Artificial Intelligence and Virtual Reality

Digital transformation, research and society

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https://audi-konfuzius-institut-ingolstadt.de

Agenda

A perspective, current projects and future work

- Introducing the speaker

- Introducing AKII Microlab

- AI and VR? What, where, why?

- AI in the digital world

- VR in the digital world

- When AI meets VR for society

- Where are we heading?

Introducing the speaker

PhD in Neuroscience and Autonomous Robotics, Summa cum Laude

Specialized in designing and implementing AI and ML system for real-world problems

Academic Research

Head of Research Lab AI and VR
As of 2017

AUDI
KONFUZIUS-INSTITUT
INGOLSTADT

Lecturer
As of 2017

Technische Hochschule Ingolstadt

Postdoctoral Fellow, Lecturer
2016-2017

TUM bccn munich
Center of Competence on Neuroengineering

Research Assistant (PhD)
2011-2016

Technical University of Munich TUM

Industry Research

Senior Research Engineer AI, ML & Big Data
As of 2017

HUAWEI

Software Engineer Automotive
2009-2011

intel

Software Engineer Automotive
2009-2011

WIND RIVER

Software Engineer Embedded Systems
2007-2008

freescale
semiconductor

Confucius Institutes in Germany

Audi Konfuzius Institut Ingolstadt (AKII)
Specialization in Technology, Innovation, Management and Sustainability

- Among **19 locations** in Germany, **AKII** is **unique** in its **focus**.

- **AKII** offers the usual **basic Chinese language** and **cultural** programs.

- **AUDI** and the **Local Administration Ingolstadt** are dominant partners bringing a **technological**, **innovation management** and **sustainability** component to AKII.

- **AKII** has an **advisory board** from **SCUT** and **THI** as academic components.
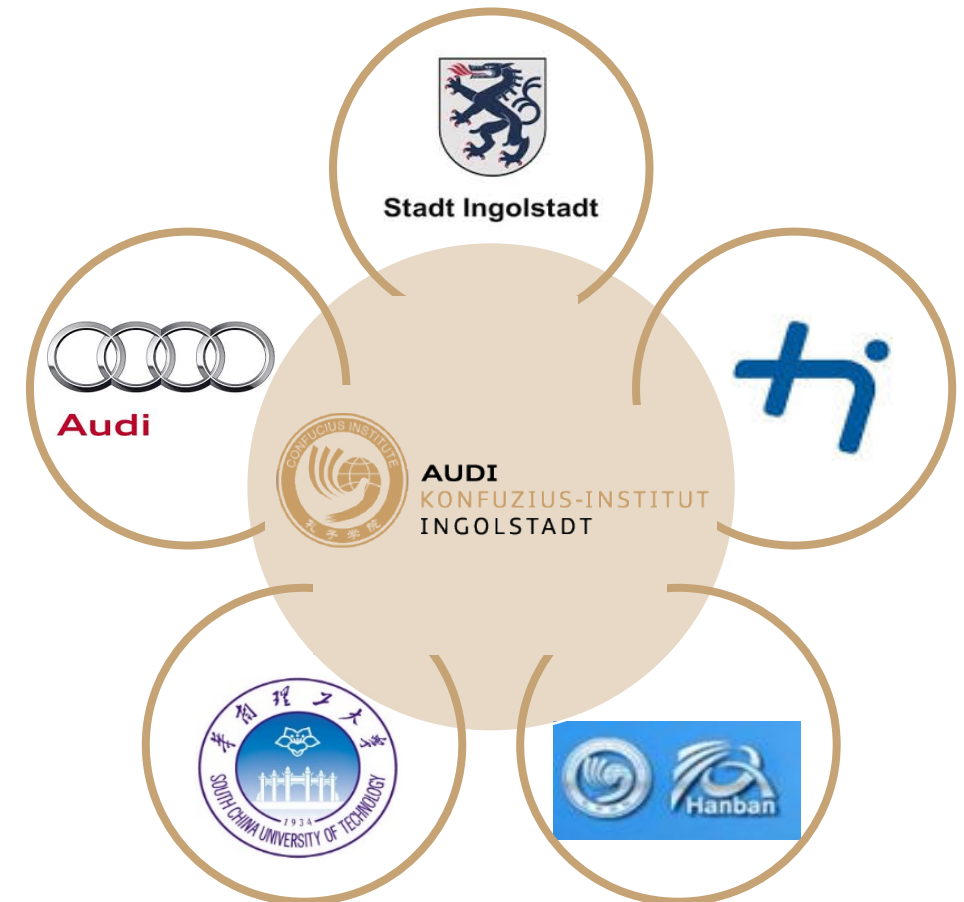
AI and VR? What, where, why?

