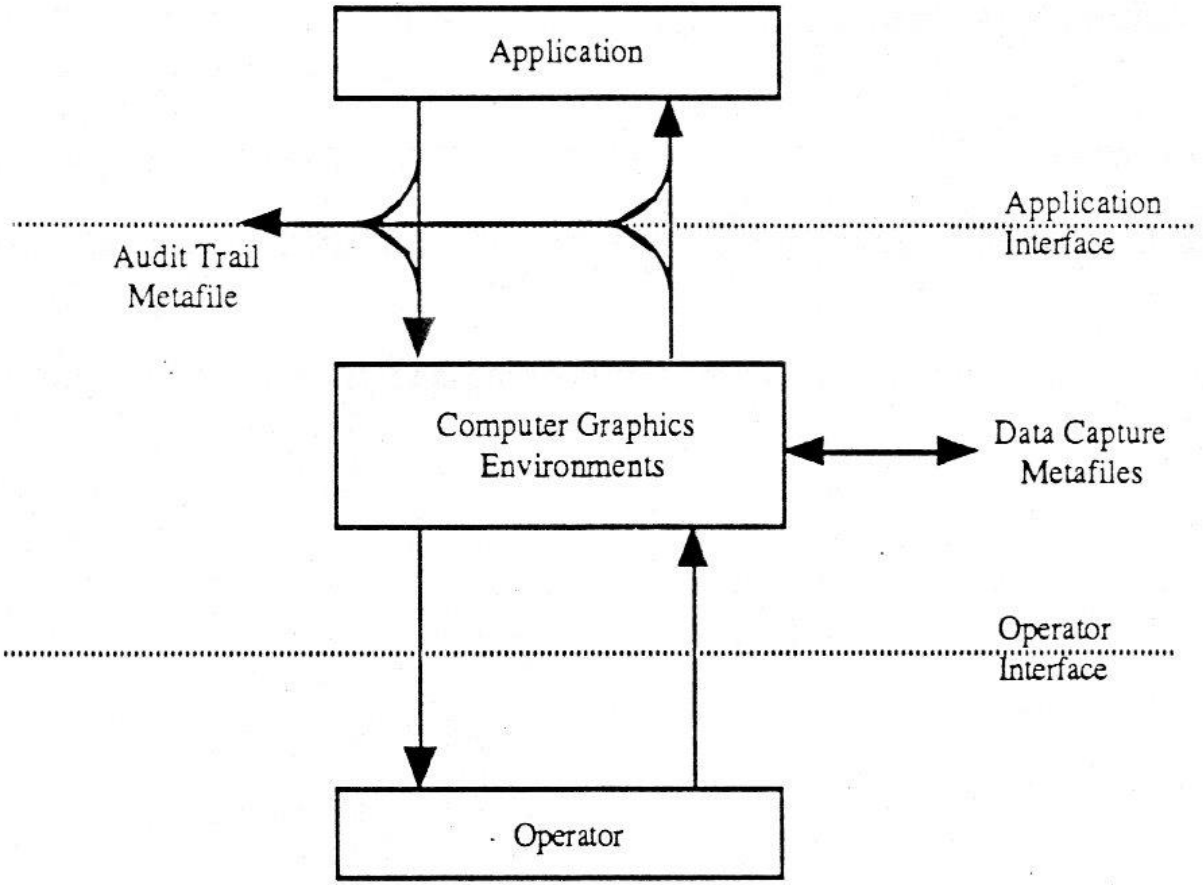

Figure 1 – External interfaces

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Environments by CGRM

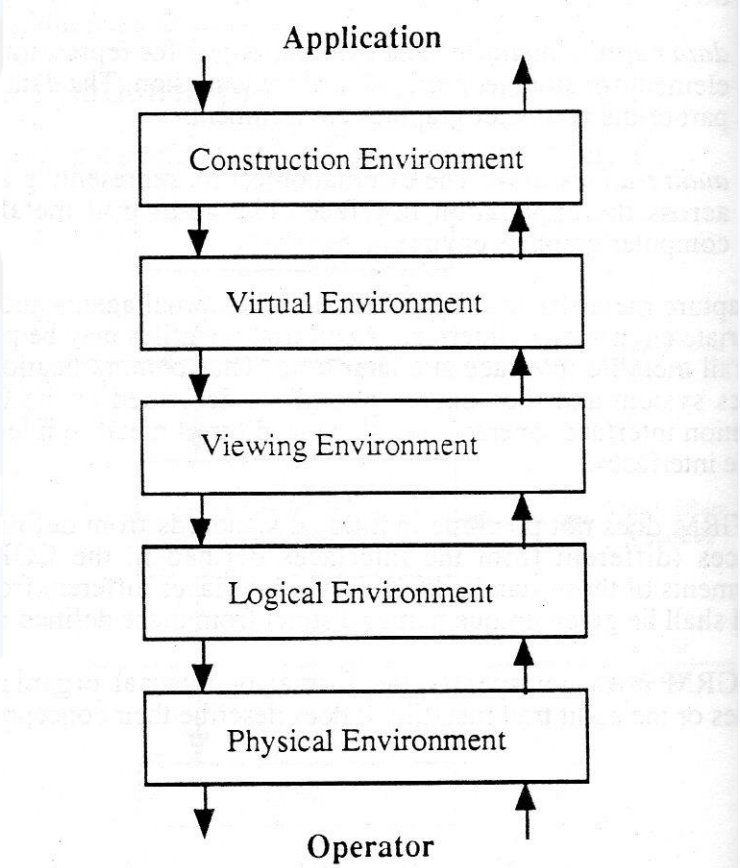

Figure 2 – Computer graphics environments

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Environment Model by CGRM

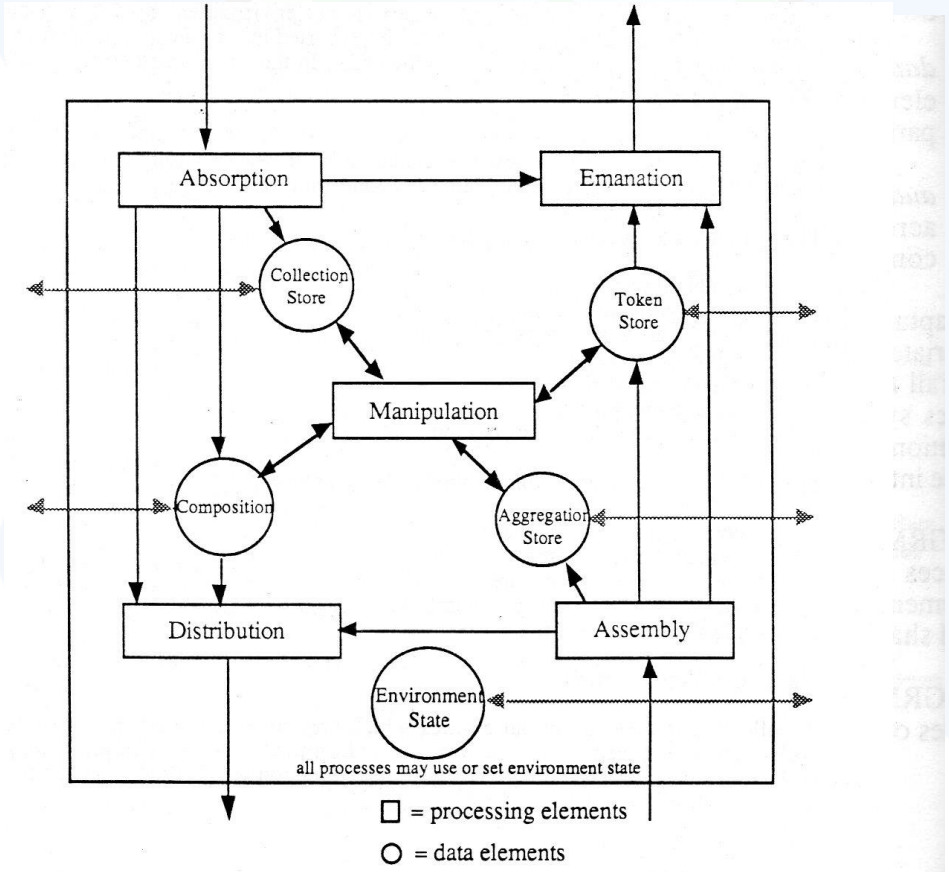

Figure 3 – Environment model

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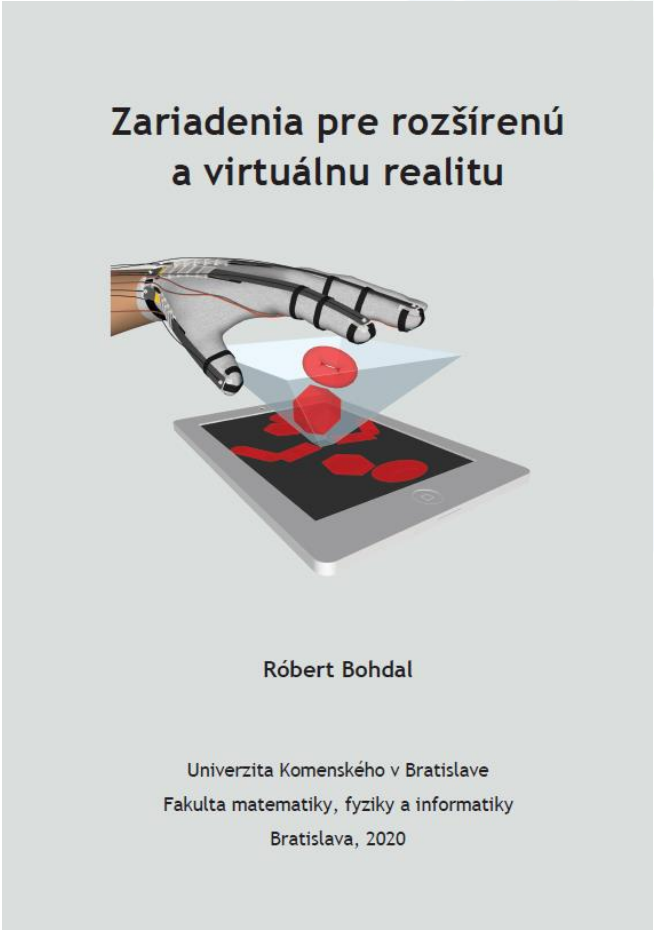
W. as GS
HW
R. Bohdal



