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NACHRICHTENTECHNIK Dialogue Systems

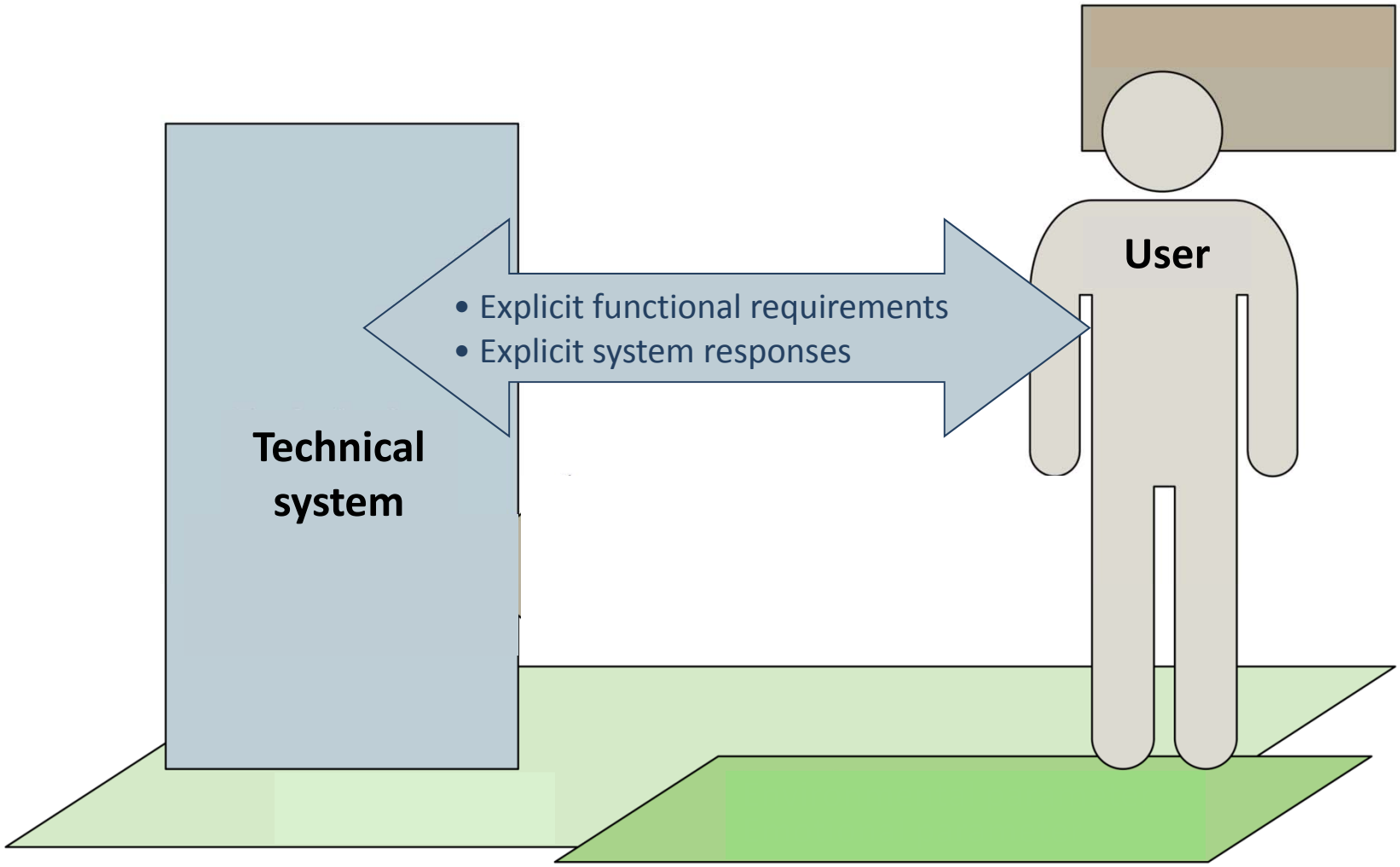
Dialogue Systems Research at Ulm University – Adaptive Speech Interfaces for Technical Companions

Communications Engineering – Dialogue Systems
Ulm University (Germany)
dialogue-systems.org