AI and VR? What, where, why?

From the OR …

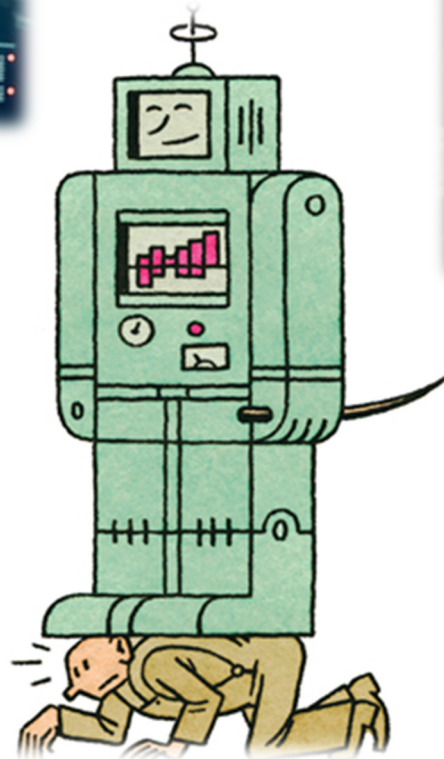… to the grocery store.

From the theater …

… to the classroom.
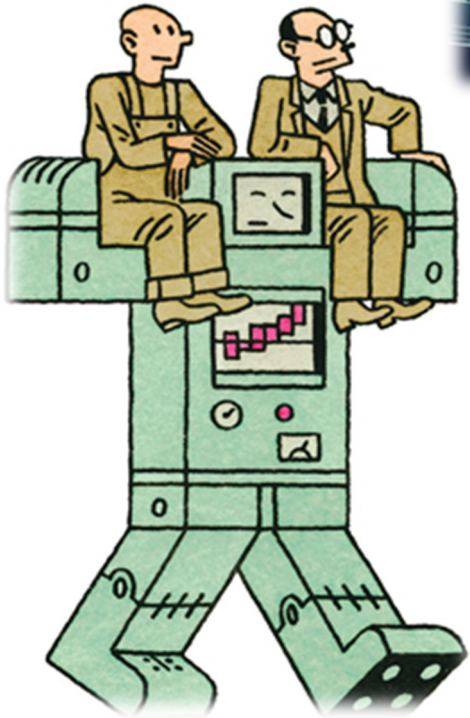
AI and VR? What, where, why?

Toward utopia…   … or dystopia …
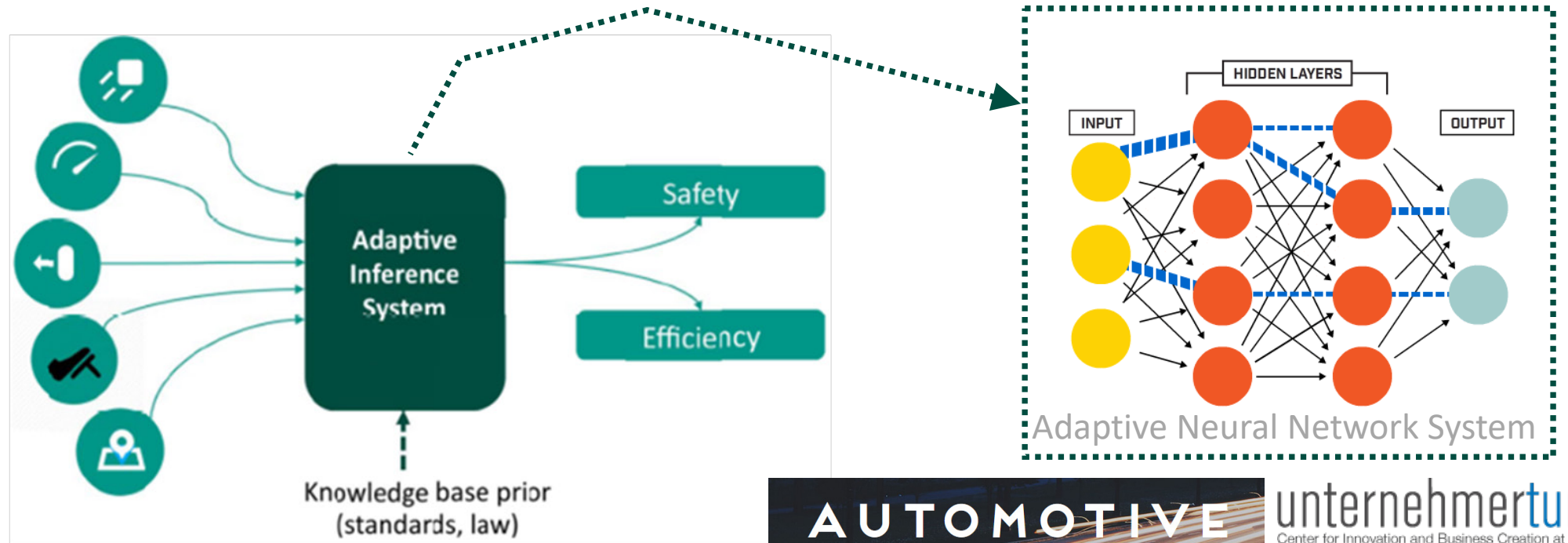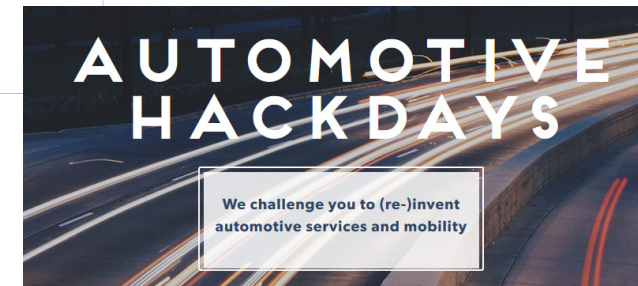
AI in the Digital World