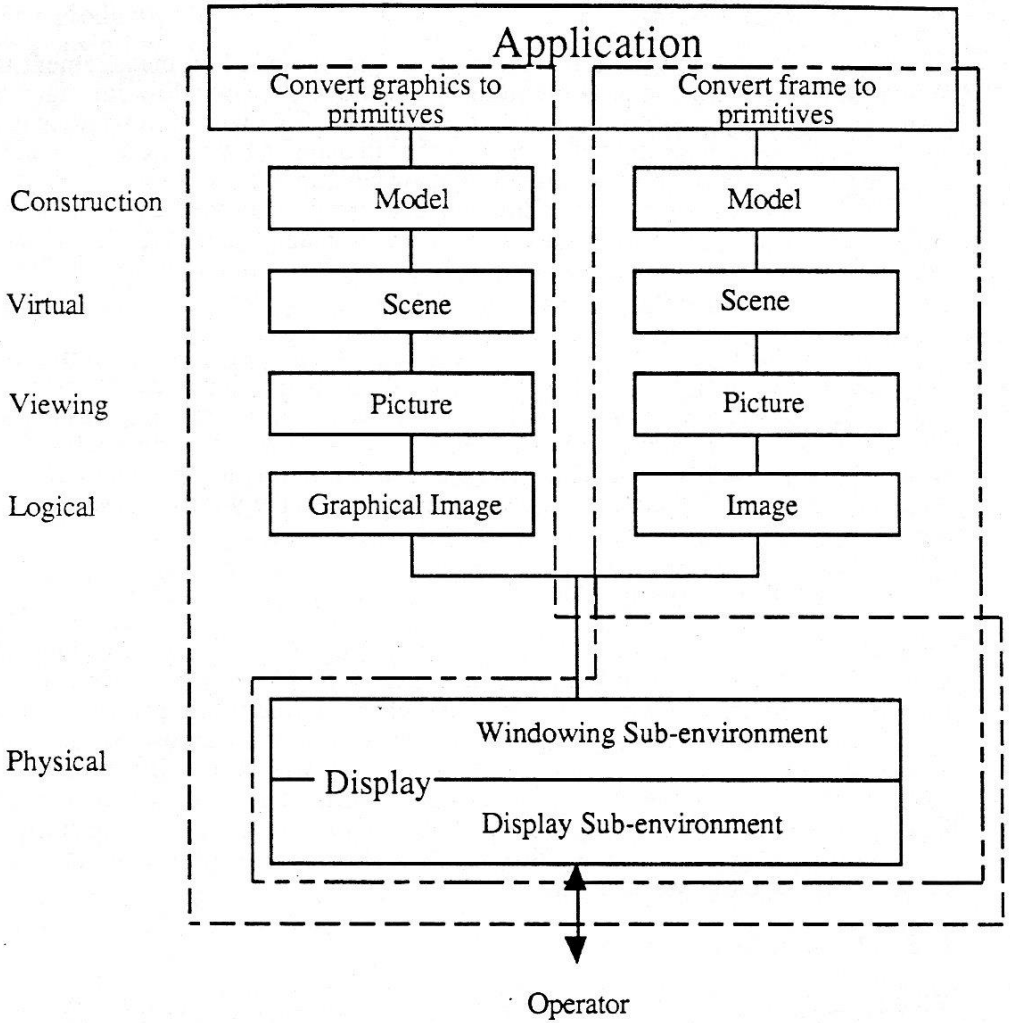
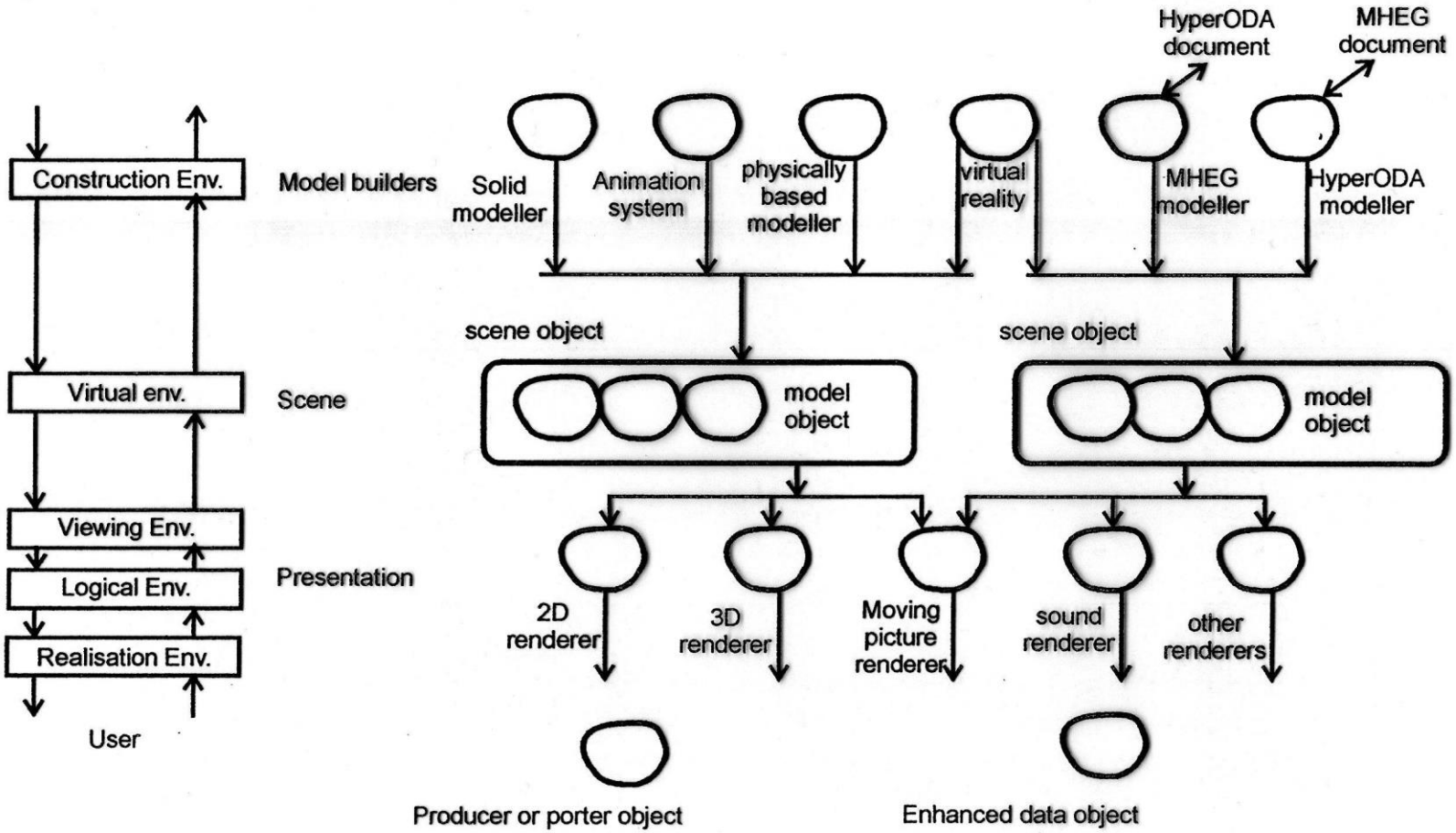


Figure C.2 – Windowing as a graphics system

PREMO



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Science

- Discovery

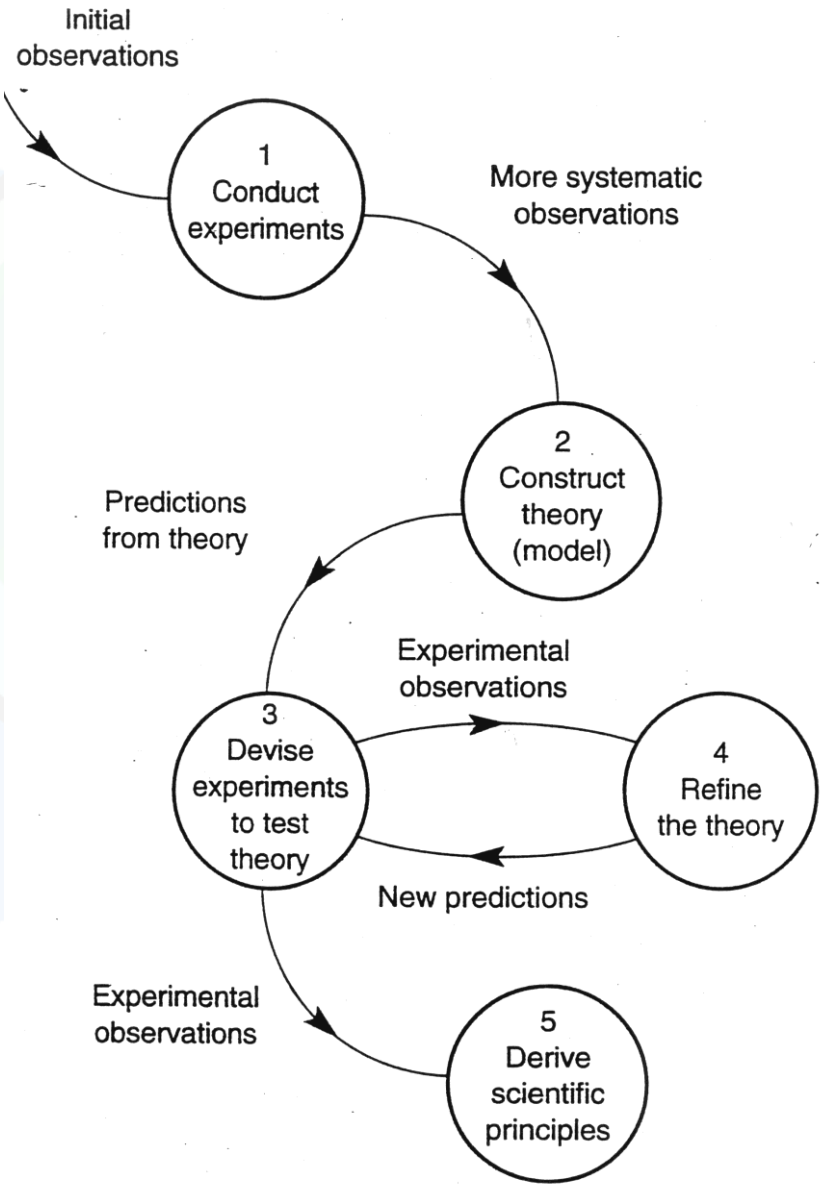

Figure 1.1 The nature of scientific analysis.

