Universität Rostock
Traditio et Innovatio

E·BRAiN

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Using the Social Humanoid Robot Pepper for Training Tasks

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Outline

- Introduction
  - Stroke statistics
  - Training tasks for post-stroke patients
  - Digitalisation of training tasks
- Social-Humanoid Robot Pepper as motivator
  - Replacement of the therapist after first training
  - Specification of collaboration
  - Interaction design
  - Models of patients
- Discussion of challenges
- Outlook

Introduction

- **Stroke** is currently a very important disease.
- According to he American Heart Association Statistics Committee and Stroke Statistics Subcommittee in 2017 every 40 seconds someone in the United States had a stroke.
- Every four minutes, someone died of stroke.

- Even that this is bad news, it means that a lot of stroke patients survive. However, they have to cope with defects. Often one arm is disabled, which creates a lot of problems for the daily life.
- Fortunately, there are opportunities to train the brain in not effected areas in such a way that patients can recover.

Arm-Ability Training

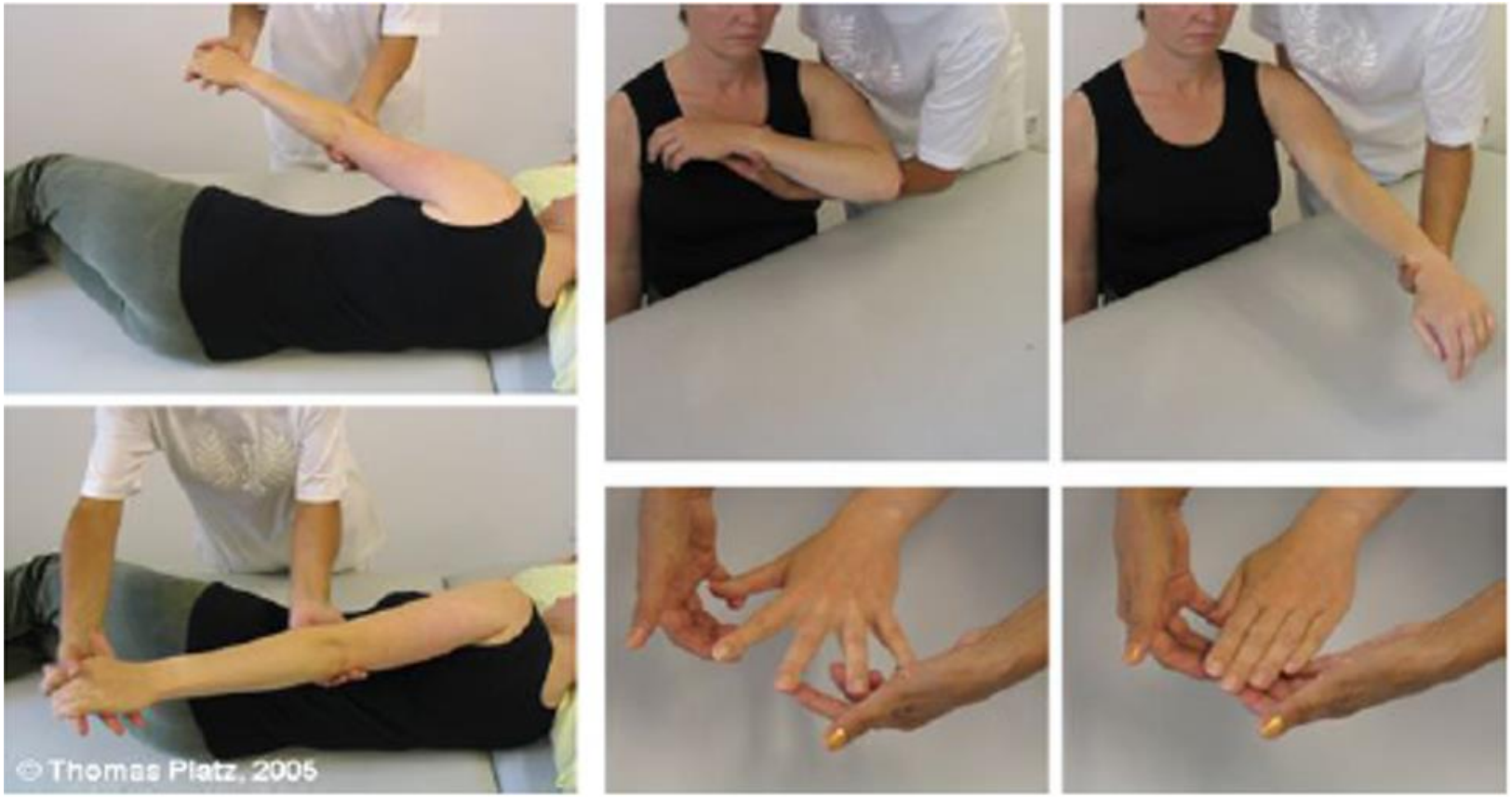
Mirror Training

The patient is asked to imagine that the hand in the mirror is his Disabled arm.

Several exercises have to be performed.

Arm-Basic Training

Training with a supportive person.



