

The background features a stylized globe with green continents and a light blue background. The globe is surrounded by several white stars of varying sizes, all set against a light blue, abstract, cloud-like shape that frames the central elements.

Vízie internetu v roku 2042

Andrej Ferko
Comenius University, Bratislava
ferko@sccg.sk

Den otvorených 2ri @ matfyz, Feb 15, 2012, covideo 2020

Agenda

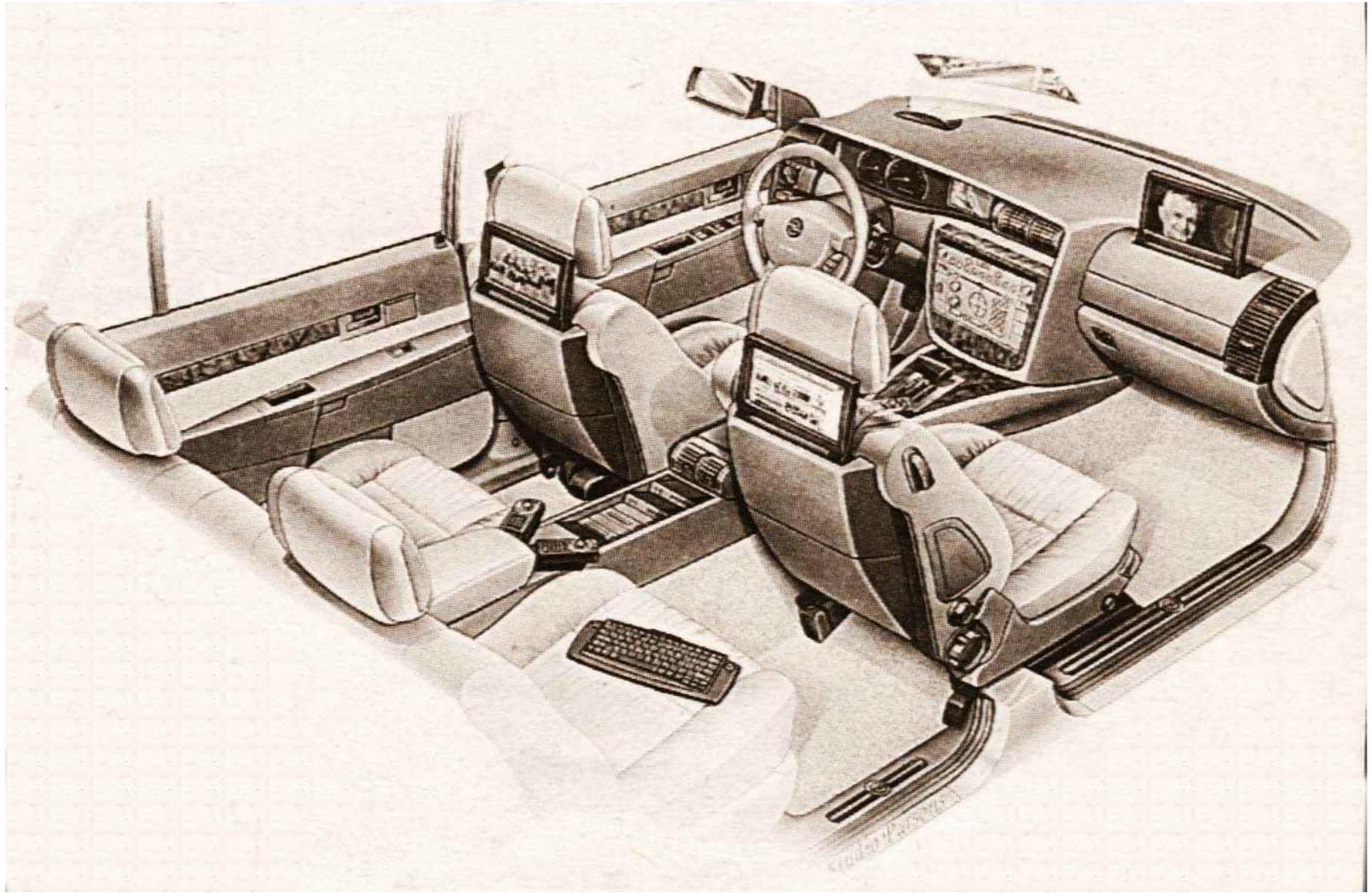


- **Intro**
- **Prehistory & Artificial Reality**
- **MUDVR et al.**
- **Digital Libraries and Semantic Web**
- **MPEG-7, Interactive Storytelling, VM**
- **VHCE, VrBA, PM3DOL**
- **Conclusions & Future Work**

2042

- **Moskva 2042 by V. Vojnovic**
- **2042 ~ 1984 by G. Orwell**
- **2042 Hispanic majority in US**
- **2042 economy of India, Brasilia etc.**
- **2043 ?communication with ETs from another solar system**
- **2042 trends/directions**

Opel OMEGA



IT future by prof. Plander

- **Technology: micro 2012, opto, nano, quantum**
- **Parallel & distributed computing: WWW, GRID**
- **AI ~ brain $10E10$.. $10E12$ neurons, slow but...**
- **e.g. HVS 5 human faces a second**
- **Autonomous agents online**
- **CERN $10E15$ bytes/year (petabytes)**
- **Bremermann's limit $10E93$ bits by a hypothetical computer the size/time of Earth**

WS future by Bebo White

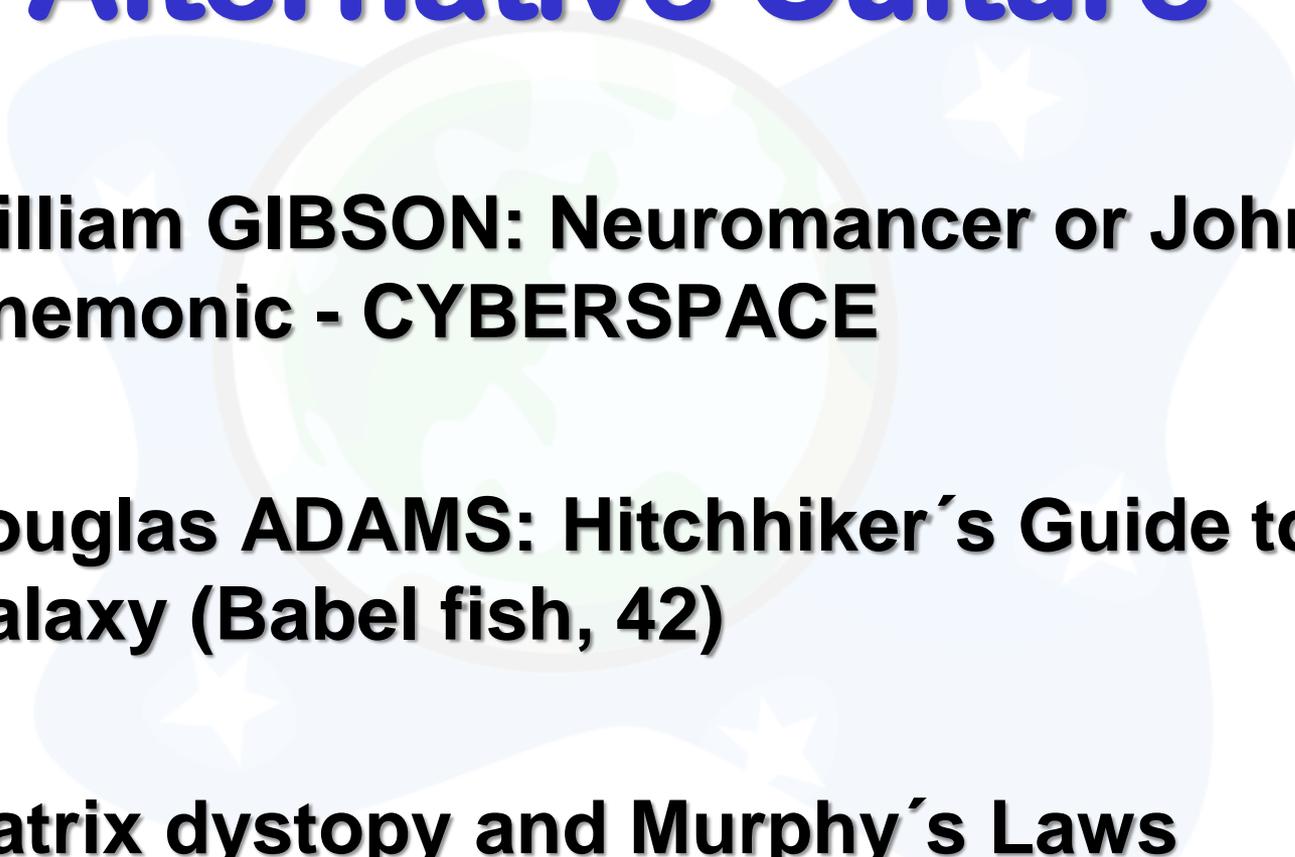
- **Context: PITAC, Russian 5 goals, MS Natal...**
- **The rise of a new science – Web Science**
- **How people asked questions before Google?**
- **Page Rank ~ Albert Einstein $E=mc^2$**
- **Science vs. Engineering**
- **Science without any model? (e.g. Goldbach)**
- **Web Science conference this week, Sir TB-L**
- **AF: Which law in WS will hold forever?**

The Third Wave

The background of the slide features a central green and white globe. Surrounding the globe is a large, light blue abstract shape that resembles a stylized wave or a cloud. This shape contains several white, five-pointed stars of varying sizes, scattered across its surface.