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Design

- Invention

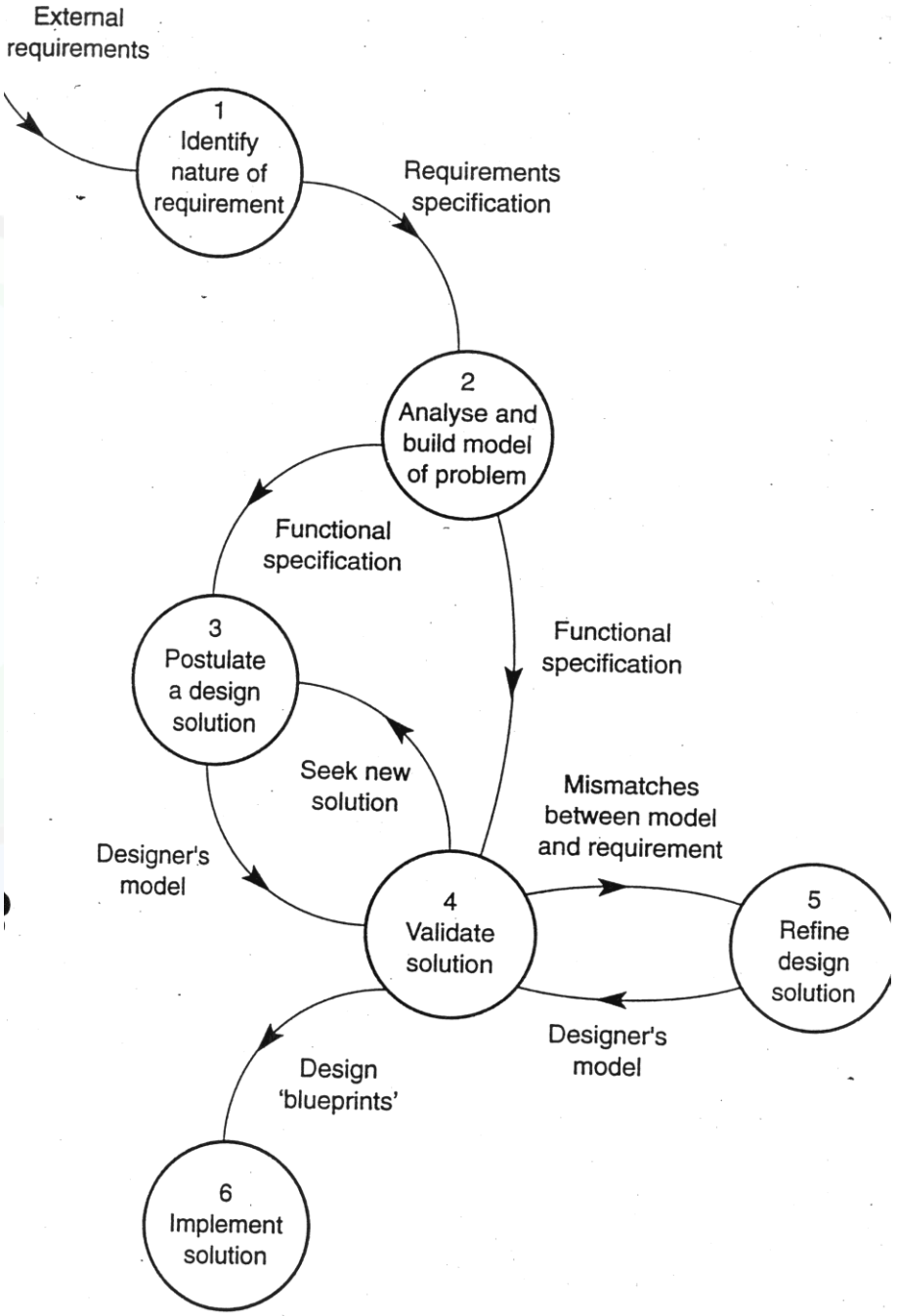


Figure 1.2 A model of the design process.

Design, MARS, Novotny et al.

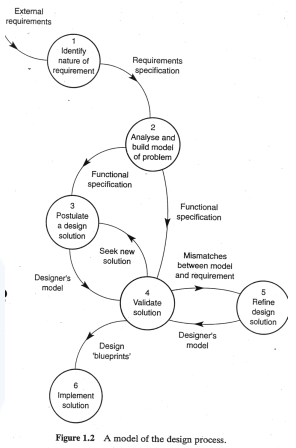


Figure 1.2 A model of the design process.

- Invention

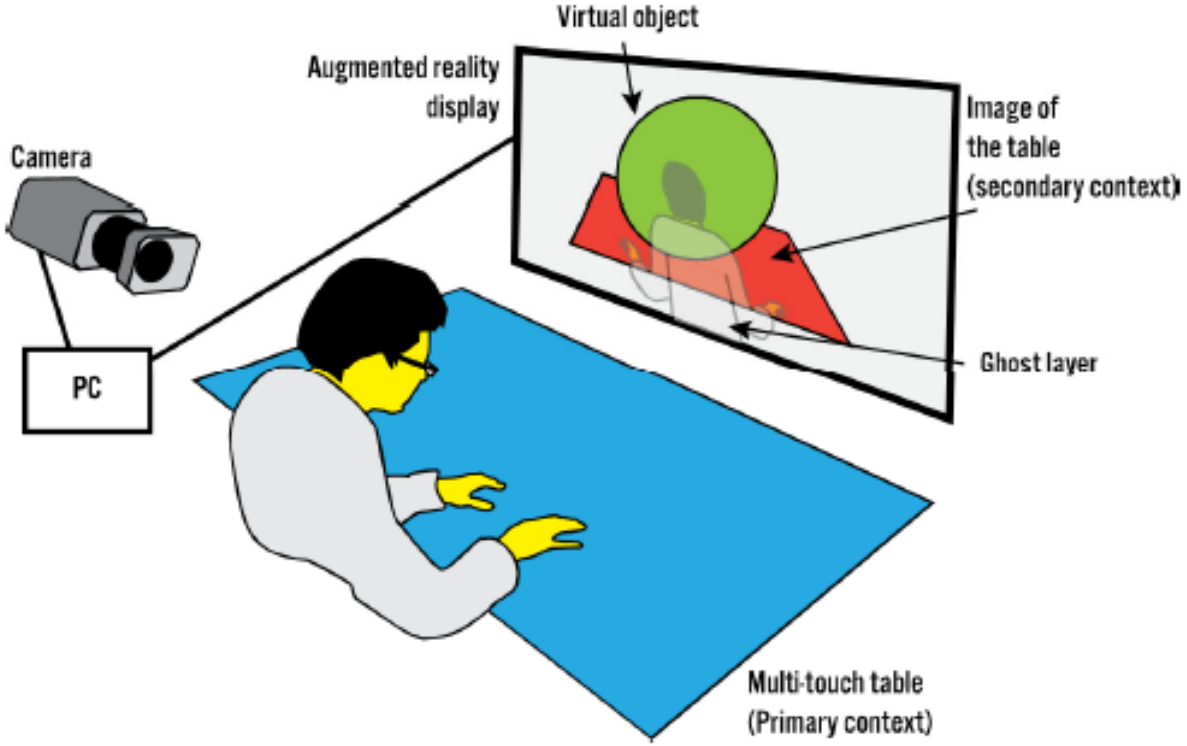
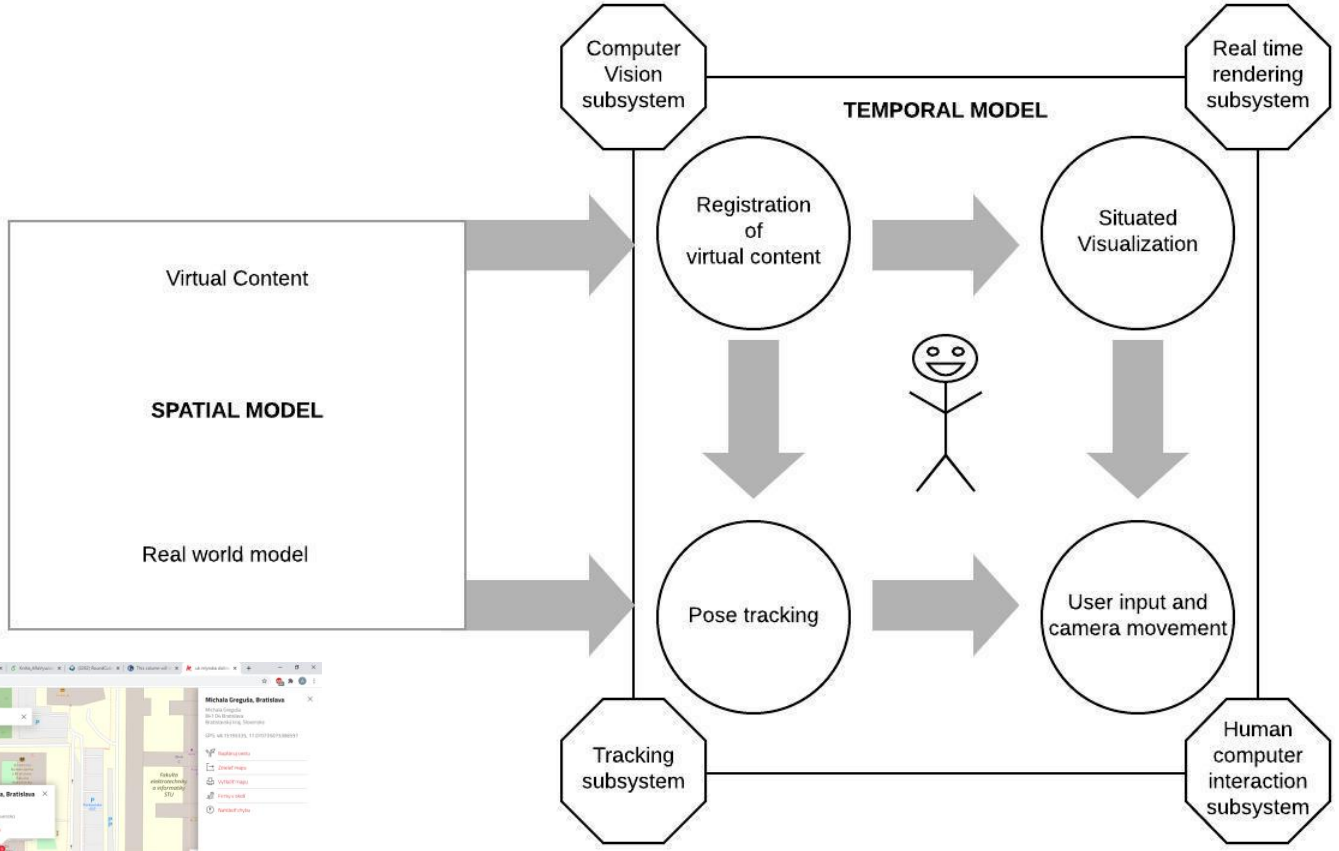
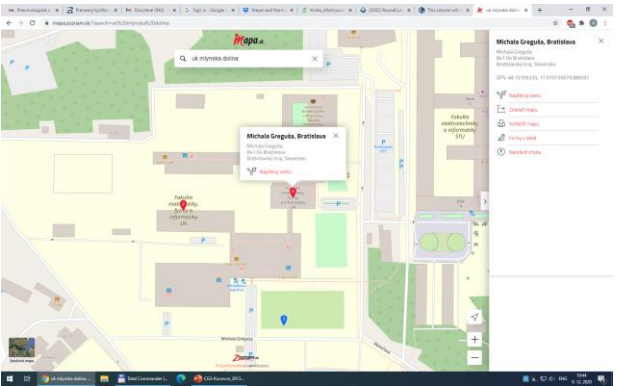
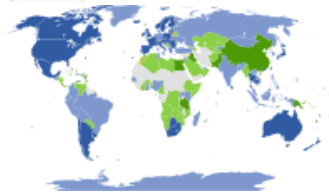