AI in the digital world – Automotive

BMW Automotive Data Hackdays* – Mobility SaaS *(Project completed)*

The Automotive Hackdays are a 5 day coding event where developers, designers, engineers and makers get together to rapidly prototype and iterate new automotive concepts using data gathered from real BMW and MINI cars.

Adaptive Neural Network System
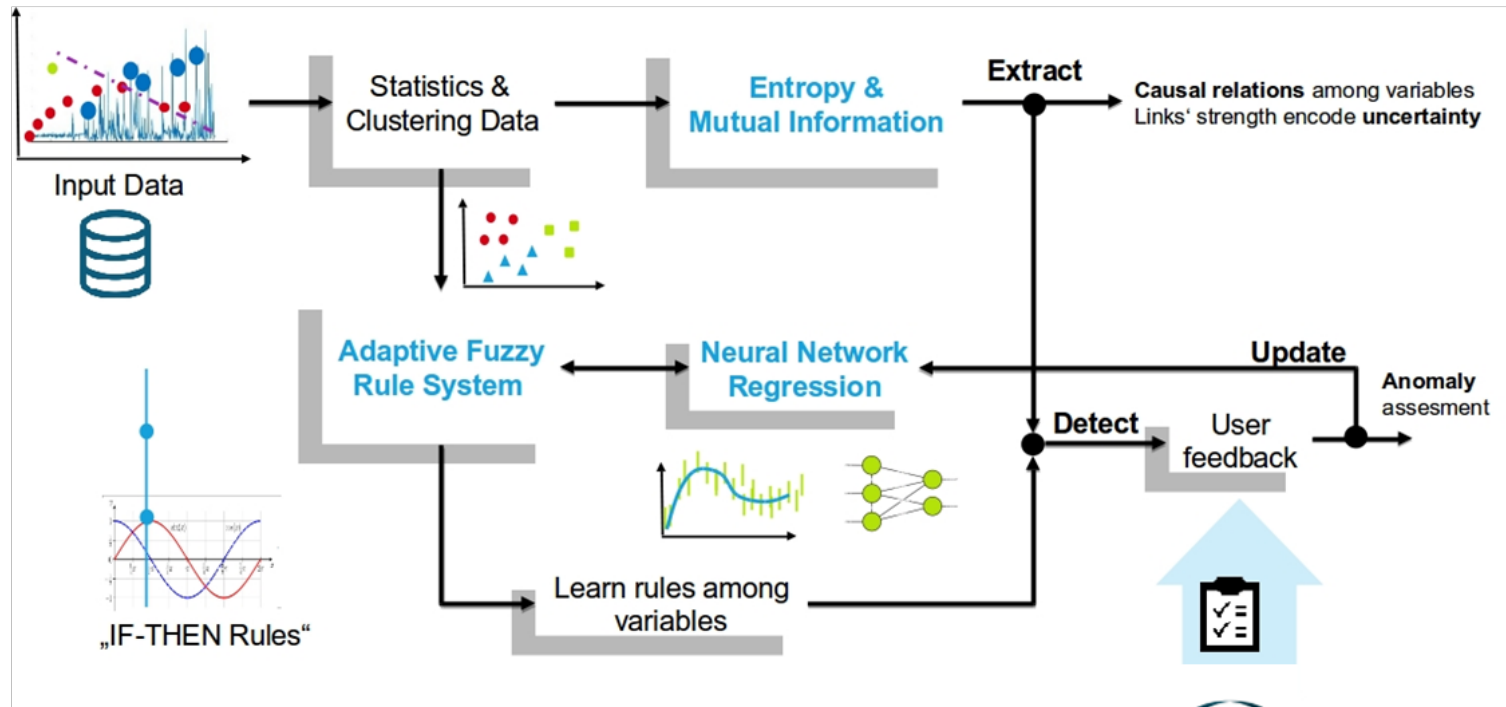
*Awarded 1st prize (5000EUR)