- **Alwin TOFFLER**
- **agricultural wave**
- **industrial civilization and thinking**
- **postindustrial wave, information society**
- **information overload... ECO**

Alternative Culture



- **William GIBSON: Neuromancer or Johnny Mnemonic - CYBERSPACE**
- **Douglas ADAMS: Hitchhiker's Guide to Galaxy (Babel fish, 42)**
- **Matrix dystopy and Murphy's Laws**
- **BTW Absurdity & 4 fears vs. Optimism**

Internet before Computers

- **IDEA (Verne, Borges, Gibson, Stephenson, Lem)**
- **METHODOLOGY**
- **TECHNOLOGY**

-
- **Computer in 19th Century: Ch. Babbage**
 - **Software Idea: Ada Lovelace**
 - **Internet Idea – smoke and mirror signals, carrier pigeon (bird postman), rumors...**

Cyberspace

“Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts... A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding.”

Gibson, W. 1984. Neuromancer. London 1984. (CZ)

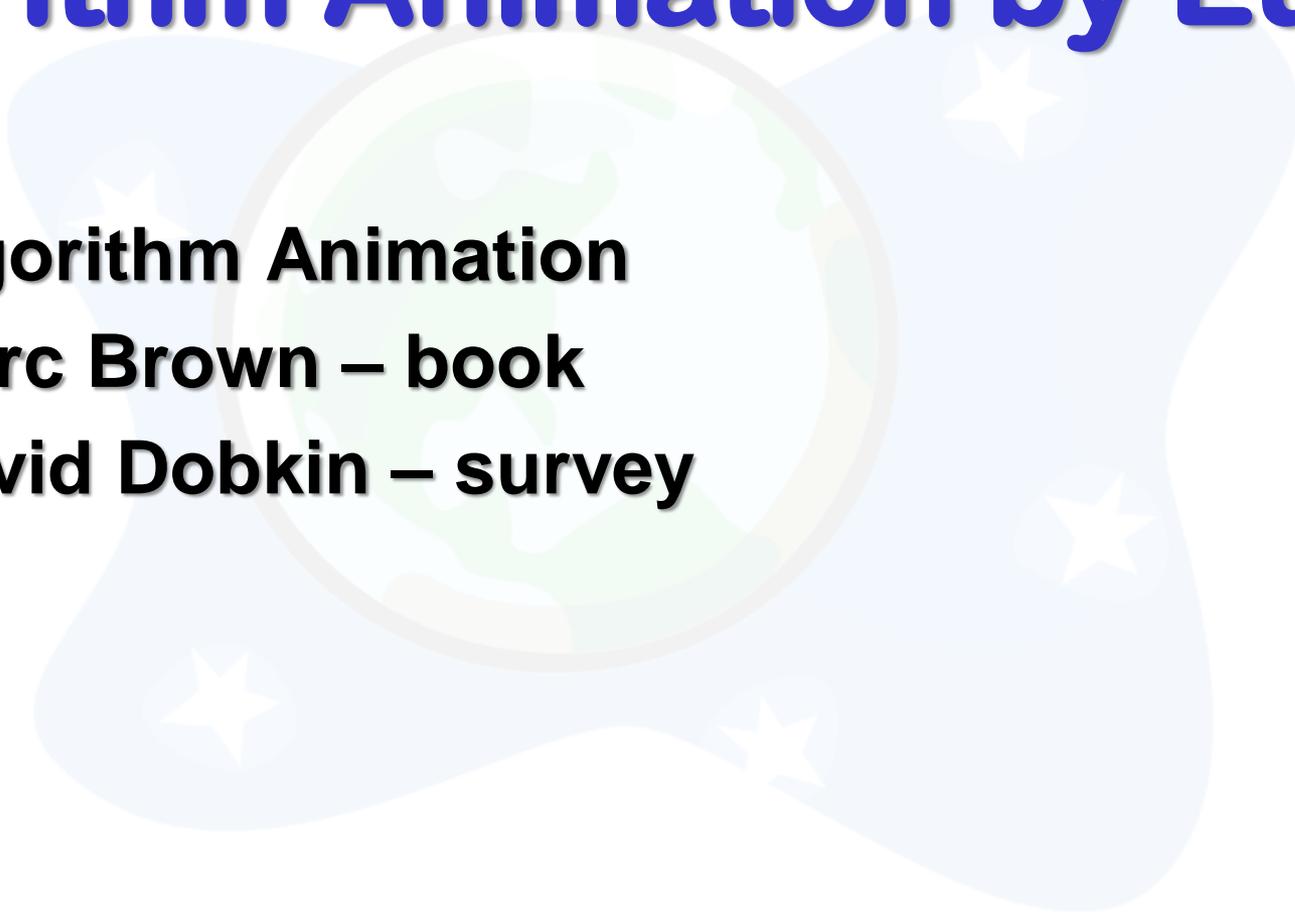
VR Prehistory

- **Neuromancer/Johnny Mnemonic novel/movie by W. Gibson ... (Matrix like dystopy), cyberpunk, CYBERSPACE... immersion**
- **Ivan Sutherland, Sketchpad, (1965) ,The Ultimate Display paper, stereoscopic images 1968, prof. Brooks, ... VR hardware and software**
- **Golem, humanoid, ROBOT, Metaversum... avatar, virtual population**

Early Use of CG Methods

- **Virtual Space Discovery by Pythagoras (600 BC)**
- **Algorithm Animation by Euclid**
- **Font Design in 9th Century**
- **Virtual Reality in 17th Century**
- **Voice Synthesis and Humanoid for Maria Theresia**
- **Robot in 30s**
- **...**

Algorithm Animation by Euclid

The background features a stylized globe with green and blue continents and oceans, centered within a light blue, irregular shape. Several white, five-pointed stars are scattered around the globe, creating a celestial or digital theme.

- **Algorithm Animation**
- **Marc Brown – book**
- **David Dobkin – survey**

Font Design in 9th Century

- **GLAHOLICA FONT DESIGN –**

- the oldest Slavonic alphabet was created by **St. Cyrilus/Constantinus** before **863**.

Thus, he is the first known font designer in world history. Glaholica celebrates its **1150th anniversary** in 2013. Unfortunately, we do not know neither the exact date nor the hour of the release.



НА ПОЧІАТКУ БОЛО СЛОВО ЦРЬЦРЬЦ ЦА Ц ЦЦЦЦ ЦКККК КББ СЛОБО

Virtual Reality in 17th Century

- **VISIBILITY HINT** – the Osman expansion started to finish in the Battle at Vienna in 1683. The giant Turkish army was headed by Kara Mustafa, no hope. The only help came with **Polish King Jan III. Sobiesky** and his soldiers. He confused Kara Mustafa using the following (in)visibility procedure. One – nontrivial – part of Polish army marched all the day around the same hill. The Osmans counted the same people multiple times. **VR show => Kara Mustafa decided to escape...**
- **Perfect immersion, low interactivity, good display devices, adequate scaling factor...**