Fig. 1. Setup of Multi-touch augmented reality system

AR







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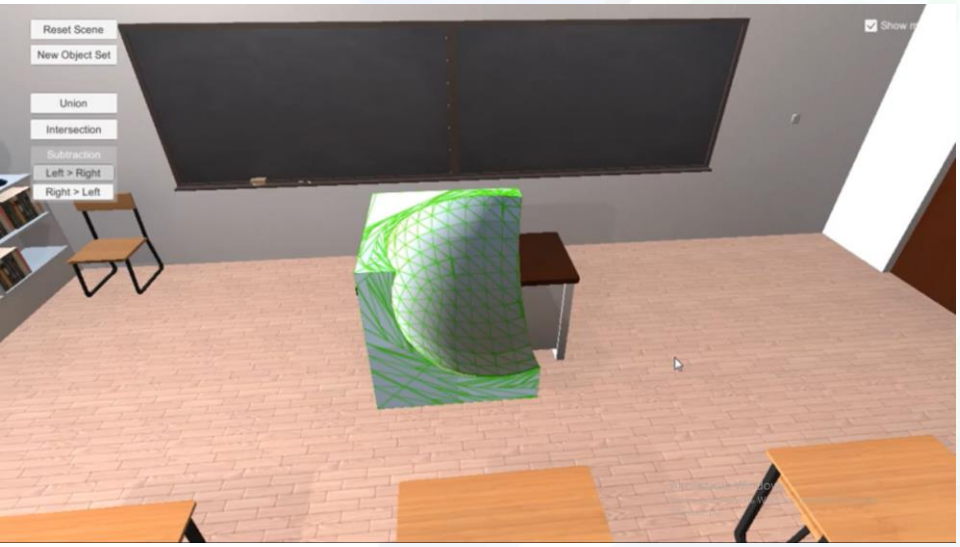
AR @ matfyz/ISO,

Olena MORDAS & Katia BARABASH



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ORGANISATION INTERNATIONALE DE NORMALISATION
ISO/IEC JTC1/SC29/WG11
CODING OF MOVING PICTURES AND AUDIO

ISO/IEC JAHG MAR J0007
Sapporo, JP, July 2014

ISO/IEC JTC1/SC29/WG11 N14769
Sapporo, JP, July 2014

Source SC24 WG9 and SC29 WG11
Title Proposed text for CD of Mixed and Augmented Reality Reference Model
Editors Gerard J. Kim, Christine Perey, Marius Preda

ISO/IEC JTC 1 N 0000

Date: 2014-07-8

ISO/IEC CD 24-29-1

ISO/IEC JTC 1

Secretariat:

Information technology — Computer graphics, image processing and environmental data representation and Coding of audio, picture, multimedia and hypermedia information — Part 1: Mixed and Augmented Reality Reference Model

Technologie de l'information — Infographie, traitement d'image et données d'environment ET Codage de l'audio, image, multimédia et hypermédia — Partie 1: Modèle de référence pour la Réalité Augmentée

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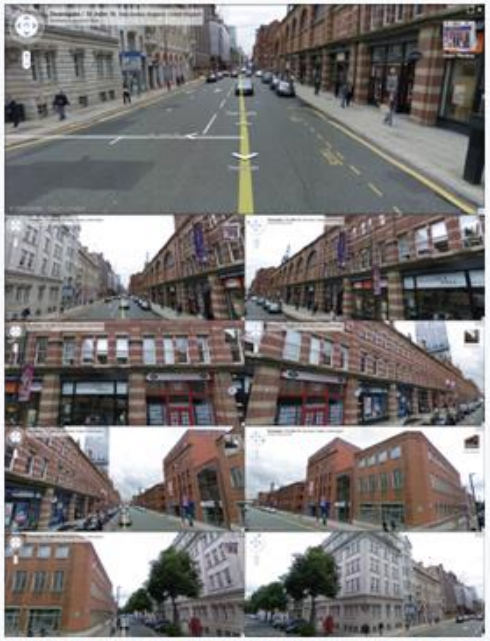
Google Street View



A road junction in Manchester, England, showing nine different angles

Initial release	May 25, 2007; 13 years ago
	Stable release(s) [±]
Android	2.0.0.332819934 / September 25, 2020; 2 months ago[1]
iOS	2.17.2 / July 16, 2020; 4 months ago[2]
Online	Release 266 (*see list*) / November 30, 2020; 8 days ago
Platform	Android, iOS, web
Available in	Multiple languages
Website	www.google.com/streetview/

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TU WIEN — INTERACTIVE MEDIA SYSTEMS — Vienna University of Technology

Welcome About Us Research Teaching

TU Wien › Faculty of Informatics › Institute of Visual Computing and Human-Centered Technology
Interactive Media Systems › Projects › Construct3D - An Augmented Reality System for Mathematics and Geometry Education (1999)

Construct3D - An Augmented Reality System for Mathematics and Geometry Education

Research project in the area of Virtual and Augmented Reality.

Keywords: Studierstube, Augmented Reality, Applications.

"Construct3D"
Research Project

January 1999 to December 2008.

Contact
Hannes Kaufmann

Team
- Hannes Kaufmann
- Dieter Schmalstieg

About this Project

Construct3D is a three dimensional geometric construction tool based on the collaborative augmented reality system "Studierstube". Our setup uses a stereoscopic head mounted display (HMD) and the Personal Interaction Panel (PIP) - a two-handed 3D interaction tool that simplifies 3D model interaction. Means of application in mathematics and geometry education at high school as well as university level are being discussed. A pilot study summarizes the strengths and possible extensions of our system. Anecdotal evidence supports our claim that the use of Construct3D is easy to learn and encourages experimentation with geometric constructions.

Additional Information

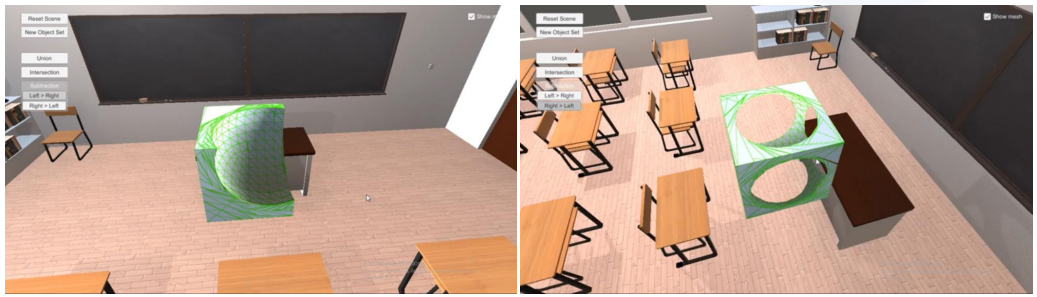
Spatial abilities present an important component of human intelligence. The term spatial abilities covers five components, spatial perception, spatial visualization, mental rotations, spatial relations and spatial orientation [Maier 1994]. Generally, one goal of geometry education is to improve these spatial skills. In a long term study by Gittler and Glück [1998], the positive effects of geometry education on the improvement of spatial intelligence have been verified. Various other studies [Osberg 1997; Rizzo et al. 1998] conclude that spatial abilities can also be improved by virtual reality (VR) technology. However, little to no work has been done towards systematic development of VR applications for practical education purposes in this field.