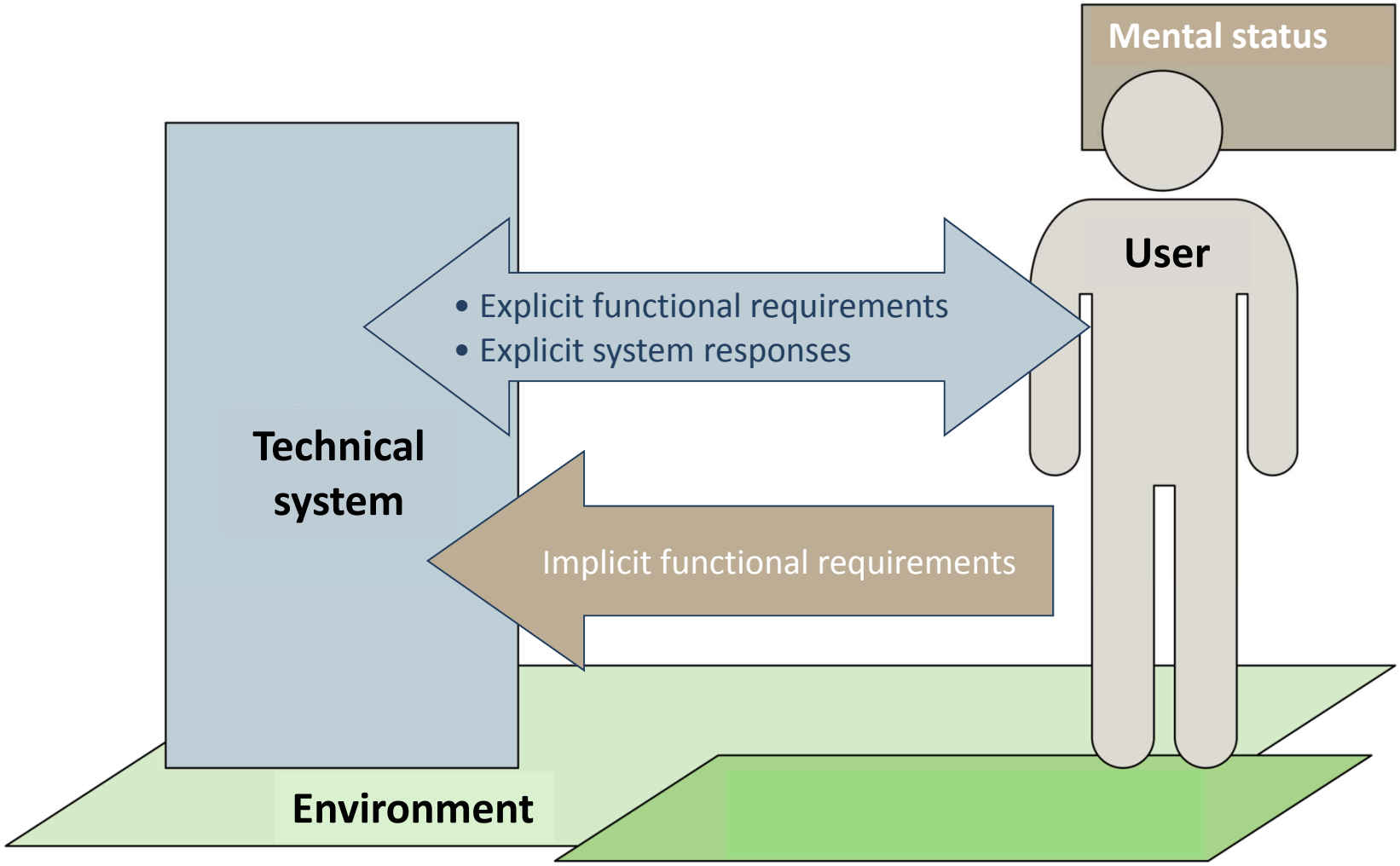
TGMIS Istanbul | November 2014

Wolfgang Minker, Maxim Sidorov and Stefan Ultes

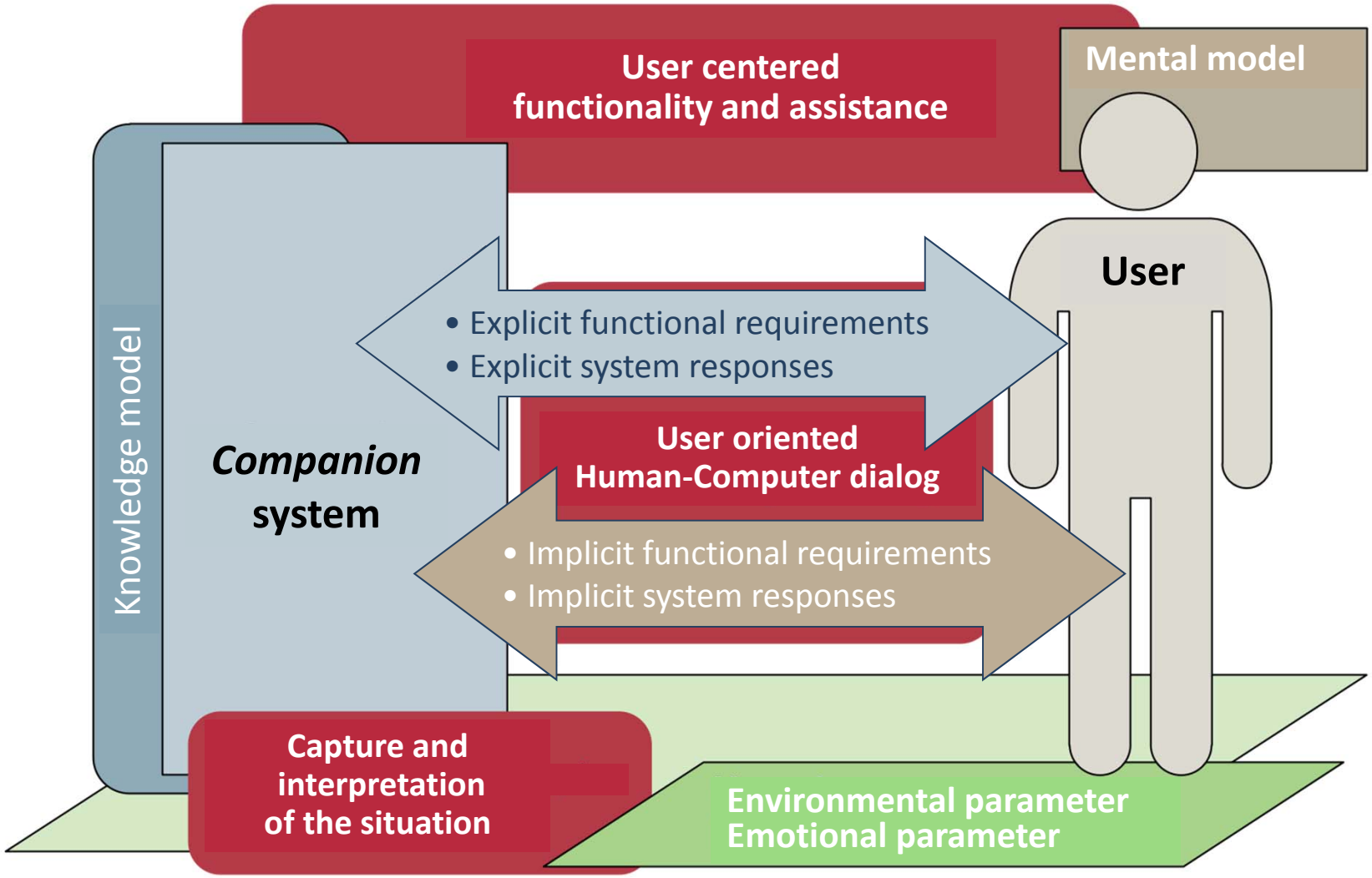
Human-Computer-Interaction – State-of-the-Art



Human-Computer-Interaction – Beyond State-of-the-Art



Spoken Dialogue Systems – Towards Companions



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Companion Systems

- Contain beyond state-of-the art technical systems that are able to
  - autonomously perceive their environment
  - plan actions and pursue aims
  - carry out natural and unconstrained dialogues with users