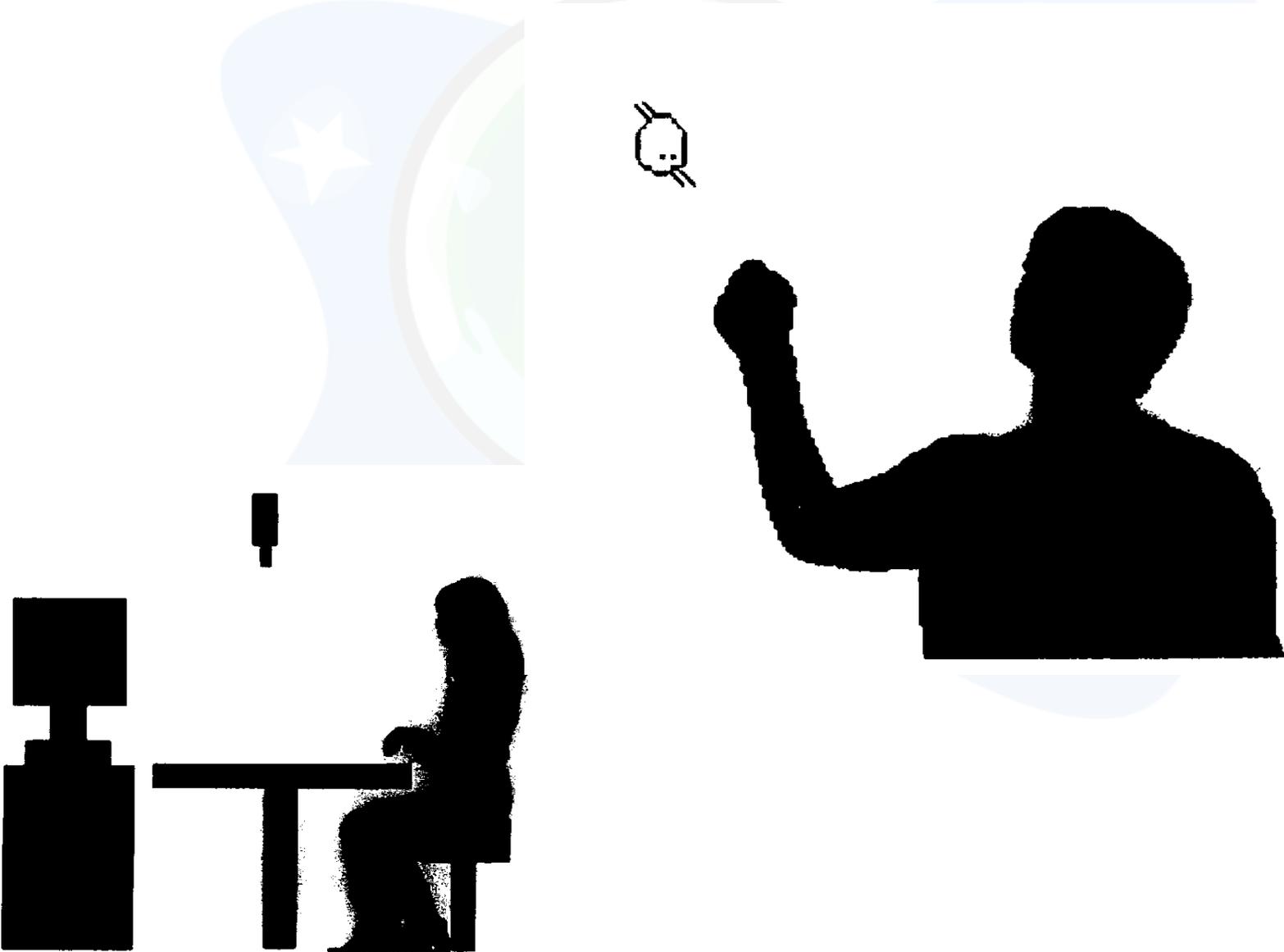
Robot in the R. U. R. novel

- **Czech fiction writer Karel Capek**
- **Slovak word near T. Teplice spa**
- **How to translate?**
- **Let it be...**
- **Etc.**

Voice Synthesis & Humanoid for Maria Theresia

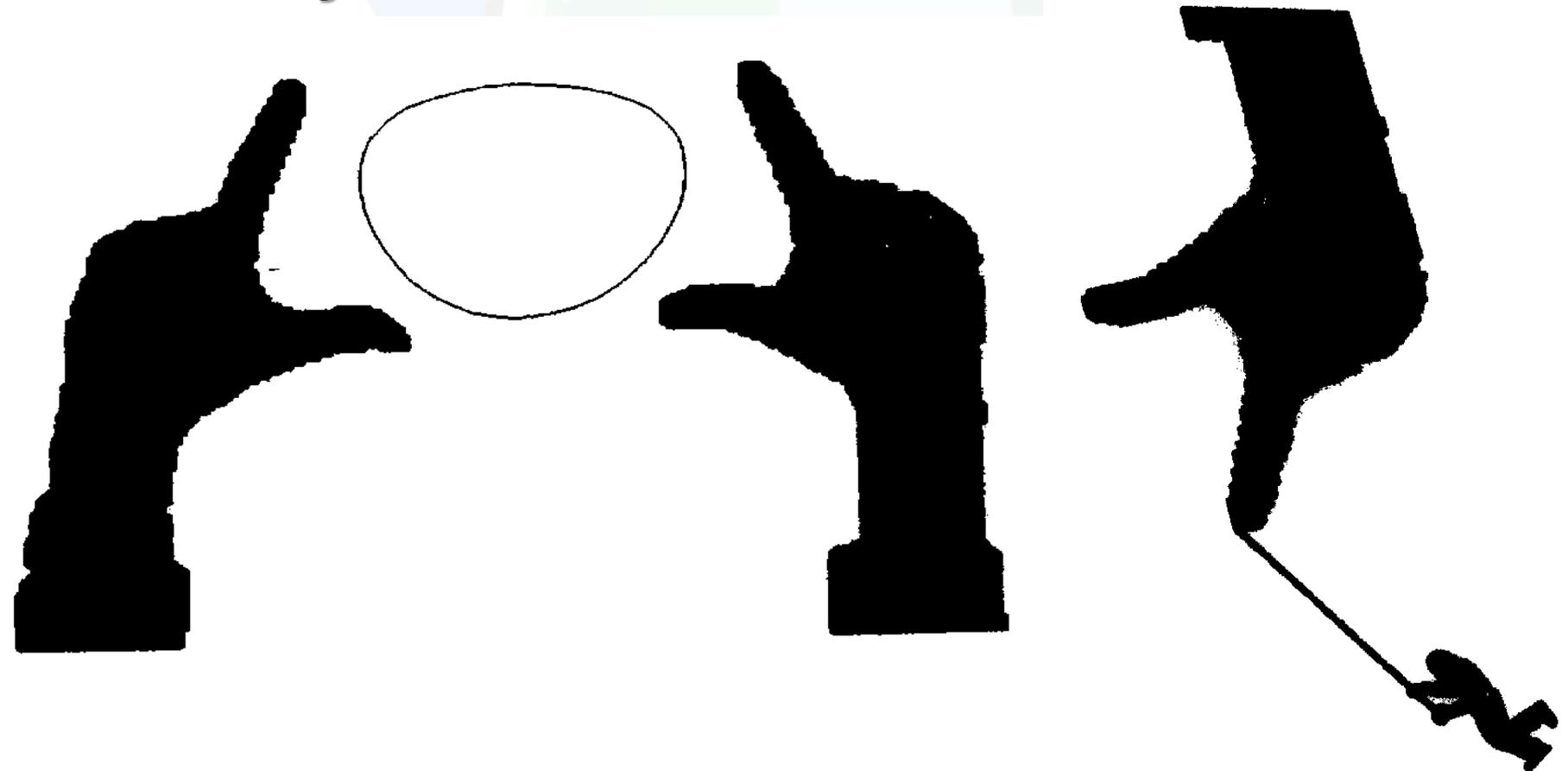
- **HUMAN VOICE SYNTHESIS –**
- **Wolfgang KEMPELEN (1734 – 1804)** became famous by constructing of robotized automatic chess player in the size of human figure. Moreover, he invented the typewriter for blind people and output device, imitating the human voice system. The working voice generator prototype by Kempelen can be admired at the Museum of Computers. The house where he was born is in Bratislava at Dunajska street.