Using Augmented Reality in Education

To fill the gap of next-generation virtual reality interfaces for mathematics and geometry education we are developing a three dimensional geometric construction tool called Construct3D that can be used in high school and university education. Our system uses Augmented Reality (AR) [Azuma 1997] to provide a natural setting for face-to-face collaboration of teachers and students. The main advantage of using AR is that students actually see three dimensional objects which they until now had to calculate and construct with traditional (mostly pen and paper) methods. We speculate that by working directly in 3D space, complex spatial problems and spatial relationships can be comprehended better and faster than with traditional methods.

Supporting different learning styles & providing multimodal/hybrid hardware setups for classroom use

For productive use in the classroom, a number of circumstances must be accommodated: Support for a variety



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MAR/ISO

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ISO/IEC JTC 1

Secretariat:

Information technology — Computer graphics, image processing and environmental data representation and Coding of audio, picture, multimedia and hypermedia information — Part 1: Mixed and Augmented Reality Reference Model

Technologie de l'information — Infographie, traitement d'image et données d'environment ET Codage de l'audio, image, multimédia et hypermédia — Partie 1: Modèle de référence pour la Réalité Augmentée

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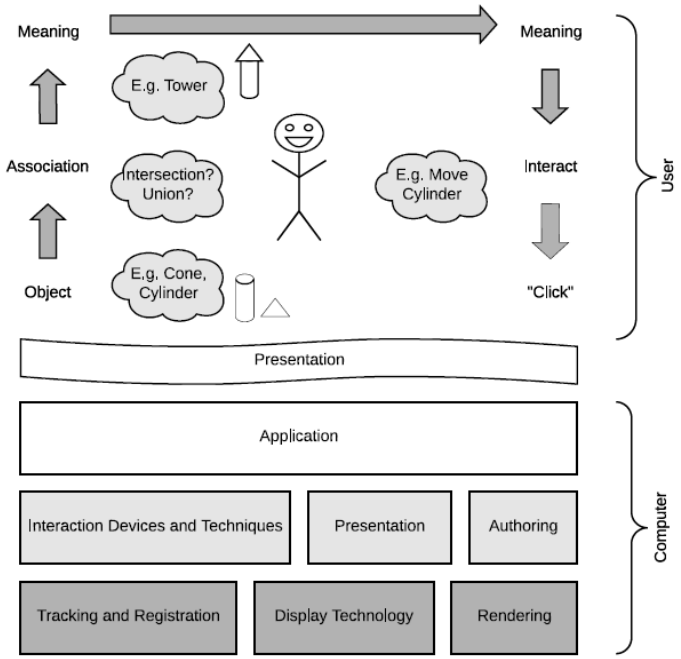
MR Continuum

AZUMA

GLOBÁLNA A LOKÁLNA ZAUJÍMAVOSŤ VO VYUČOVANÍ GEOMETRIE A ROZŠÍRENEJ REALITY



Obr. 2.7: Stavebné bloky AR (Bimber; Raskar, 2005) a príklad úrovní odoziev, rozpoznané objekty, generované asociácie, určenie významu a prípadná interakcia. Horná časť obrázku schematizuje vytváranie významu šípkami nahor na ľavej strane a prípadne premenu významu, znázornenú dlhou šípkou doľava na interakciu znázornenú šípkami nadol. Hoci je používateľ vyznačený mimo týchto tokov dát, nad úrovňou prezentácie sa odohrávajú v jeho vnútornom svete a do vonkajšieho sveta sa vracia zadaním vstupného dátového záznamu, napr. kliknutím.

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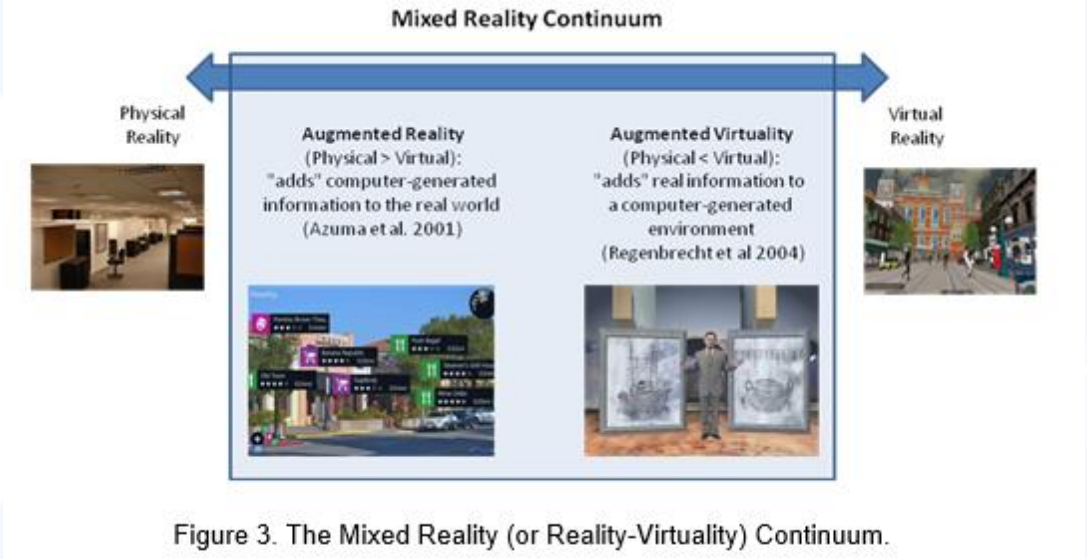
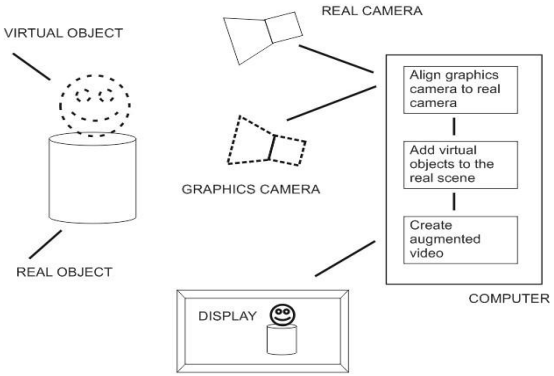


Figure 3. The Mixed Reality (or Reality-Virtuality) Continuum.

AZUMA 1997, combine real & virtual, interactive in real-time, registered in 3D



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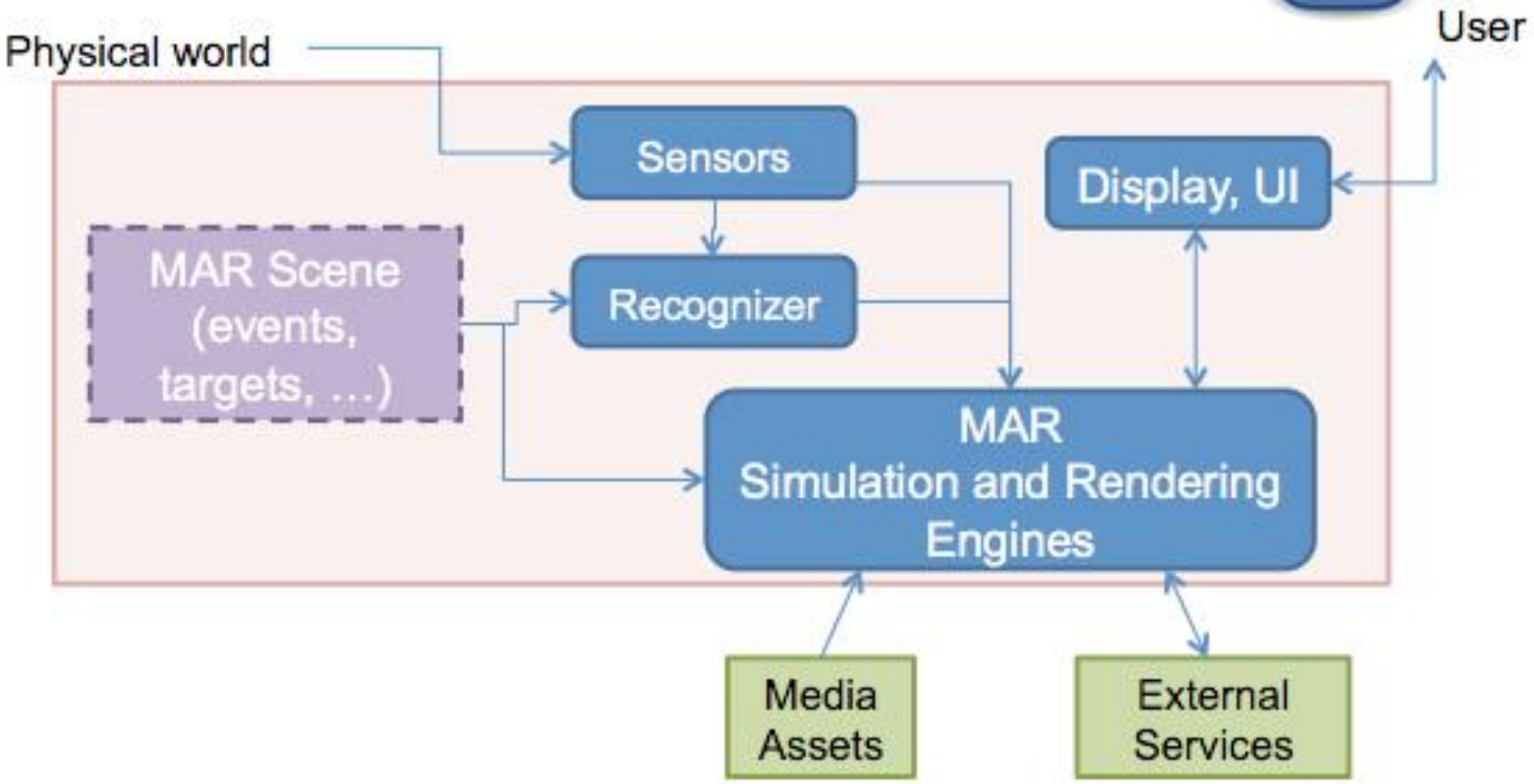
MR Components