AI in the digital world – Fintech

Daimler Financial Tech Data Hackaton* – Anomaly Detection Agent *(Project completed)*

Develop an AI agent constantly runs through the data (leasing contracts in Sweden) and makes the user aware of potential data inconsistencies, incorporates user's feedback and adapts.


Input Data

Statistics & Clustering Data

Entropy & Mutual Information

Extract

Causal relations among variables
Links' strength encode **uncertainty**

Adaptive Fuzzy Rule System

Neural Network Regression

Update

Anomaly assesment

Detect

User feedback

"IF-THEN Rules"

Learn rules among variables

DAIMLER

Daimler Financial Services

Artificial Intelligence Hackathon | Package for the participants
26-28th of April, 2016

*Awarded 1st prize

AI in the digital world – HR and Psychology

Burda HR Data Hackaton* – Psychometric Data Mining *(Project completed)*

Using neural networks to learn the complex patterns that exist among and between the responses to items in questionnaires. These could represent crucial aspects of human personality if only they could be made available to human resource professionals.

Self-Organizing Feature Maps
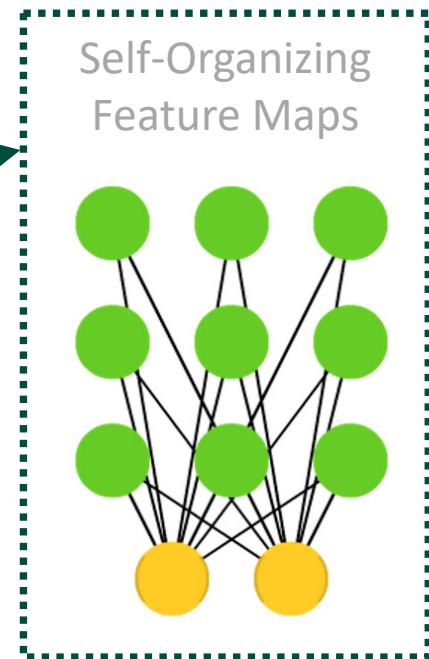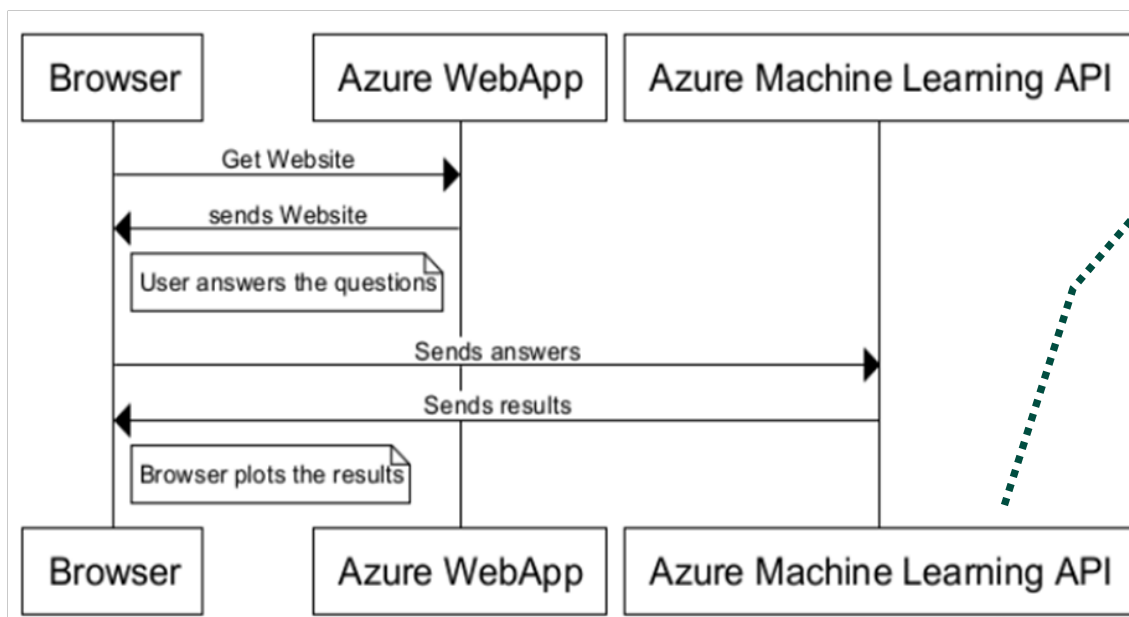
Hubert Burda Media