ARTIFICIAL REALITY: Myron KRUEGER

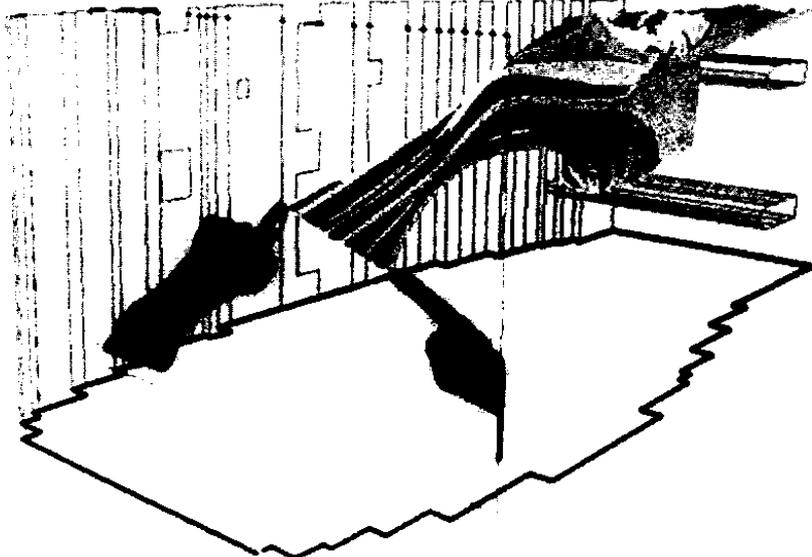


AR by Myron Krueger

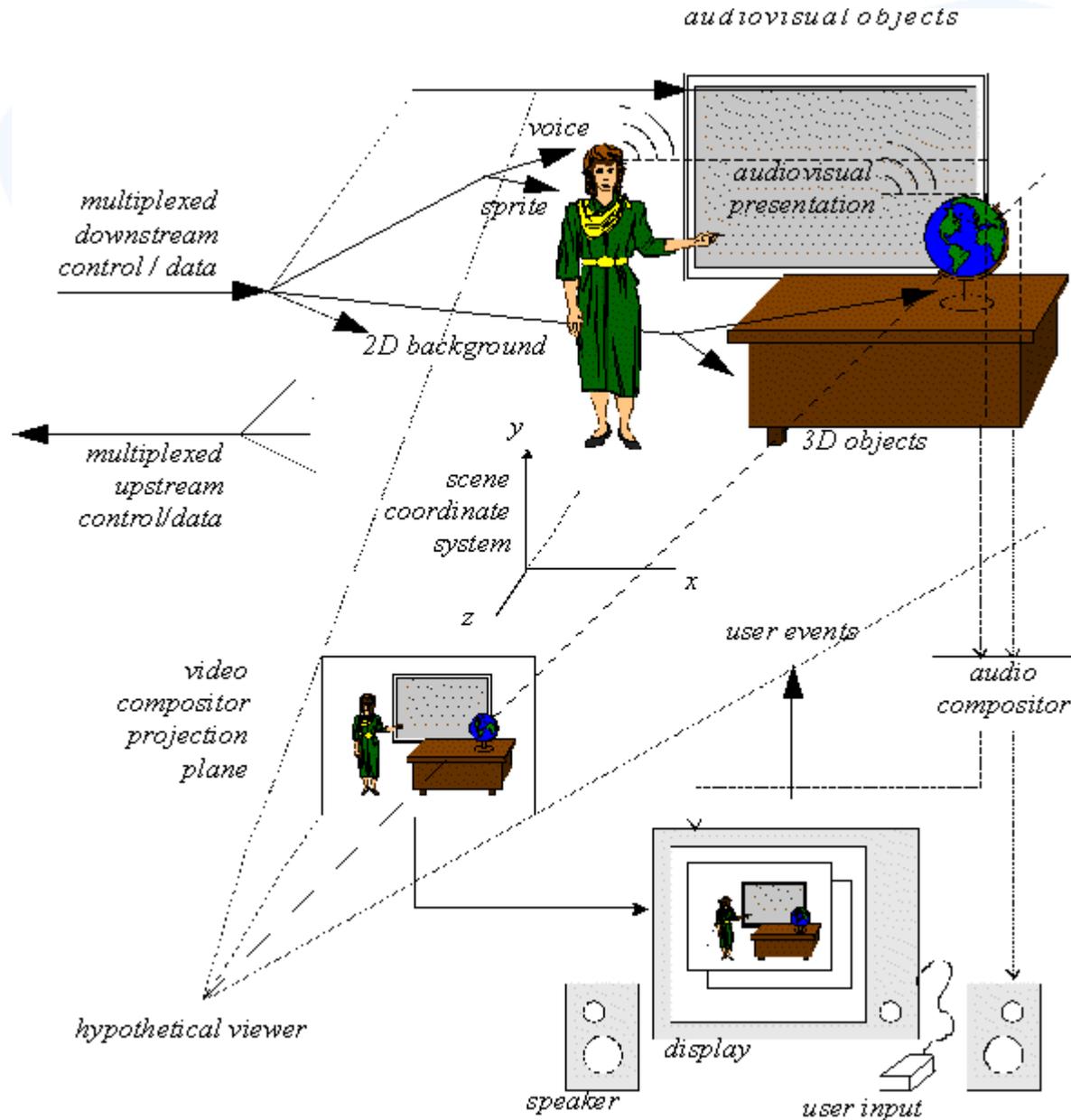
- Interaction of participants... collaboration
- Play with the “world”



ARTIFICIAL REALITY plane & statue



MPEG-4

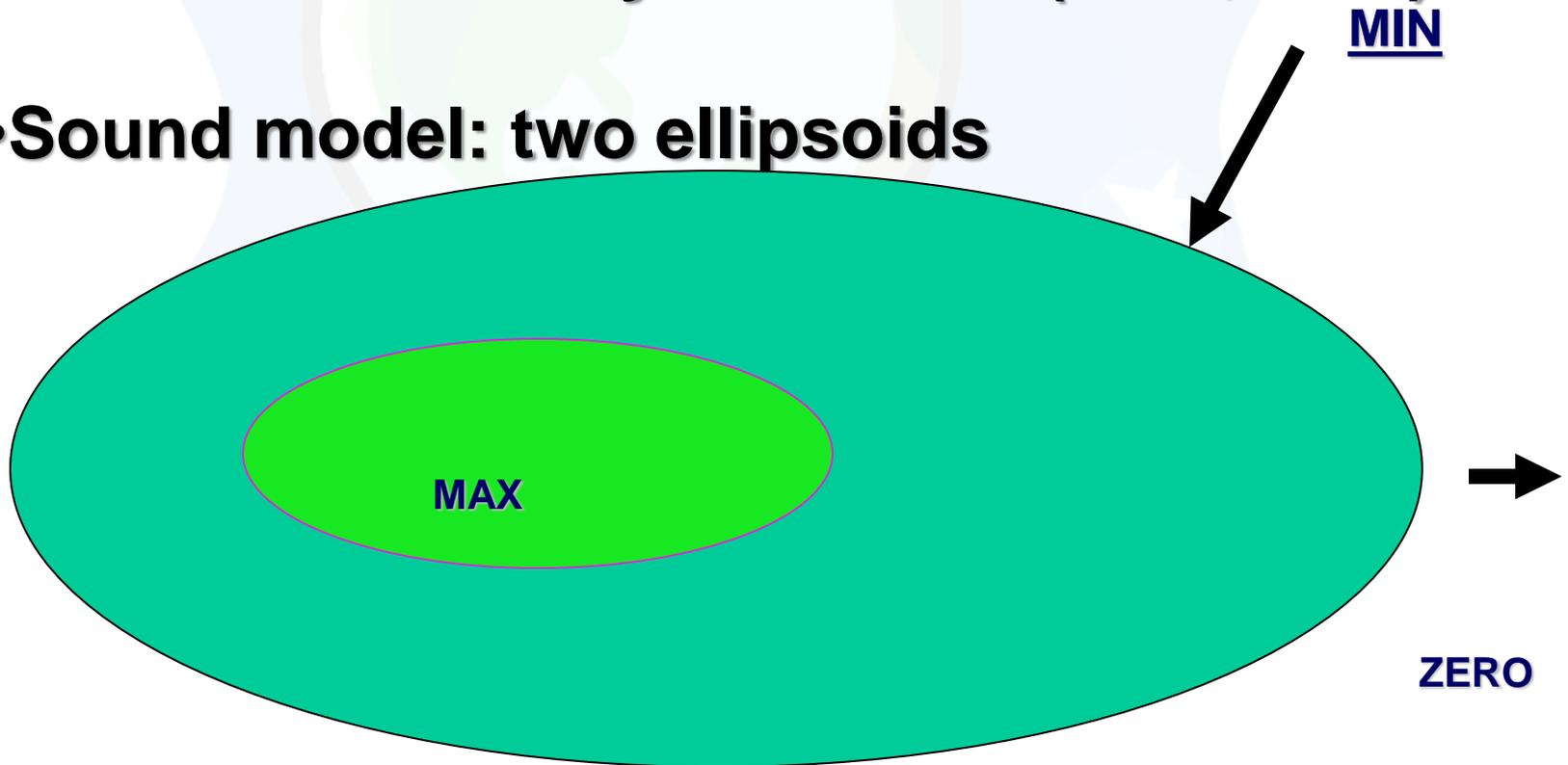


VIRTUAL REALITY: Jaron LANIER

- **NASA, dataglove, HMD...**
- **3D “world” interaction**
- **Rename of Krueger’s AR**
- **... Japanese fan club for a virtual pop star**

VRML 3D Sound

- Sound source: any sound file (MIDI, MP3)
- Sound model: two ellipsoids



The VRML Sound Node

- The syntax of the Sound Node:
- Sound {
- exposedField SFVec3f direction 0 0 1
- exposedField SFFloat intensity 1
- exposedField SFVec3f location 0 0 0
- exposedField SFFloat maxBack 1
- exposedField SFFloat maxFront 1
- exposedField SFFloat minBack 1
- exposedField SFFloat minFront 1
- exposedField SFFloat priority 0
- exposedField SFNode source NULL
- field SFBool spatialize TRUE
- }

Semantic Web

- **The end of WWW**
- **BERNERS-LEE, T. et al. 2001. The Semantic Web. *Scientific American*, May 2001.**
- **Ontology, AI, avatars & autonomous agents**
- **Information (digital libraries) vs. Knowledge & creativity support (semantic web)**
- **Dilema ☺ (thesis, antithesis, synthesis)**

WWW & XML >> WWD

- **Million User Interface**
- **VRML 1.0 & 2.0 and X3D/Collada**
- **VRML ECMA Script, VRML EAI...**
- **Data Mining**
- **Collaborative Hypermedia, e.g. Virtual Sculpting, MUDVR**
- **MPEG-4 & MPEG-7 Goals**
- **2 alternatives: Content Age, Semantic Web**

WWD ~ Digital Libraries

- Million User Interface
- VRML 1.0 and VRML 2.0 and X3D
- VRML ECMA Script, VRML EAI...
- Data Mining
- Collaborative Hypermedia, Virtual Sculpting, MUDVR
- MPEG-4 & MPEG-7 Goals

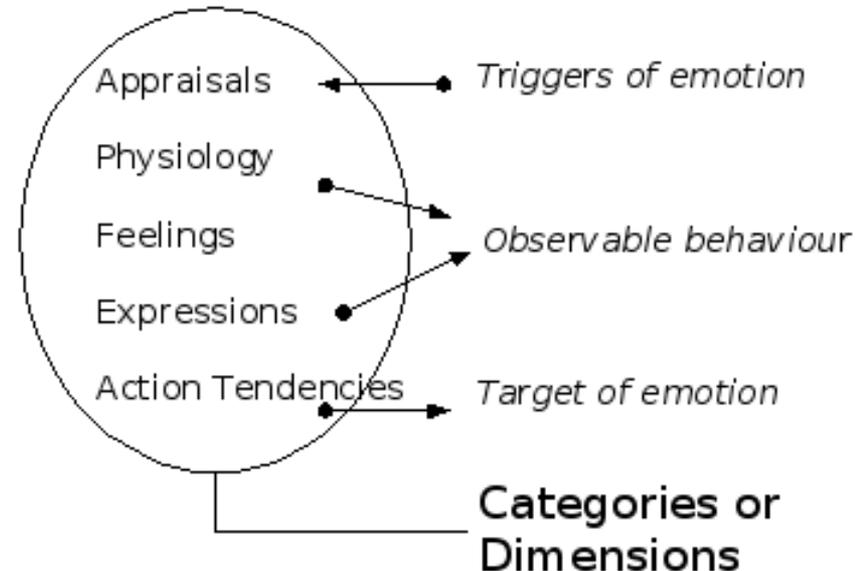
- 2 alternatives: **Content Age,**
Semantic Web (AI)