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Computation Viewpoint, e.g. Magic Book

Physical world

Pure sensors

Real world capturer

Sensors

User

UI

Display

MAR Scene (events, targets, …)

Tracker

Recognizer

Context Analyzer

Renderer

Event Mapper

Spatial Mapper

Simulator

MAR Execution Engine

Media Assets

External Services

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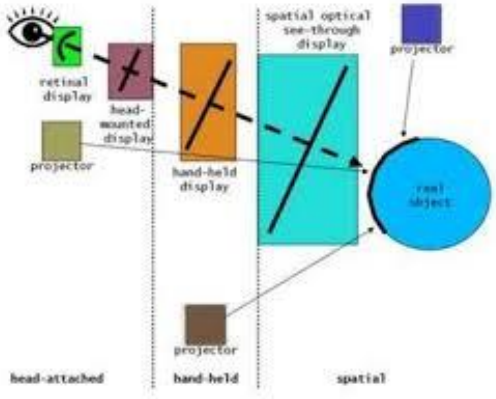
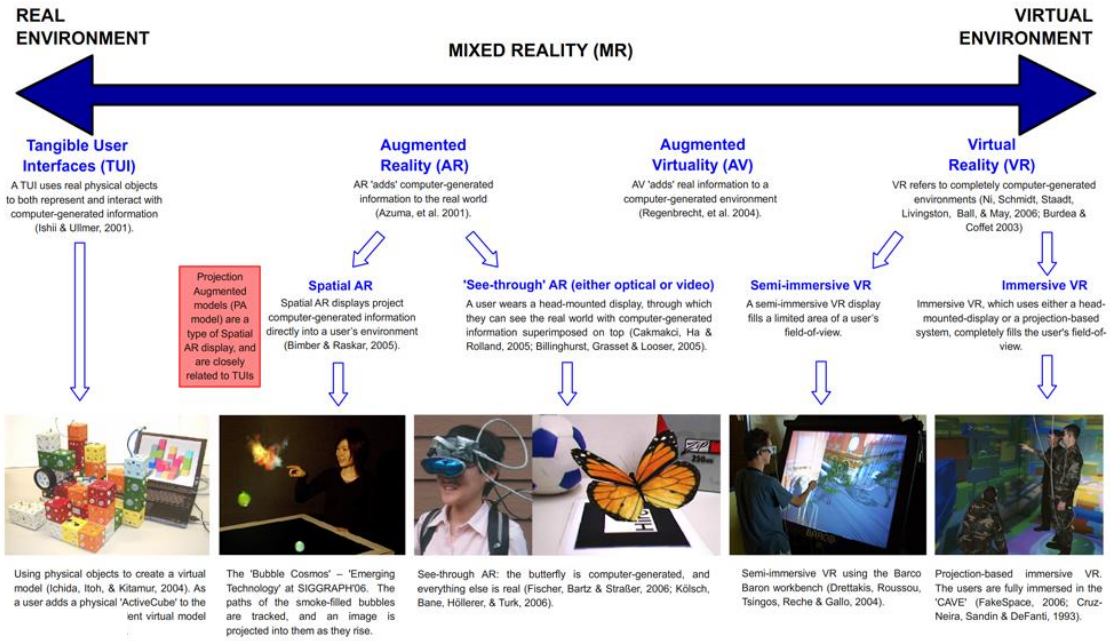
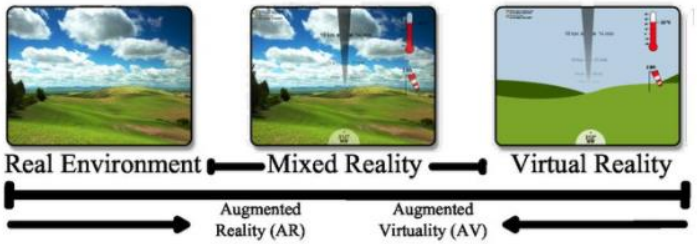


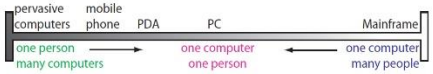


of advanced computer interfaces, based on Milgram and Kishino (1994).

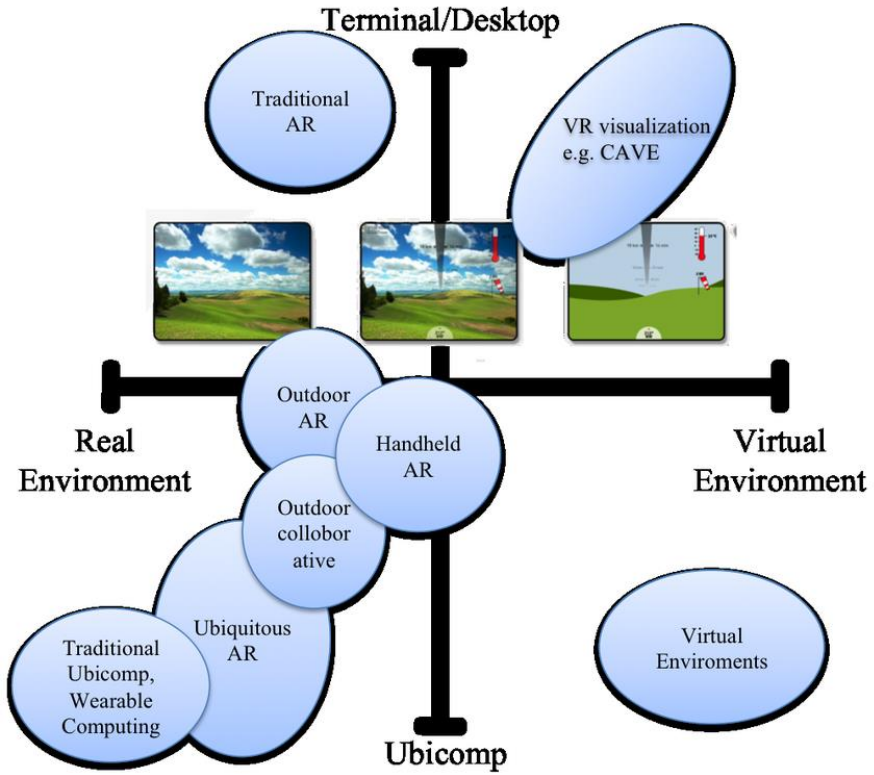
wikipedia.org/wiki/Projection_augmented_modelAR Layers