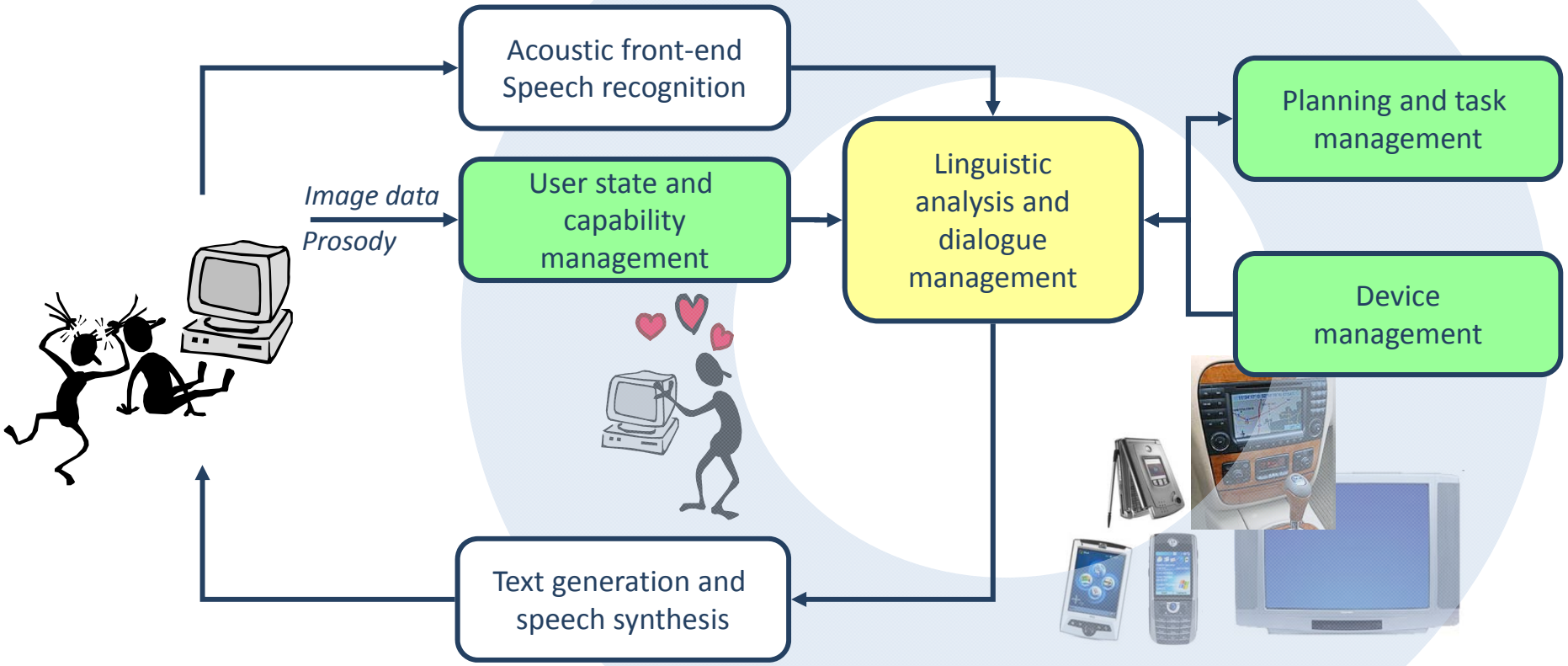
→ Properties close to human interaction partners:

- assistiveness
- adaptiveness
- proactiveness
- individuality
- availability
- cooperativeness
- Trustworthiness

- *A Companion-Technology for Cognitive Technical Systems (2009-16)*
- *Adaptive and TRusted Ambient eCOlogies (2008-11) (EU-FP7)*
- *A Knowledge-Based Information Agent with Social Competence and Human Interaction Capabilities (2015-18) (EU-HORIZON2020)*

Spoken Dialogue Systems – Towards Companions

- Assistiveness, adaptiveness and proactiveness



→ Enhance the linguistic analysis and dialogue management components

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Current and Past PhD Theses

Speech Analysis

Classification and Optimization:

- Automatic Categorization of Human-Human and Human-Machine Conversation based on Hierarchical Classification
- Interaction Quality Modelling for Human-Human Conversations
- Evolutionary Algorithms for Automated Classifier Design in Spoken Dialogue Systems
- Automatic Estimation of Verbal Intelligence

Emotion Recognition:

- Speech-Emotion Recognition in Adaptive Dialogue Systems
- Emotion Recognition for Adaptive Spoken Dialogue Systems

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Dialogue Management

Assistiveness:

- User- and situation-adaptive explanations in dialogue systems
- Domain-Level Reasoning for Dialogue Systems

Adaptiveness:

- Statistical Modeling for Online Monitoring of Adaptive Spoken Dialog Systems
- User-Adaptive Spoken Dialogue Management
- Situation- and User-Adaptive Dialogue Management
- Model-Driven Adaptation for Spoken Dialogues in Intelligent Environments