Ontology Example

- **CIDOC CRM**
- **Conceptual Reference Model for Virtual Museums – entities, properties**
- **The Nose of Michael Jackson before and after
=> ontology is a data model**
- **Alphaworld – profit+cybercity, 1995, ~ size of CA**

Ontologies Forever

- **CIDOC CRM & FRBRoo** – creative process ontology
- **Collada 3D Conversion Solution** (both geometry and radiometry, even FX)
- **Emotion ML 1.0 @ W3C** ~ 30 use cases
- **Cameron&Kenderdine**
- **...on Metadata/Meaning**
- **Importance ~ SCI, Page**
- **Labanotation**, Bratislava 100+
- **Open – comic**



Defining Game (Play)

- **J. Huizinga: Homo Ludens**
- **J. A. Comenius: Schola Ludus**
- **Marxists: just a preparation for work**
- **E. Fink: Oasis of Happiness**
- **A. Ferko: Behavioral Mirror**

- **Serious Games = 21. century school**

Games & Stories => 16

- **The end of computer games**
- **A. Glassner: Interactive Storytelling, p. 205**
- **Social – individual**
- **Story – no story**
- **Computer – no computer**
- **Game – no game**

Many VEs

- **Virtual Space 8D ($x, y, z, t, r, g, b, \textit{alfa}$)**
- **Sound Space**
- **Social Space**
- **Story Space (Glassner)**
- **Knowledge**
- **No time problem => interestingness**
- **ECO, emotional & cognitive overload (Rutkowski-Sanders 2010), information pollution (Nielsen)...**

Time... hm...

- **Qvortrup... Borges... no sensor**
- **Everybody publishes, nobody reads...**
- **The answer is blowing in the data mining community only – they use 9 measures of interestingness**
- **Koestler? NLP?**
- **Virtual museums – engagement, enchantment – hermeneutic place**

MPEG Agenda

- Future web, XML, WWD
- MPEG
- MPEG-4
- MPEG-7... 21
- ... Descriptors
- Conclusions

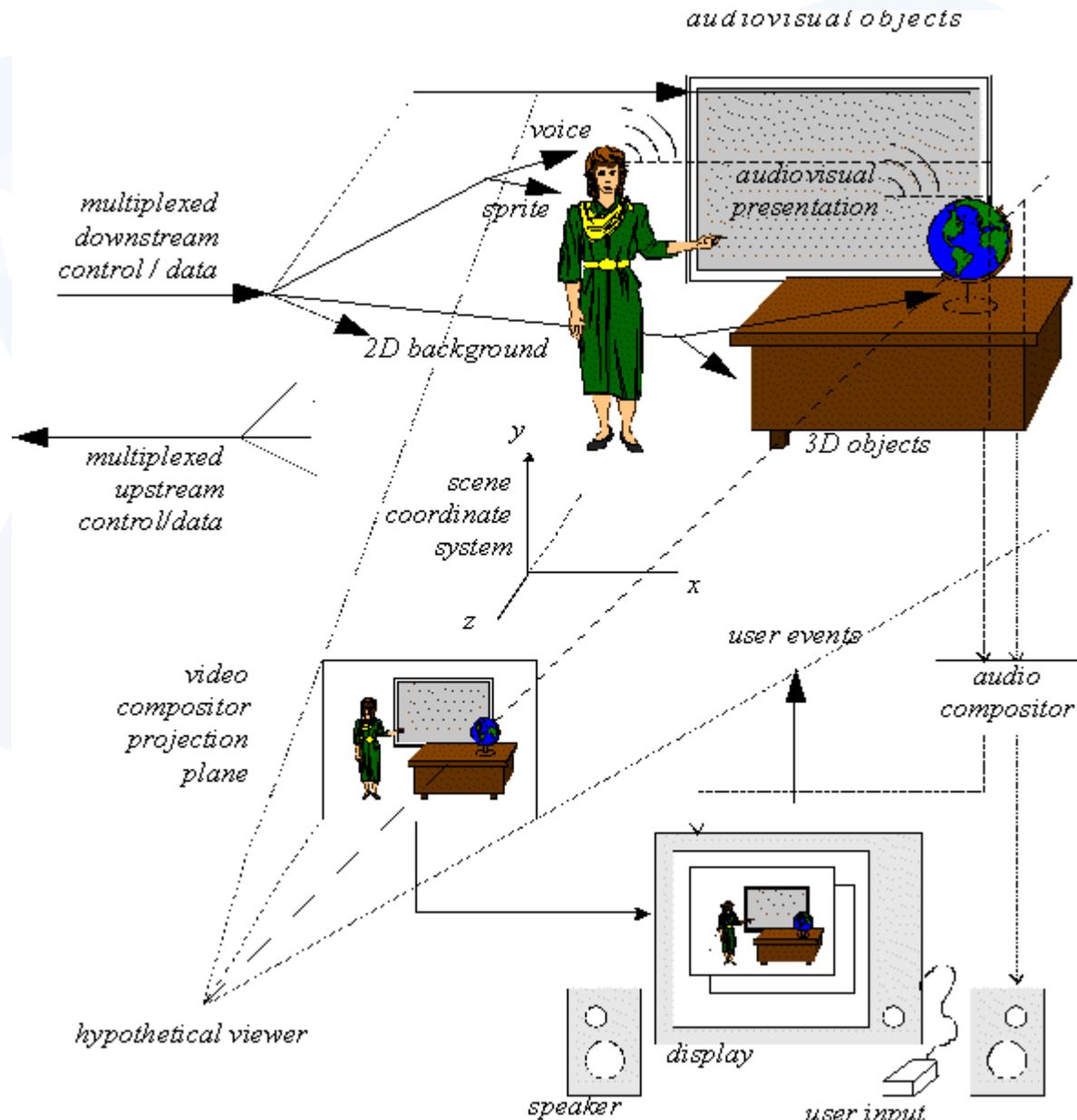
“By 1996, MPEG had reached the conclusion that the wealth of content that the predictable evolution of the Web would be able to provide was going to make the finding of content of interest to the user impossible. This explains why it proposed the MPEG-7 work item “Multimedia Content Description Interface.””



MPEG

- **ISO = INTERNATIONAL ORGANISATION FOR STANDARDISATION**
- **ISO/IEC JTC1/SC29/WG11 – Moving Pictures Experts Group**
- **CODING OF MOVING PICTURES AND AUDIO**
- **MPEG-7 - ISO/IEC standard developed by MPEG, Multimedia Content Description Interface**
- **MPEG-1 - interactive video on CD-ROM**
- **MPEG-2 – digital TV**
- **MPEG-4 – standard representation of 2D/3D worlds, fixed & mobile web, multiple platforms, models audiovisual data as a composition of audiovisual objects (MP3, VRML, video...) both synthetic and natural**

MPEG-4



MPEG-4 Goal & Requirements

- **ISO/IEC 14496, 1999, people need video & audio with internet and interaction**
- **technique of objects compositing, based on VRML, streamed audio & video, real objects and UR**
- **MPEG-4 format, MPEG-J enables for applets to support complex behaviors**
- **requirements: encoding, scalability, compression/quality, error handling, facial animation, 3D sound, music richness beyond MIDI, content description (metadata), objects multiplexing MPEG-2, H.223, scene composition, programmable content, interaction protocol**
- **format for complete exchange of application between client and server**
- **URL and transport protocol**
- **content representation independent from delivery (disc, net, broadcast)**
- **quality specification and authorized users support**

MPEG-7

- **formally named "Multimedia Content Description Interface"**
- **supports some degree of interpretation of the information meaning**
- **developed by broadcasters, electronics manufacturers, content creators and managers, publishers, intellectual property rights managers, telecommunication service providers and academia**
- **...**
- **MPEG-7 descriptions do, however, not depend on the ways the described content is coded or stored**
- **MPEG-7 Multimedia Description Schemes (DSs) are metadata structures for describing and annotating audio-visual (AV) content... a standardized way of describing in XML**

MPEG-7 Descriptors

The background of the slide features a central globe with green and yellow continents. To the right of the globe is a large, light blue abstract shape with several white five-pointed stars scattered across it. The overall aesthetic is clean and modern.