Ubiquitous Computing Continuum



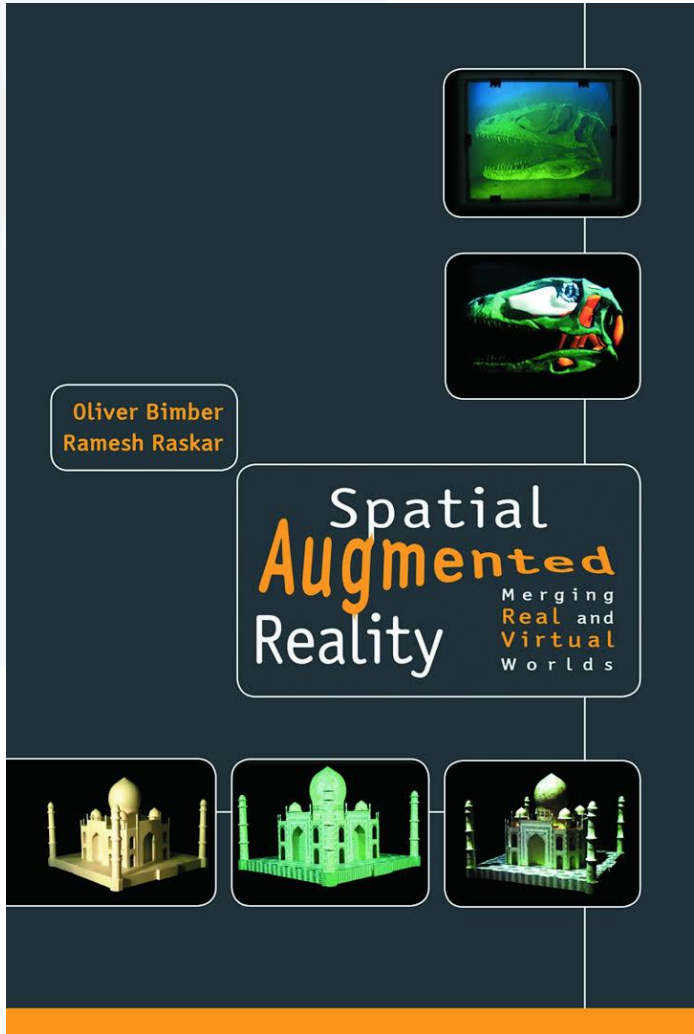
- Weiser Continuum



Milgram-Weiser

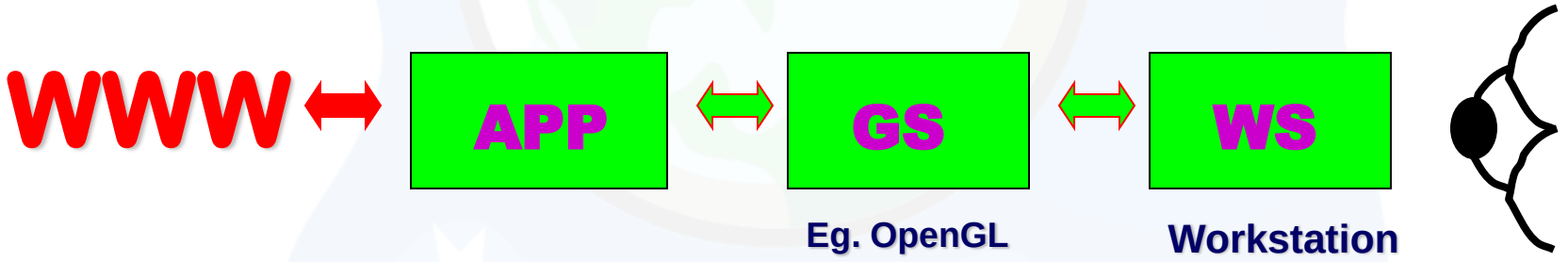
AR Quality,

https://arbook.icg.tugraz.at/Schmalstieg-2016-AW



Communication Interfaces >> AUTHORING

- Author - Application Programmer - GS Author - User

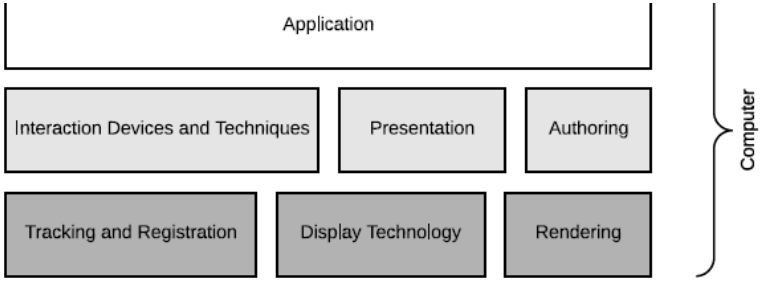


- What is interesting for users?

AR Layers

I. Tvorba virtuálneho prostredia, II. Návrh virtuálnej interakcie (navigácia, kooperácia, interaktívne príbehy). Rozpísať tieto dve etapy možno do siedmich krokov:

1. **Politika pamäti**, t.j. identifikácia miery zaujímavosti a rozhodnutie o tvorbe virtuálneho múzea ako virtualizácie svetovo unikátneho súboru dát
2. **Zber primárnych dát**
3. **Spracovanie dát, selekcia a vytvorenie sekundárnych dát na prezentáciu**
4. **Návrh a implementácia** hardverového a softverového riešenia
5. **Organizácia digitálneho obsahu** na prezentáciu, t.j. tvorba scenárov na základe predpokladov, dát a východísk v krokoch 3. a 4.
6. **Integrácia, verifikácia a testovanie** virtuálneho múzea
7. **Inštalácia, promócia, publikovanie, distribúcia** a medializácia, vyhodnotenie riešenia



Obr. 2.7: Stavebné bloky AR (Bimber; Raskar, 2005) a príklad úrovní odoziev, rozpoznané objekty, generované asociácie, určenie významu a prípadná interakcia. Horná časť obrázku schematizuje vytváranie významu šípkami nahor na ľavej strane a prípadne premenu významu, znázornenú dlhou šípkou doľava na interakciu znázornenú šípkami nadol. Hoci je používateľ vyznačený mimo týchto tokov dát, nad úrovňou prezentácie sa odohrávajú v jeho vnútornom svete a do vonkajšieho sveta sa vracia zadaním vstupného dátového záznamu, napr. kliknutím.

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Virtual Museum Quality

Lyn Elliot Sherwood navrhla vzorec: Visits/Visitors*Duration.

I. Tvorba virtuálneho prostredia, II. Návrh virtuálnej interakcie (navigácia, kooperácia, interaktívne príbehy). Rozpísať tieto dve etapy možno do siedmich krokov:

1. **Politika pamäti**, t.j. identifikácia miery zaujímavosti a rozhodnutie o tvorbe virtuálneho múzea ako virtualizácie svetovo unikátneho súboru dát
2. **Zber primárnych dát**
3. **Spracovanie dát, selekcia a vytvorenie sekundárnych dát na prezentáciu**
4. **Návrh a implementácia** hardverového a softverového riešenia
5. **Organizácia digitálneho obsahu** na prezentáciu, t.j. tvorba scenárov na základe predpokladov, dát a východísk v krokoch 3. a 4.
6. **Integrácia, verifikácia a testovanie** virtuálneho múzea
7. **Inštalácia, promócia, publikovanie, distribúcia** a medializácia, vyhodnotenie riešenia

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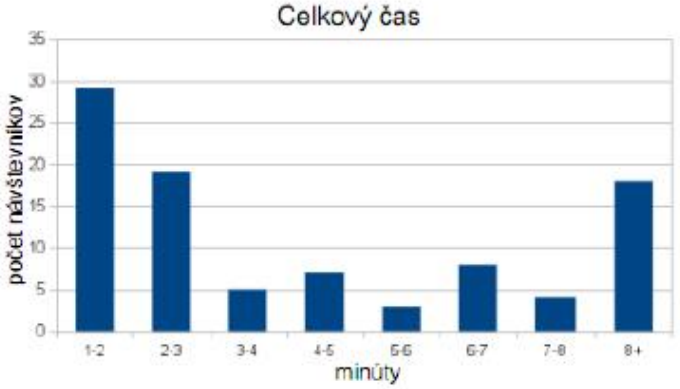
Virtualne Brhlovce, R. Svarba



Obr. 2.8: Jeden z interiérov v projekte Virtuálne Brhlovce a celkový čas návštev

Cieľom systematického prieskumu (Hookham et al., 2019), bolo vyriešiť otázku „Čo je zapojenie (účasť, engagement), ako sa používa, definuje a meria v kontexte vzdelávacích hier?“. Cieľom bolo zozbierať, vyhodnotiť a analyzovať literatúru v rokoch 1970 až 2015 v rôznych odboroch, z identifikovaných 1390 dokumentov vybrali 107 článkov, vrátane (Ferko; Černeková et al., 2011), opisujúceho aj virtuálne múzeum Virtuálne Brhlovce s aktivizačnou hrou, ktorú navrhol hlavný autor, Rastislav Švarba. Možno si do virtuálneho turistického uzlíčka zbierať označené objekty ako spomienky, obr. 2.8. Technicky sa nazývajú rozšírenia, lebo rozširujú funkčnosť kruho-

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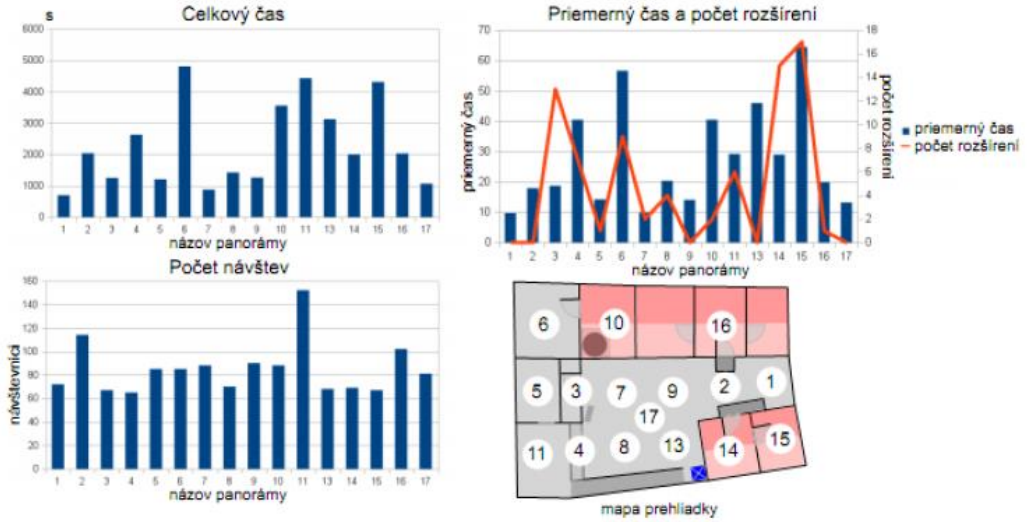
Virtualne Brhlovce 2



Obr. 2.9: Vyhodnotenie počtu a času návštev jednotlivých sférických panorám, očíslovaných v pôdoryse

Obr. 2.10: Dve víťazné „spomienky“, pohľad z „okna“ a záhadná slamienka

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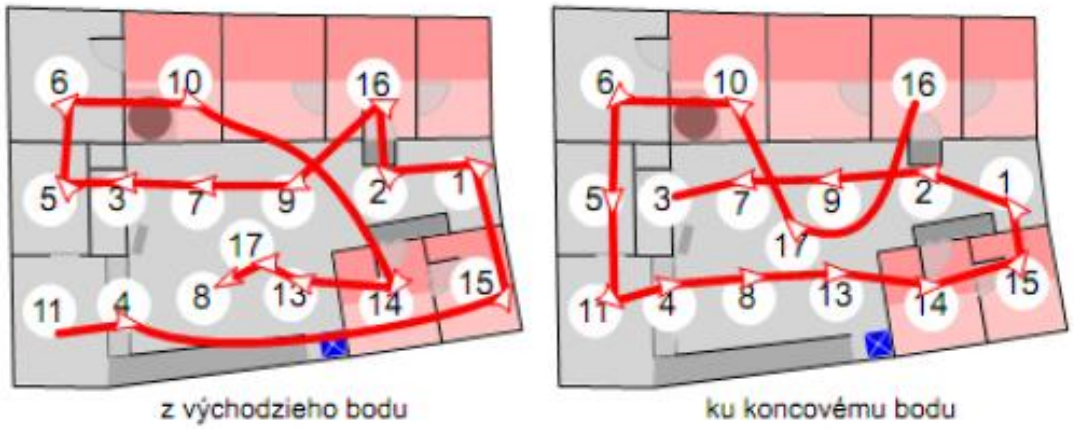
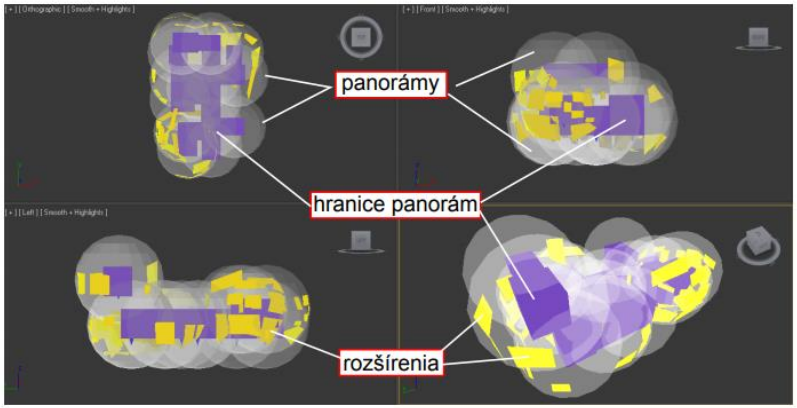
Virtualne Brhlovce 3