Adaptive Multimodality:

- Interactive Anthropomorphic Interface Assistants
- Intuitive Speech Interface Technology for Information Exchange Tasks
- Adapting Multimodal Interactive Systems to User Behaviour

Proactiveness:

- Proactive Spoken Dialogue Interaction in Multi-Party Environments

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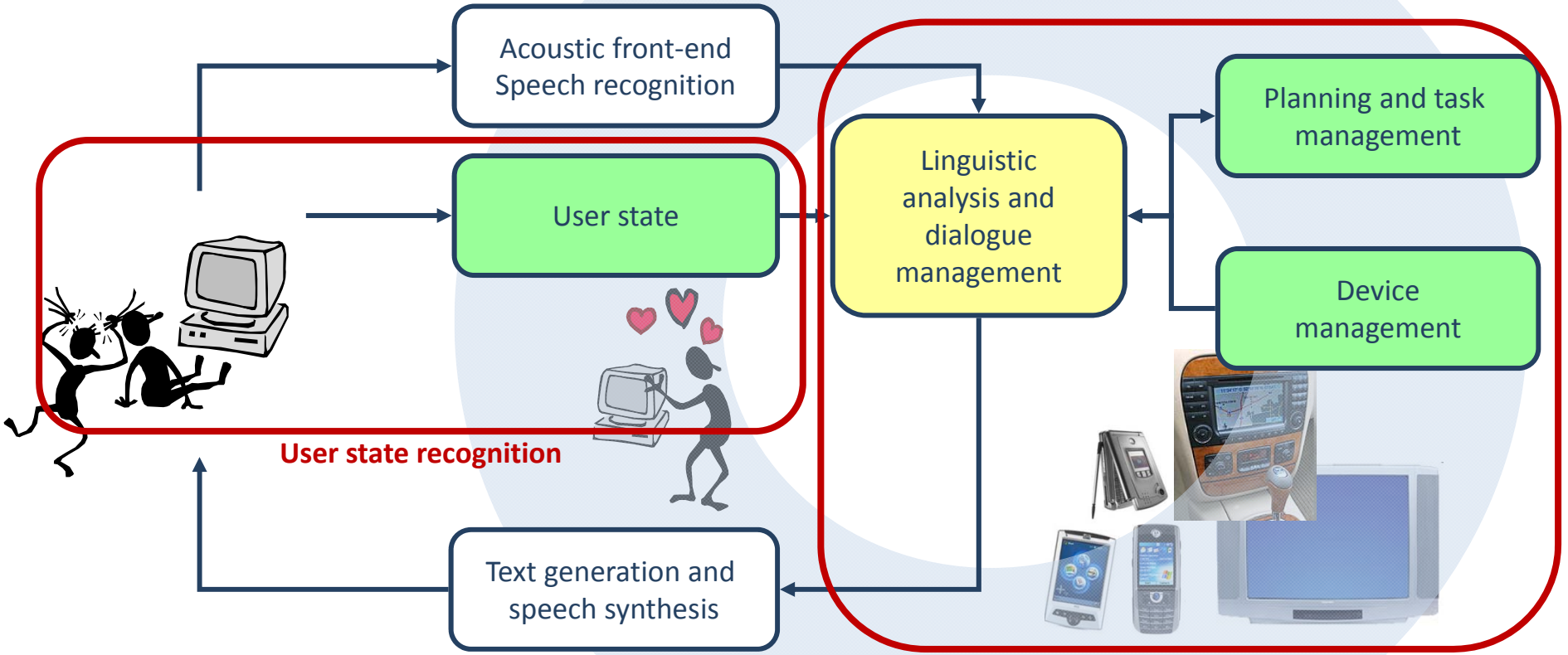
User-Adaptive Spoken Dialogue Management (Stefan Ultes)