Project E-BRAiN

- Within the project

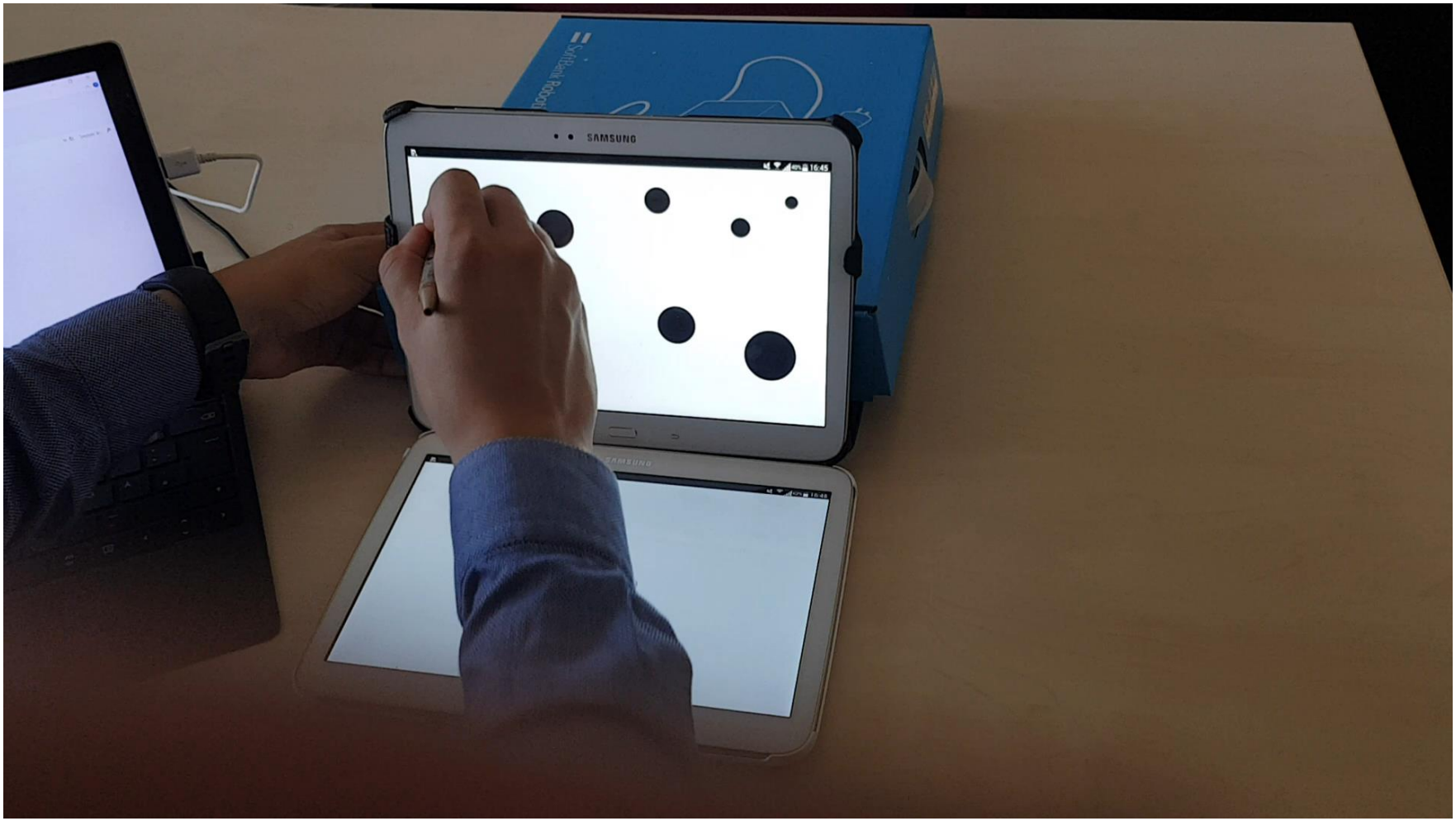
  E-BRAiN

  (Evidence-based Robot-Assistance in Neurorehabilitation)

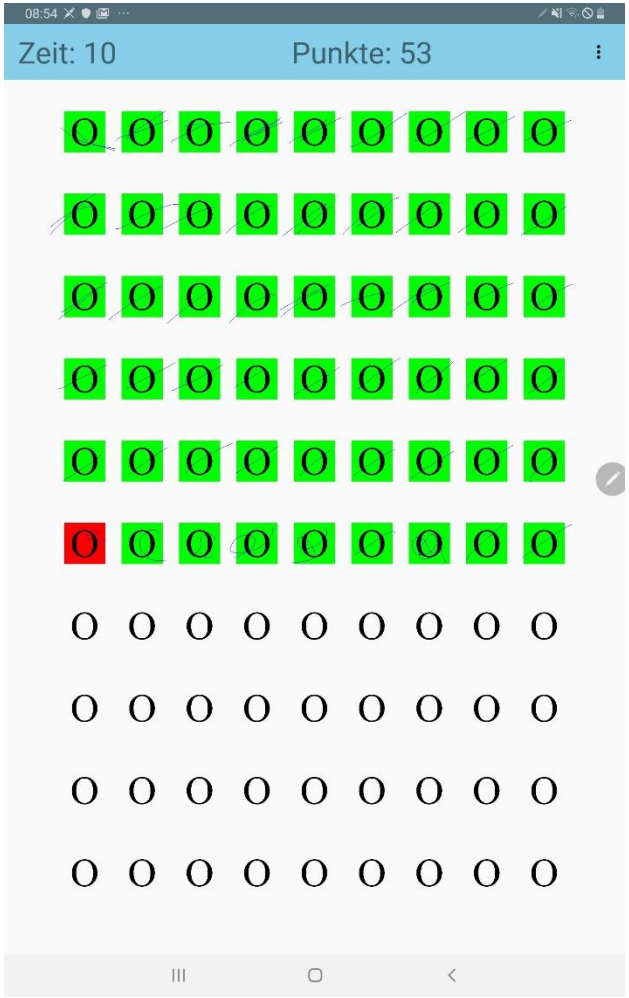
  we want to develop software that allows a social humanoid robot to give instructions to perform and to observe carefully selected exercises and provide feedback.

- In addition, the robot should motivate patients in continuing their training tasks.
- The team consists of researchers from Medicine, Psychology, Sociology and Computer Science.