BURDA HACKDAY — Episode 5 —

*Awarded Microsoft Cognitive Technologies Prize

AI in the digital world – Industrial Automation

Andritz Big Data Analytics – Industrial Process Optimization *(Project completed)*

The task was to find relationship between alarms, operator actions and process data from some pulp and paper mill. The process data was given as time series, where the variables values always have a timestamp.
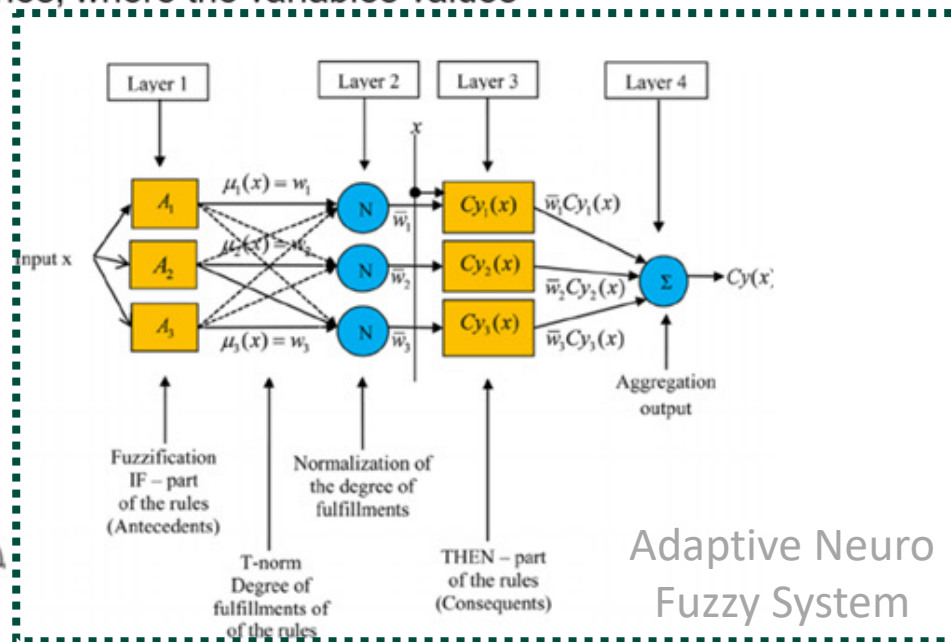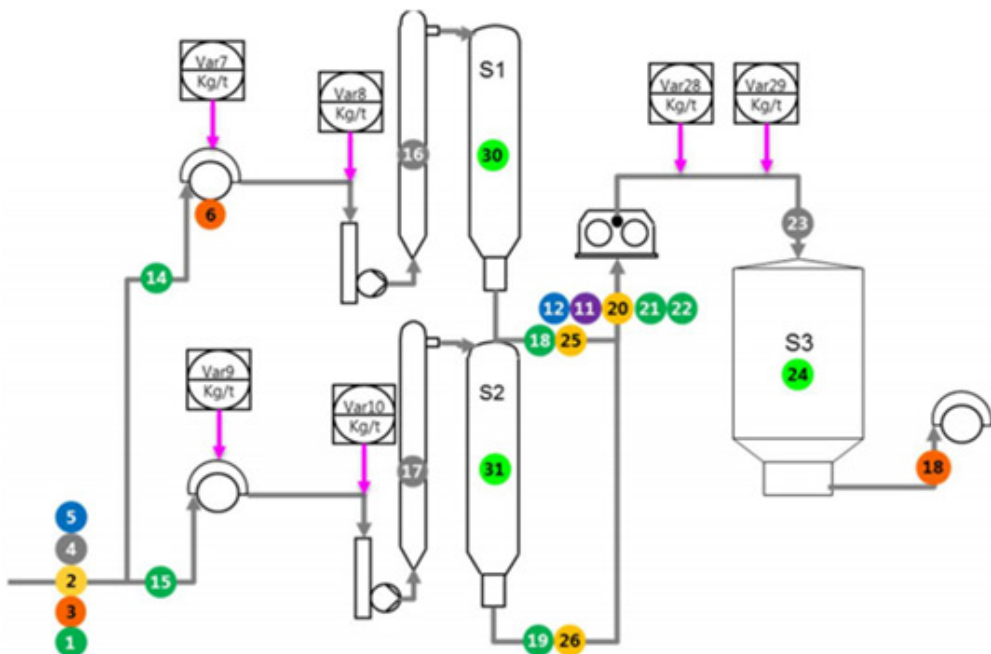
Adaptive Neuro Fuzzy System

VR in the Digital World

VR in the digital world – Automotive *(Projects ongoing)*

- Project with VW and Audi which want to collaborate in VR:

  - High-end renderings;

  - Construction validation;

  - Virtual installation;

  - Ergonomics.