- Provide **appropriate system behavior** based on perceived user state



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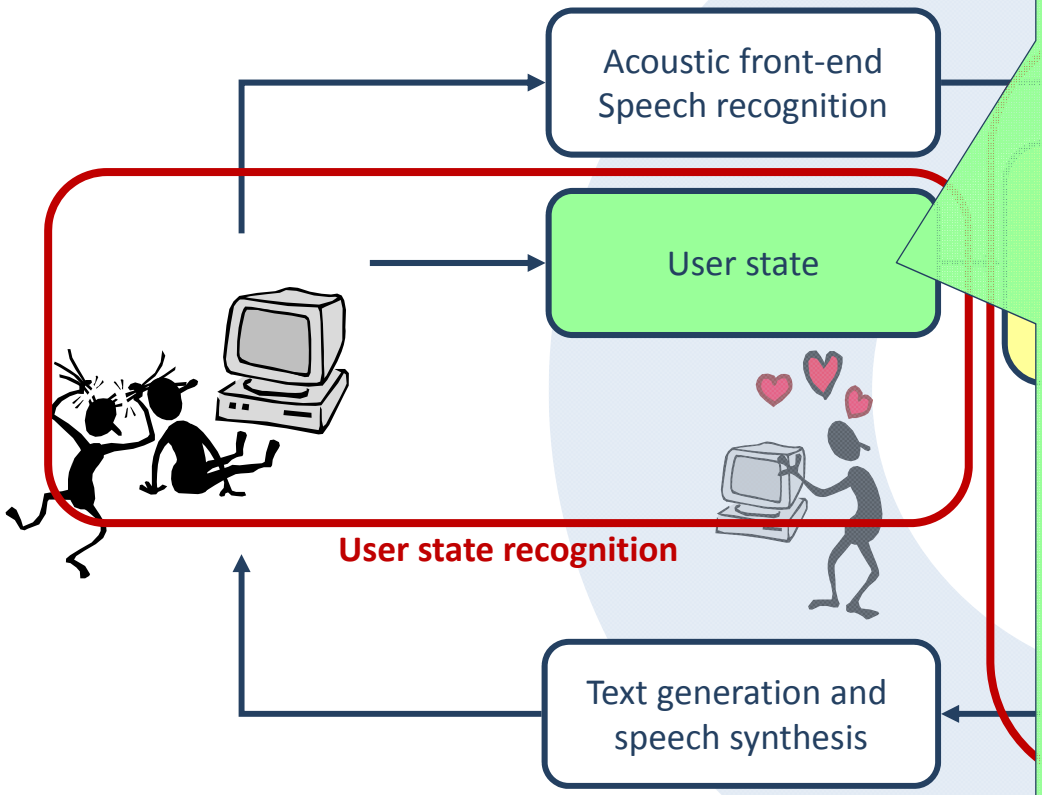
User-Adaptive Spoken Dialogue Management

- Provide **appropriate system behavior** based on perceived user state



Automatic user state recognition:

- idea: usage of statistical classifiers to recognize:
  - intoxication
  - emotions
  - user Satisfaction
  - perceived coherence
- focus on **Interaction Quality** (IQ)
  - objective form of user satisfaction
  - analysis of multiple statistical modeling approaches
    - static models (SVM...)
    - sequence models (HMM...)
  - evaluation of IQ in dialogues

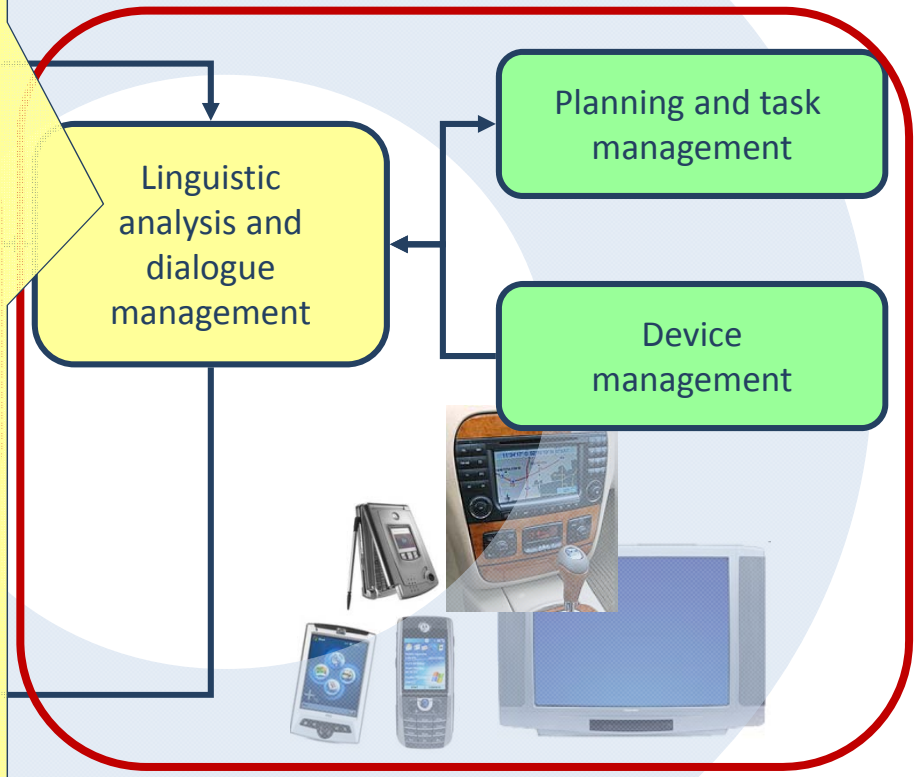
User-Adaptive Spoken Dialogue Management