- **Color descriptors**
- **Texture descriptors**
- **Shape descriptors**
- **Motion**
- **Others - localization, face**
- **Audio**

24 Content Descriptors

- **Color 7 - space, quantization, dominant, scalable, layout...**
- **Texture descriptors 3 - homogenous, browsing, edge histogram**
- **Shape descriptors 3 - region shape, contour shape, shape 3D**
- **Motion 4 - camera, trajectory, parametric motion, action**
- **Others 2 - localization, face**
- **Audio 5 – signature, instrument, melody, indexing, spoken**
- **In total, 10 radiometric, 9 geometric, 5 others in **MPEG-7****

Shape Descriptors

- **Region** - all pixels, robust to minor deformation along the boundary of the object, fast, 17.5 bytes
- **Contour** – captures similarity = perceptually meaningful features of the shape, CSS (Curvature Scale-Space representation), robust to partial occlusion, non-rigid motion and perspective transformations
- **Shape 3D** - search & retrieval and browsing of 3D model databases

Contour vs. Region

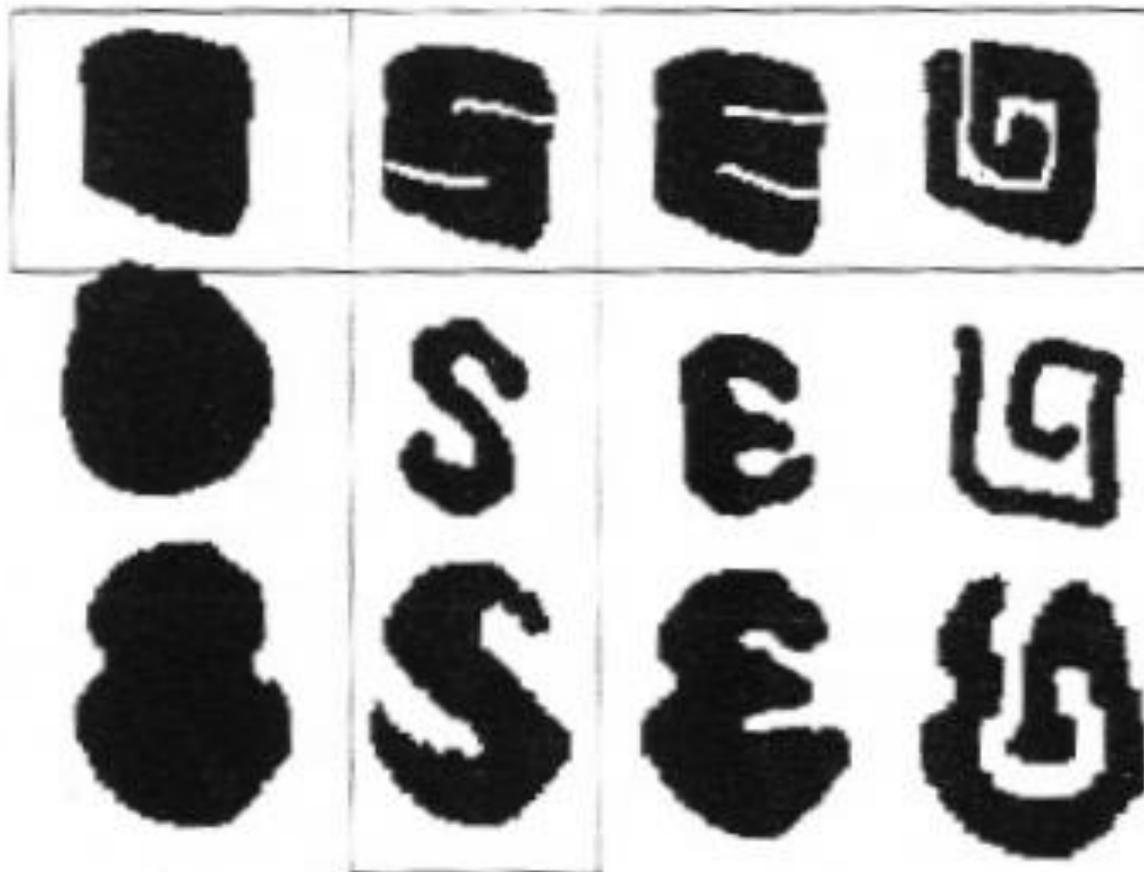


Figure 15.1 Example of contour-based and region-based region similarity (© 2001 IEEE, from M. Bober; MPEG-7 Visual Descriptors, IEEE Transactions on Circuits and Systems for Video Technology, Vol. 11, No. 6, June 2001)

ART Transform

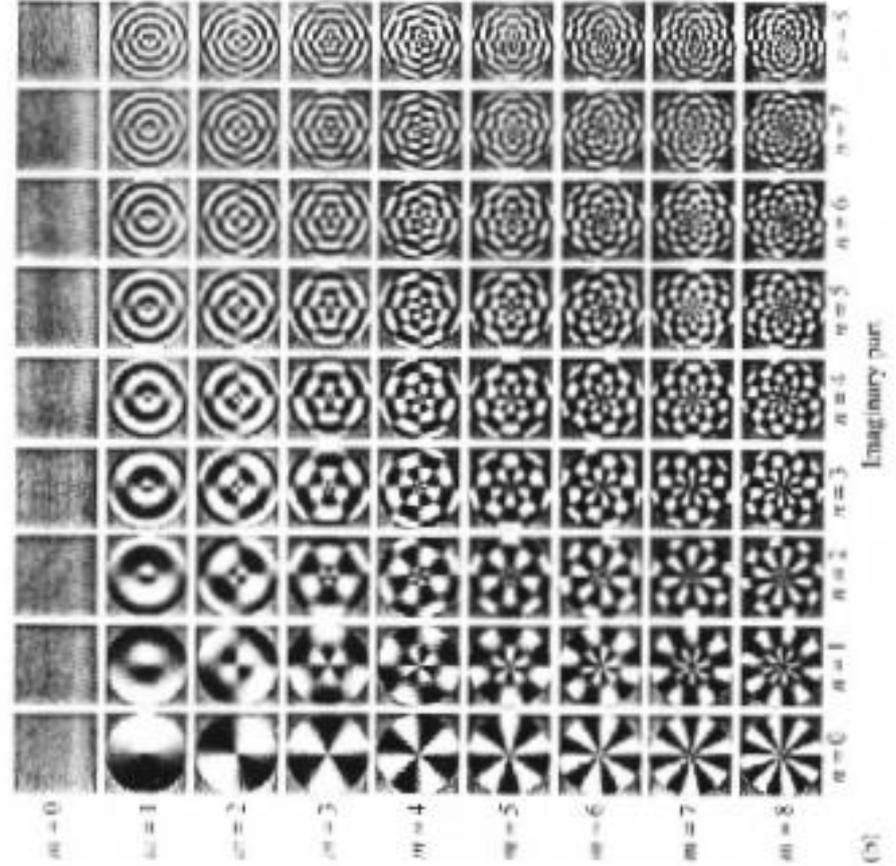
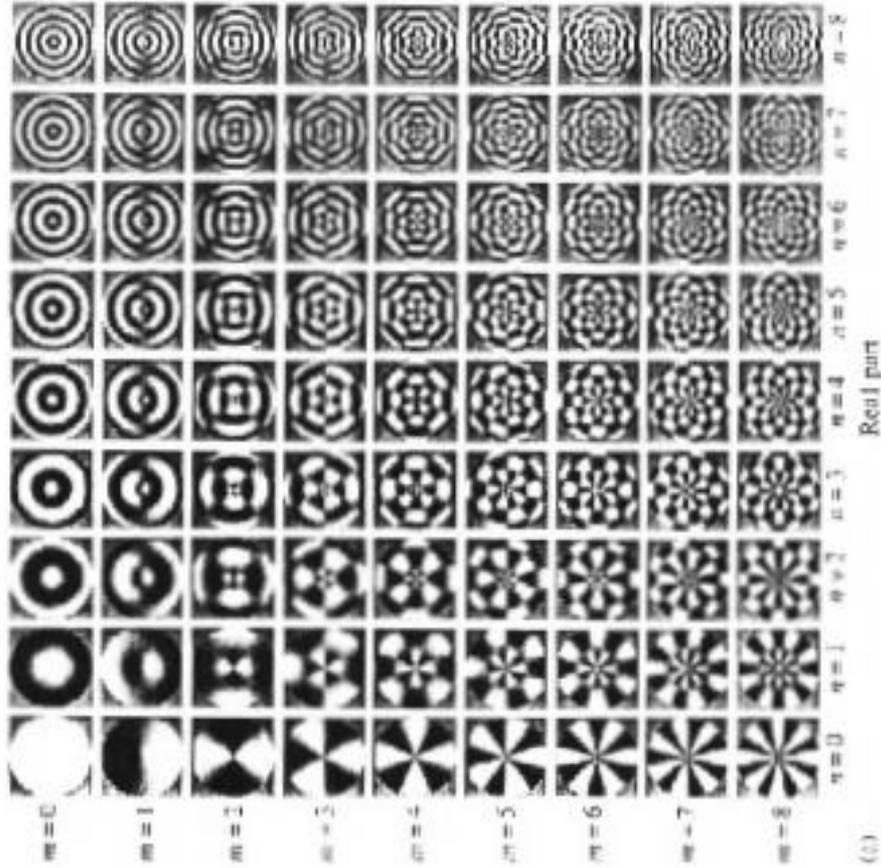


Figure 15.10 Real and imaginary parts of ART basis functions

ART Transform

ART is the orthogonal unitary transform defined on a unit disk that consists of the complete orthonormal sinusoidal basis functions in polar coordinates. The ART coefficients are defined by:

$$F_{nm} = (V_{nm}(\rho, \theta), f(\rho, \theta)) = \int_0^{2\pi} \int_0^1 V_{nm}^*(\rho, \theta) f(\rho, \theta) \rho d\rho d\theta \quad (1)$$

where F_{nm} is an ART coefficient of order n and m , $f(\rho, \theta)$ is an image function in polar coordinates and $V_{nm}(\rho, \theta)$ is the ART basis function that are separable along the angular and radial directions, that is,

$$V_{nm}(\rho, \theta) = A_m(\theta) R_n(\rho) \quad (2)$$

In order to achieve rotation invariance, an exponential function is used for the angular basis function,

$$A_m(\theta) = \frac{1}{2\pi} \exp(jm\theta) \quad (3)$$

The radial basis function is defined by a cosine function,

$$R_n(\rho) = \begin{cases} 1 & n = 0 \\ 2 \cos(\pi n \rho) & n \neq 0 \end{cases} \quad (4)$$

Region Similarity Measure

The distance (or dissimilarity) between two shapes described by the ART descriptor is calculated using an L-1 norm, for example, by summing up the absolute differences between ART coefficients of equivalent order.

$$\text{Dissimilarity} = \sum_i \|M_d[i] - M_q[i]\| \quad (10)$$

Here, the subscript d and q represent image in the database and query image, respectively and M is the array of ART descriptor values.