- Latencies in distributed VR causes misunderstandings and decreases the efficiency.

- Cooperation with Audi to develop a measurement system to measure delays between distributed VR systems.
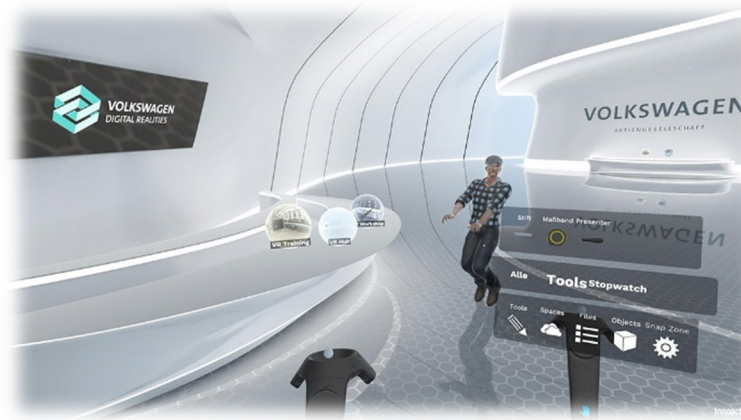
High-end renderings
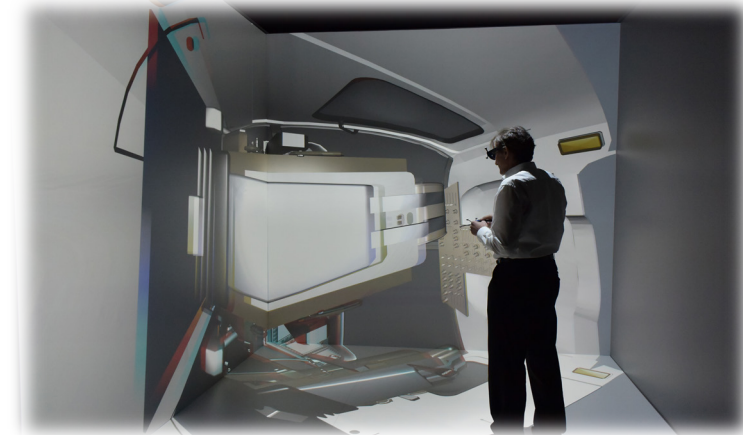
Construction validation

Virtual installation for ergonomics

VOLKSWAGEN
AKTIENGESELLSCHAFT

Audi

VR in the digital world – Artistic performances and historical projects *(Projects completed)*

- The Futurologische Kongress is an art and interactive media event in cooperation with the Theater Ingolstadt.

- Over 14.000 people visit the congress and AKII Microlab for an interactive 3D experience in the VR CAVE.

DER FUTUROLOGISCHE KONGRESS
INGOLSTADT
14.-16. JUNI 2018

Game playing
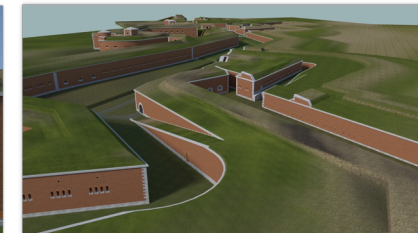
High-end renderings

- Virtual Reconstruction of the Ingolstadt Fortress as of 1875.

- Collaboration with public instutions and companies.

Stadttheater Ingolstadt

Stadt Ingolstadt

VR in the digital world – Rehabilitation *(Project completed)*

- Software to treat deficiency in stereopsis – perceiving depth using our two eyes using an immersive VR.
- Cooperation project and preliminary tests with optometrists of Brillenburg Ingolstadt.
- Preliminary study shows the effectiveness of the system in improving depth perception.

Software interface and functionality

System setup

Stereopsis in human vision
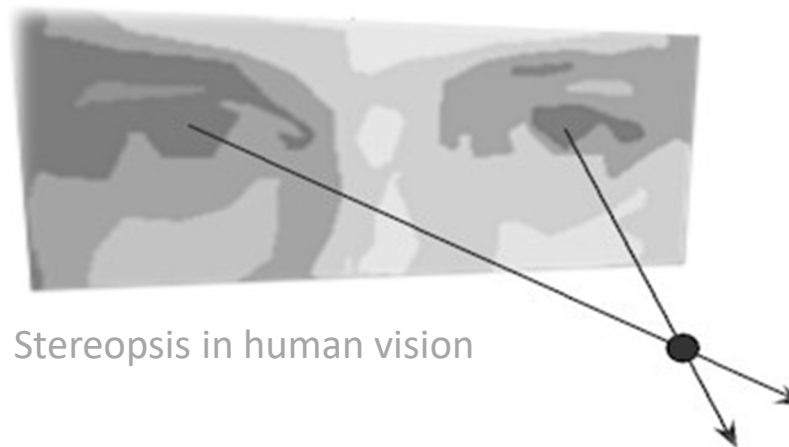
When AI meets VR for society

When AI meets VR for society

Educational Technologies (EdTech)

Context

- Hard to **attract** the students.