Provide appropriate system behavior based on perceived user state

Adaptive Dialogue Management (DM)

- change system behavior / dialogue strategy based on Interaction Quality
- explicitly
  - rule-based system
  - adapt:
    - grounding
    - initiative
    - prompt design
- implicitly
  - automatically learn best strategy
    - statistical DM (POMDP)
    - reinforcement learning
  - IQ part of dialogue state
  - IQ part of reward function

Experiments and results at my poster



Adaptive Dialogue Management

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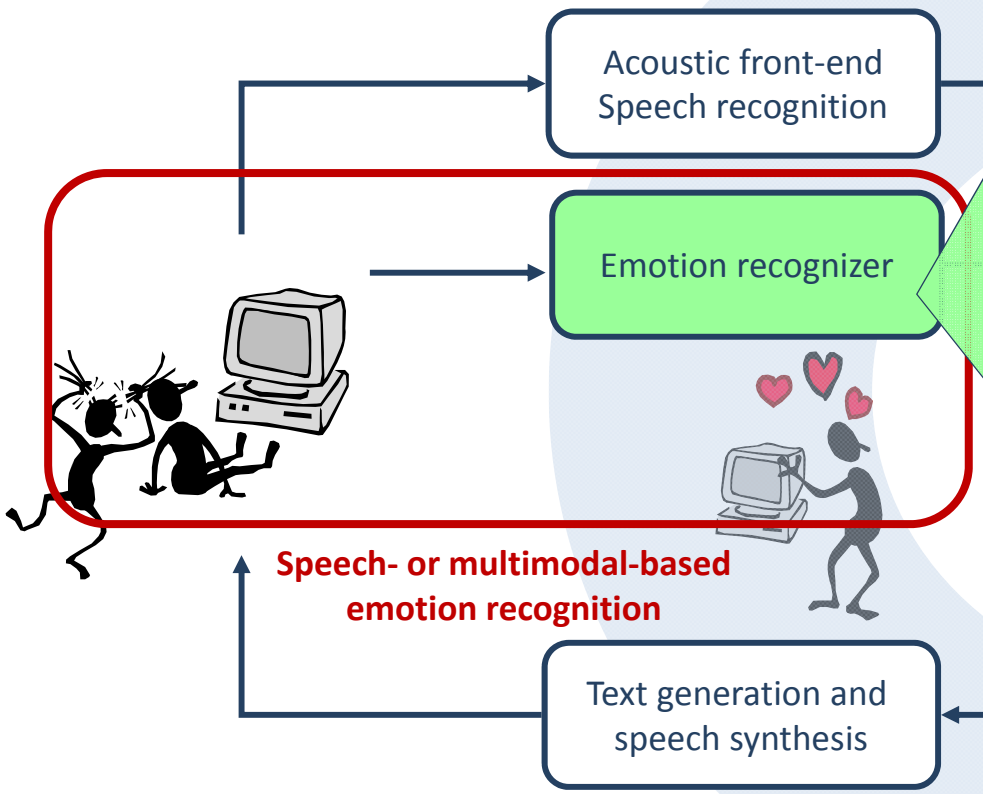
Emotion Recognition for Adaptive SDS (Maxim Sidorov)

- Emotion Recognition is used to change a dialogue strategy or to redirect an end user to a human-assistant