- **12 angular, 3 radial ART coefficients, 35*4 bits**

Shape Descriptors

- **Region** - all pixels, robust to minor deformation along the boundary of the object, fast, 17.5 bytes
- **Contour** – captures similarity = perceptually meaningful features of the shape, **CSS (Curvature Scale-Space representation)**, robust to partial occlusion, non-rigid motion and perspective transformations
- **Shape 3D** - search & retrieval and browsing of 3D model databases

CSS Image, 46 bits

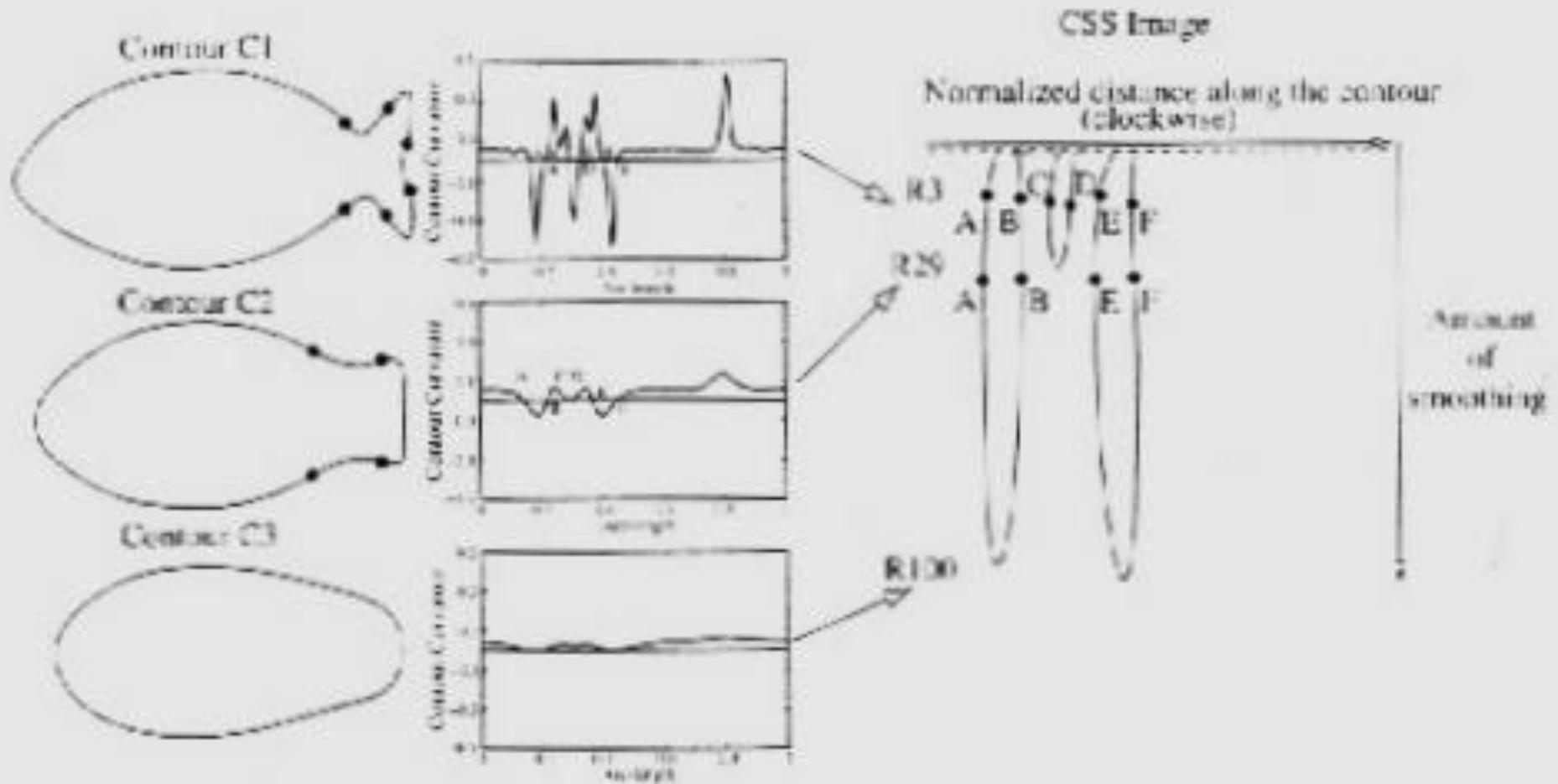


Figure 15.13 Extraction of the CSS image for the fish contour of Figure 15.12

Shape 3D

- **efficient 3D mesh model coding: location, size, mesh**
- **humanoid example**
- **3D shape spectrum descriptor as a histogram of shape index values [Koenderink90] over the entire mesh, 48 bits, giving similarity measure**
- **shape index – angular coordinate of a polar representation of the principal curvature vector, undefined for planar surfaces**
- **[0,1] 0-southern hemisphere, 1-northern hemisphere**

MPEG-7 Webpages

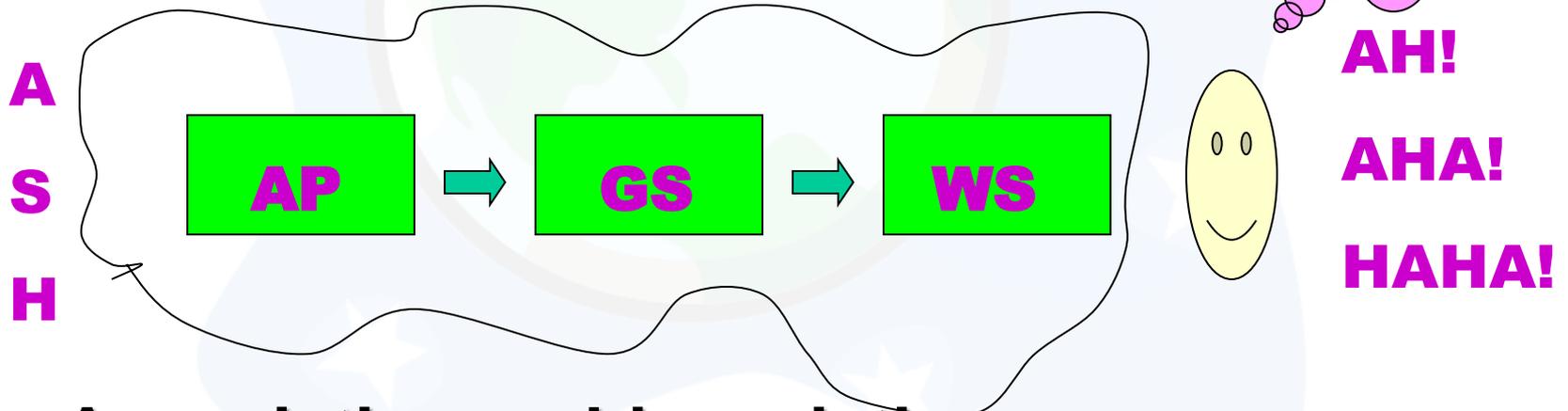
- <http://www.chiariglione.org/mpeg> - MPEG community
- <http://www.mpegif.org> - MPEG-7 community
- <http://mpeg7.nist.gov> - MPEG-7 consortium
- Reference
- MANJUNATH, B. S. et al. eds. 2002. *Introduction to MPEG-7*. Wiley 2002.