- Classroom **atmosphere** and **methods** are **not able** to **capture attention**.

- The total global investment in **EdTech** in 2017 which spiked at $**9.56 billion** in **122 countries**

  in **seven international regions**.

Our hypothesis

- **avatar** in a **virtual classroom**.

- **anonymity** and **unique experience**.

- **help students** to **focus** on the actual study learning **problem.**

How does such a paradigm shift impact learning?

- **private interaction** of the **student** with the **study materials**.

- **self-mediated**, **unbiased** learning.

- **rich virtual representation** can trigger "**thinking out of the box**".

- **knowledge acquisition** and **storage**, and **avoid "mechanical learning**".

Classroom experience
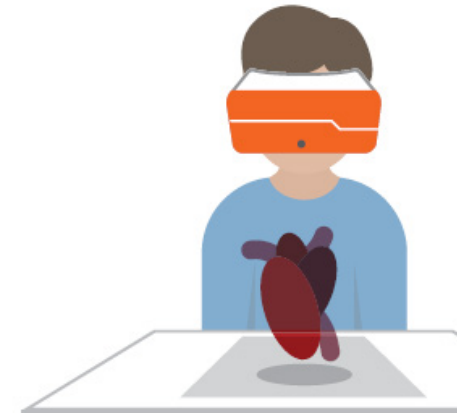
System setup

When AI meets VR for society

VolkswagenStiftung

Artificial Intelligence and the Society of the Future

Grant application in review

Educational Technologies (EdTech)

VIRTOOAIR EDTECH

Virtual Reality TOOlbox for Avatar Intelligent Reconstruction in EDucational TECHnology

https://audi-konfuzius-institut-ingolstadt.de/category/akii-microlab/current-projects

- **Combine AI and VR**

- Augment **teaching methodologies** and **learning techniques**

- Use in **remote** and **online learning**.

- Build a **high-fidelity** for **avatar reconstruction**,

- **pose** and **shape** to **facial expressions** and **dynamic textures**,

- **integrate** other **sensors**, such as **audio**, for a **dynamic merging** of **virtual** and **real objects**

- Will contribute to the advancement of **teaching methodologies**

- **easy adoption**

- relatively **immediate integration** in the educational process.

- International and interdisciplinary consortium.

Immersive Design Research—Lab

virtuelle hochschule bayern

CALIFORNIA STATE UNIVERSITY LONG BEACH 1949
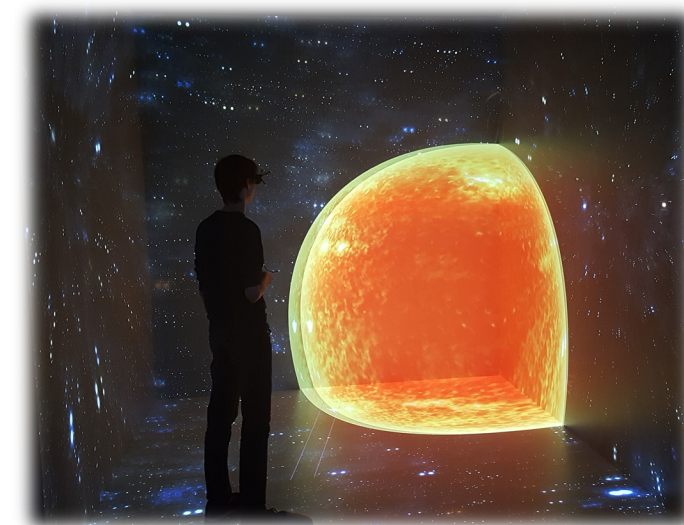
Sample experience: Solar System Lecture

When AI meets VR for society

When AI meets VR for society

Medical Technologies (MedTech)

Context

- **chronic pain** affects many people.

- tragically **overlooked public health problem**.