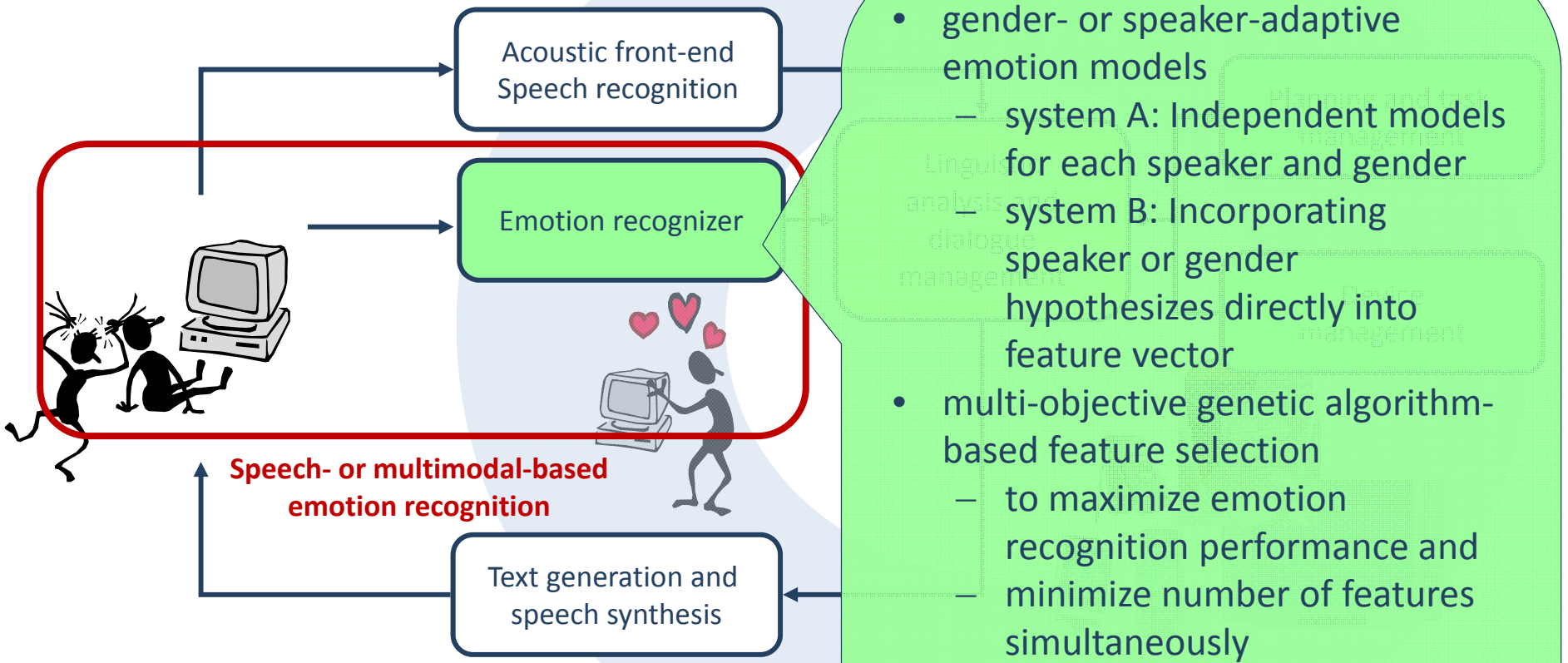


Multimodal automatic emotion recognition:

- machine learning algorithms for modelling
  - ANN
  - SVM
  - KNN
- usage of multimodal features
  - audio
  - visual
  - text
- types of fusion
  - feature-based or early fusion
  - decision-based fusion (weighted sum, product, meta-modelling algorithm)
  - model-based

Enhancement of Emotion Recognition

- Emotion Recognition is used to change a dialogue strategy or to redirect an end user to a human-assistant



- gender- or speaker-adaptive emotion models
  - system A: Independent models for each speaker and gender
  - system B: Incorporating speaker or gender hypothesizes directly into feature vector
- multi-objective genetic algorithm-based feature selection
  - to maximize emotion recognition performance and
  - minimize number of features simultaneously

Experiments and results at my poster

Conclusions

Enhanced spoken dialogue interaction plays a key role in advanced technical systems.

- *How to optimally adapt spoken language dialogue systems to user status and context of use? (→ Adaptiveness)*
  - relevant context information captured and interpreted
  - information integrated into a user-oriented human-computer dialogue
  - adaptive dialogue modeling strategies

- *How to reduce the cognitive burden of the user? (→ Assistiveness and Proactiveness)*
  - more powerful back-end and dialogue strategies
  - multi-user interaction
  - dialogue history management

Acknowledgements