MPEG-21 Interoperability

- **Compilation**
- **Who is the author of two stolen assets?**
- **Consumers (e.g. all Mona Lisa visitors)**
- **Big Brother (Zamjatin, Orwell, Matrix, Cube)**

On Model of a Human Being

- **The Act of Creation (creatology):**



- **Association >> bissociation**
- **Arthur KOESTLER: no labyrinth, no mouse, just bissociating two contexts**

Genius Loci

- **Genius Loci = Spirit of the Place, LokalGeist?**
- **Etruscans – mundus, urbs, Roma**
- **Genius Loci ... Phenomenology**
- **NORBERG-SCHULZ, CH. 2000. *Genius Loci*.**
- **Implications (Hegel, Marx, Heidegger)**
- **Bogdan Bogdanovic in Vienna**

World Cultural Heritage

- UNESCO
- 700++ items
- 30++ in AT, CZ, SI, SK, nearly no 3D models
- European added value is not added
- Digital preservation, documenting, publish...
- „... to enable Europeans to be consciously (and interactively) proud of their contribution to the World Cultural Heritage“

City = process in time & space

- **CORP 2002 paper by Bettina Kohler, Peter Ferschin et al. from IEMAR TU Wien team:**
- **The City as a Process in Time and Space**
- **Luton University research – „movie“**
- **Next slide shows this at the first glance**

Urban Process in Time & Space



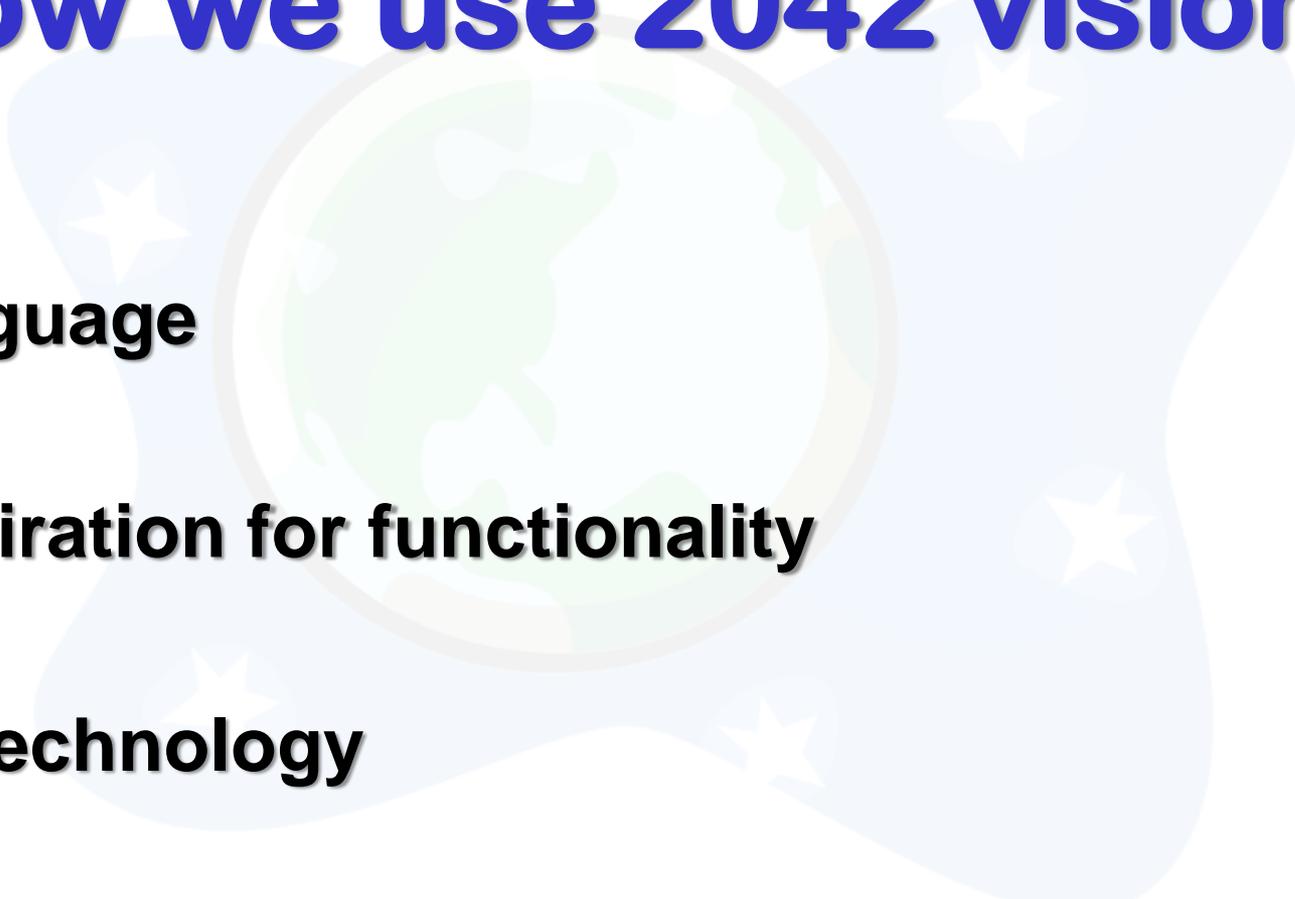
Real world photo by A. F., Graz 2001

Past & Future @ CU



- **VHCE**
- **VrBA, Historic multimedia Bratislava DVD**
- **Virtual museum**
- **EPUD**
- **Future – more cyber cities and museums, Virtual Old Prague speed with heavy dataset, e-learning, serious games...**

How we use 2042 visions

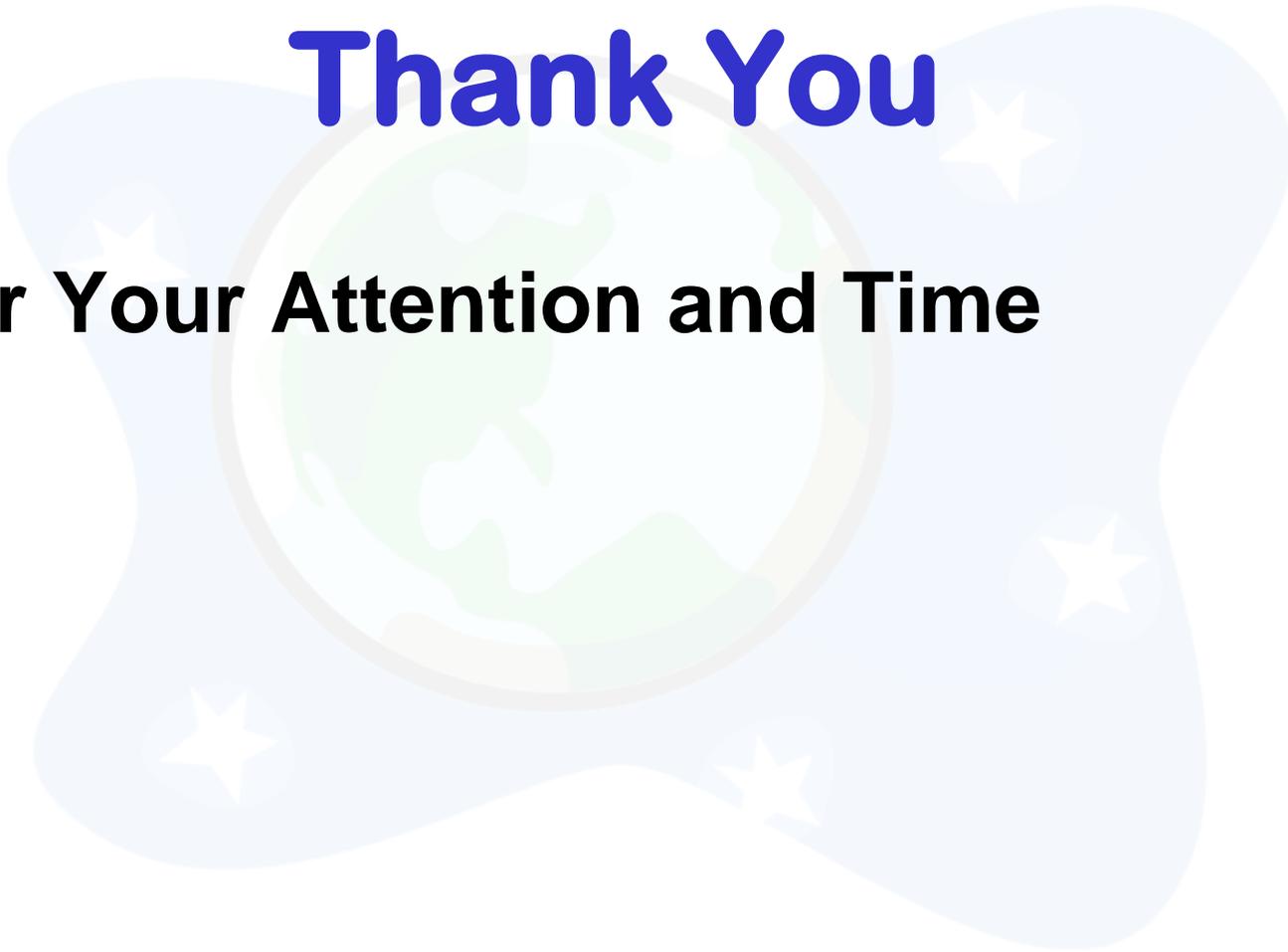
The background of the slide features a light blue, abstract, cloud-like shape. In the center of this shape is a stylized globe of the Earth, rendered in shades of green and white. Scattered around the globe are several white, five-pointed stars of varying sizes, some appearing to glow.

- **Language**
- **Inspiration for functionality**
- **No technology**

Conclusions

- **Future of internet reshapes related fields**
- **Search – indexed, content-based**
- **Interestingness undefined**
- **The science starts with measurements**
- **General answer – cultural capital & creativity**

Thank You



- **For Your Attention and Time**



Vízie internetu v roku 2042

Andrej Ferko
Comenius University, Bratislava
ferko@sccg.sk

Den otvorených 2ri @ matfyz, Feb 15, 2012, coveideo 2020