Obr. 2.11: Dve víťazné trajektórie virtuálnych návštev podľa zaujímavosti panorám



Obr. 3.1: 3D model scény

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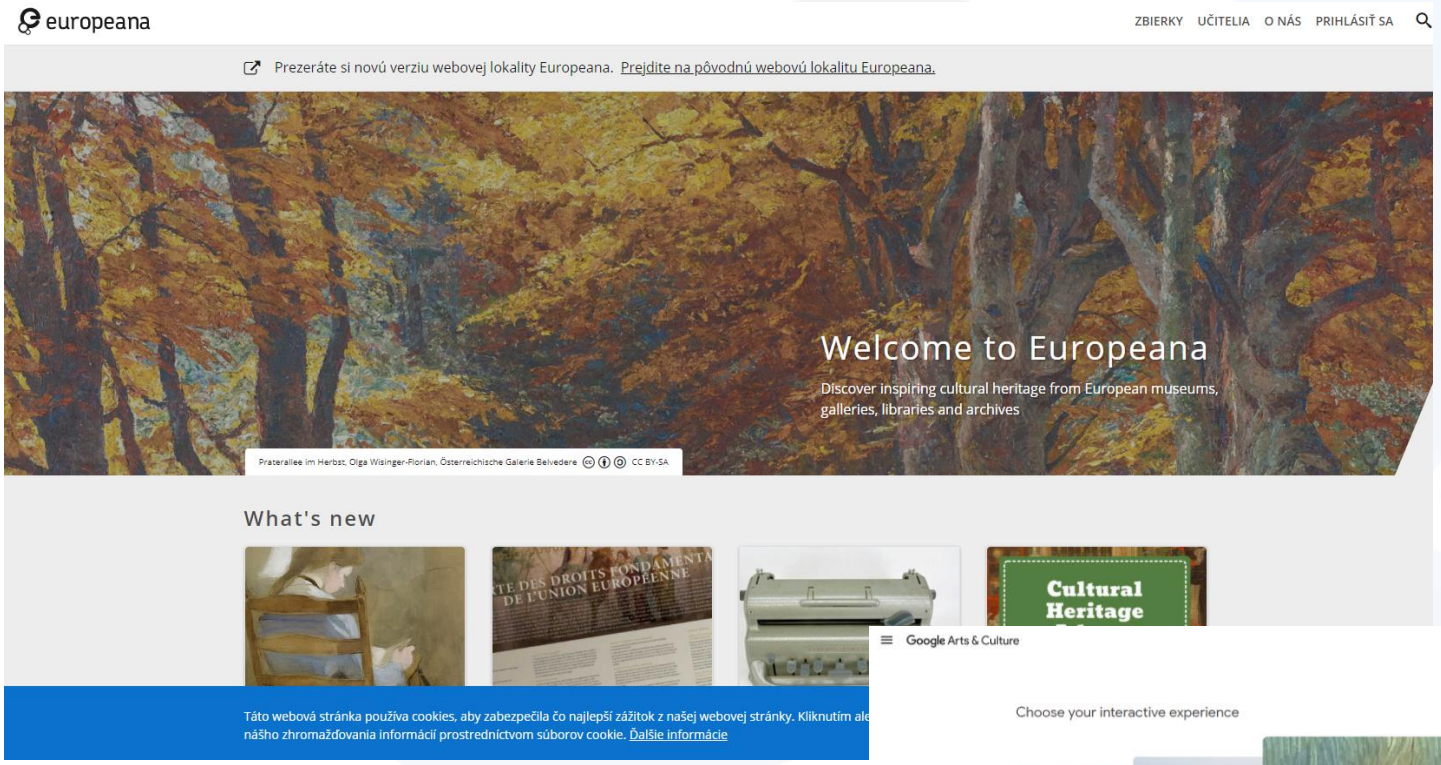
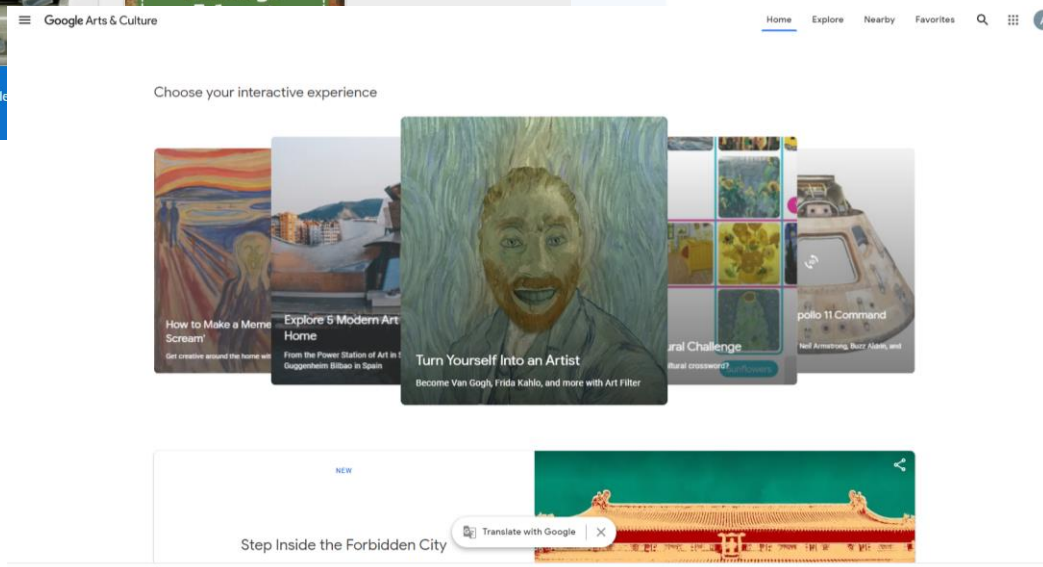
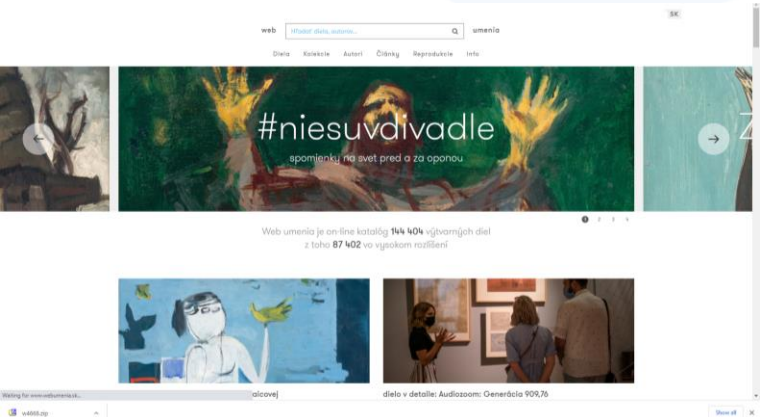
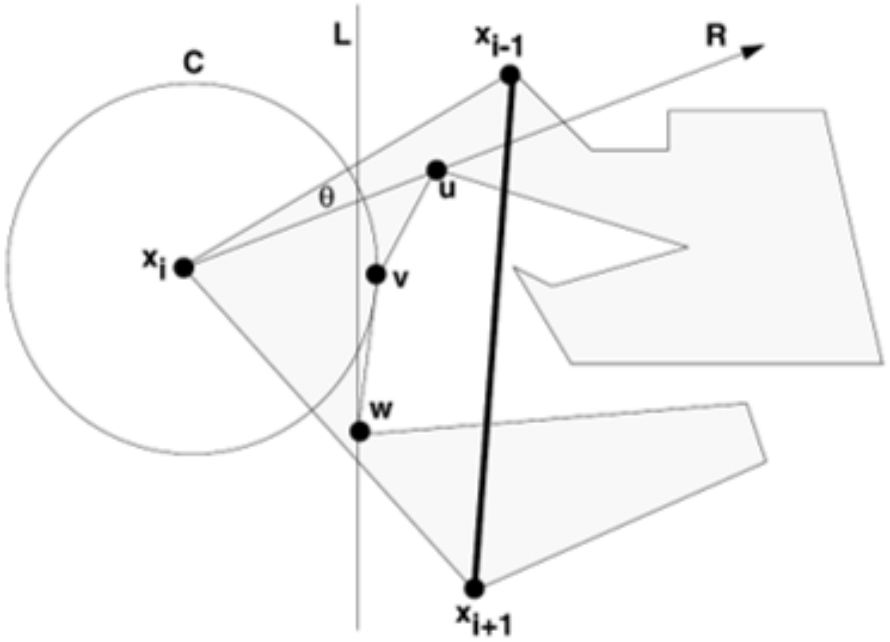
Europeana, Google Arts, Web umenia/SNG







Chyby, chytáky... narážky... rétorika



Obr. 13: Tri chybné metafory (T). Z najľavšieho vrchola jednoduchého mnohouholníka x_i hľadáme diagonálu do najbližšieho bodu u, v, w pomocou škálovania, posunutia a rotácie. Škálujeme kruh C, posúvame v smere x zametaciu priamku L a otáčame polpriamku R. Ak by trojuholník x_{i-1}, x_i, x_{i+1} neobsahoval ďalší hraničný bod, hľadanou diagonálou by bola strana x_{i-1}, x_{i+1}.

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