- **exploring** the **clinical** use of **VR** for **chronic pain management** (e.g. **chemotherapy**).
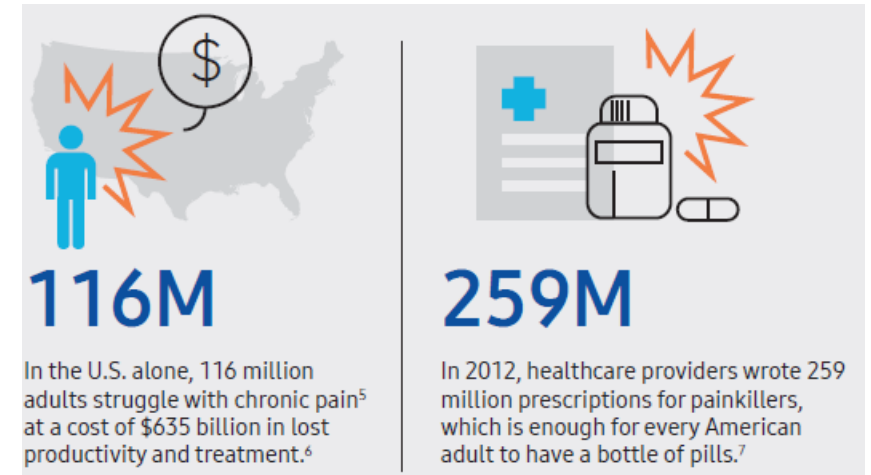
Our hypothesis

- **VR technology** is based on **integrating multiple sensory inputs.**

- **VR analgesia** comes from the **interplay** between **brain** and the **external stimulation**.

- more **realistic** stimulation the better **acceptance.**

Can such a paradigm shift impact medicine?

- Most **VR** are **not intended** as a **medical therapy**, yet **commodity**.

- A recent analysis, reviewing **299 clinical studies**, indicated that participants receiving a **VR intervention** experienced **less pain** than about **82%** of control group participants.

http://dx.doi.org/10.1037/cns0000084

116M

In the U.S. alone, 116 million adults struggle with chronic pain[5] at a cost of $635 billion in lost productivity and treatment.[6]

259M

In 2012, healthcare providers wrote 259 million prescriptions for painkillers, which is enough for every American adult to have a bottle of pills.[7]

Motivating scenario

Sample hospital setup

When AI meets VR for society

Medical Technologies (MedTech)

VIRTOOAIR MEDTECH

Virtual Reality TOOlbox for Avatar Intelligent Reconstruction in MEDical TECHnology

https://audi-konfuzius-institut-ingolstadt.de/category/akii-microlab/current-projects

- **precise avatar representation** in **VR** for **pain management** and **attenuation**.

- **high-end VR** with **precise avatars** may **decrease** the number of **treatment sessions** and may **reduce** or **eliminate** the need for **pharmaceutics** during painful procedures.

- Potential direction: **Peripheral Neuropathy caused by chemotherapy.**

  - **muscle** or **joint aches** are prevalent symptoms

  - **Taxanes** are believed to induce **sensorimotor neuropathy** by impairing **neurons' function**.

  - The **symptoms**:

    - numbness in the hands and feet,

    - tingling in the hands and feet, sensitivity to cold temperatures, nerve pain, muscle/joint aches, muscle weakness, and loss of balance.

- Local interdisciplinary collaboration.

Helios Klinikum München West

Akademisches Lehrkrankenhaus der
Ludwig-Maximilians-Universität München

Daria Kurz

Leitende Oberärztin

Gynäkologisches Krebszentrum

Interdisziplinäres Brustzentrum

Planning collaboration

HOSPITAL

VR PROGRAM

Easy adoption setup

Where are we heading?

Where are we heading?

- AI **can** solve
  - **large amounts of data** need to be **explored**,
  - **accuracy** and **speed** are **crucial**,
  - **problems without** an **analytical solution** or it is **hard** to **find one**.
- AI **cannot**
  - **replace** the **robustness**, **adaptability** that are **innate** in the **human** brain,
  - **machines** still need to be **programmed** to do that.

- VR **can**
  - **create** your **ideal world** and **immerse** your **senses**,
  - **distract**, **educate**, **entertain**, **experiment** the **impossible** in **real-world**,
  - can **bring** us **closer** but can also **set** us **apart**.
- VR **cannot**
  - **replace** the **real-world**,
  - **change** the **real-world**, but it can **augment** it.

- AI and VR **will**
  - offer new **possibilities** to **communicate**,
  - offer a **new way** to **teach**, to **think**, to **work**, to **cure** and to **experiment**,
  - offer a **safe** and **controlled environment** which can **match reality**, yet **stay separate**.

New possibilities

Reinventing our understanding

Are you ready?

Is your business / service for the digital transformation?

- We are still **focused** on **academic research**.

- We continuously **seek new challenges** and **funding options** to **support** our **research**.

- **Support** is always **appreciated**, and we are more than **happy** to **collaborate** on **new challenges**!