Digitalised Aiming



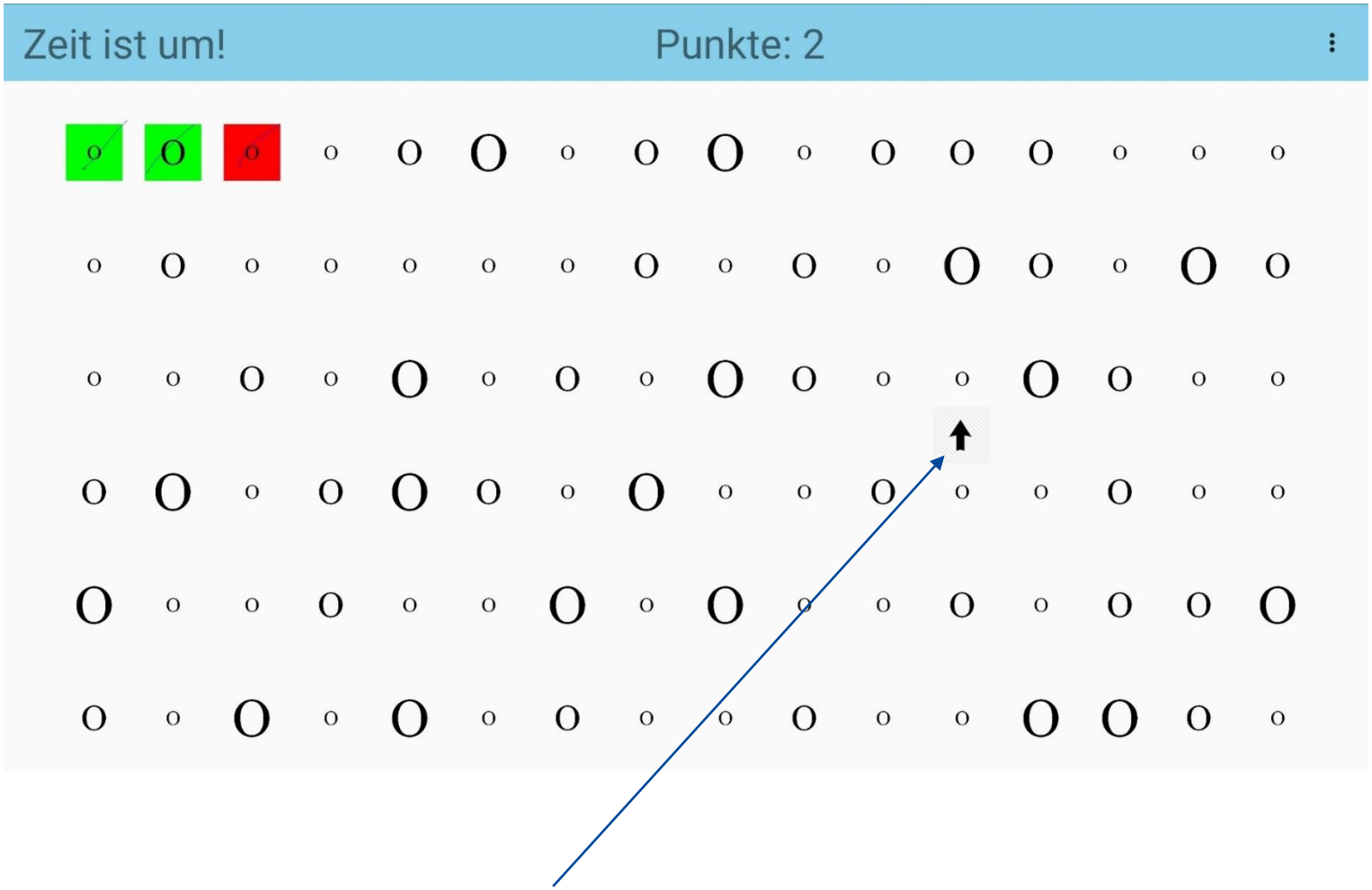
Crossing Out Task on a Tablet



- Time left is 10 seconds (Zeit: 10)
- Reached pointes is 53 (Punkte: 53)

- Green means success
- Red means failure (attempt has to be repeated)

Advanced Crossing Out (different size)

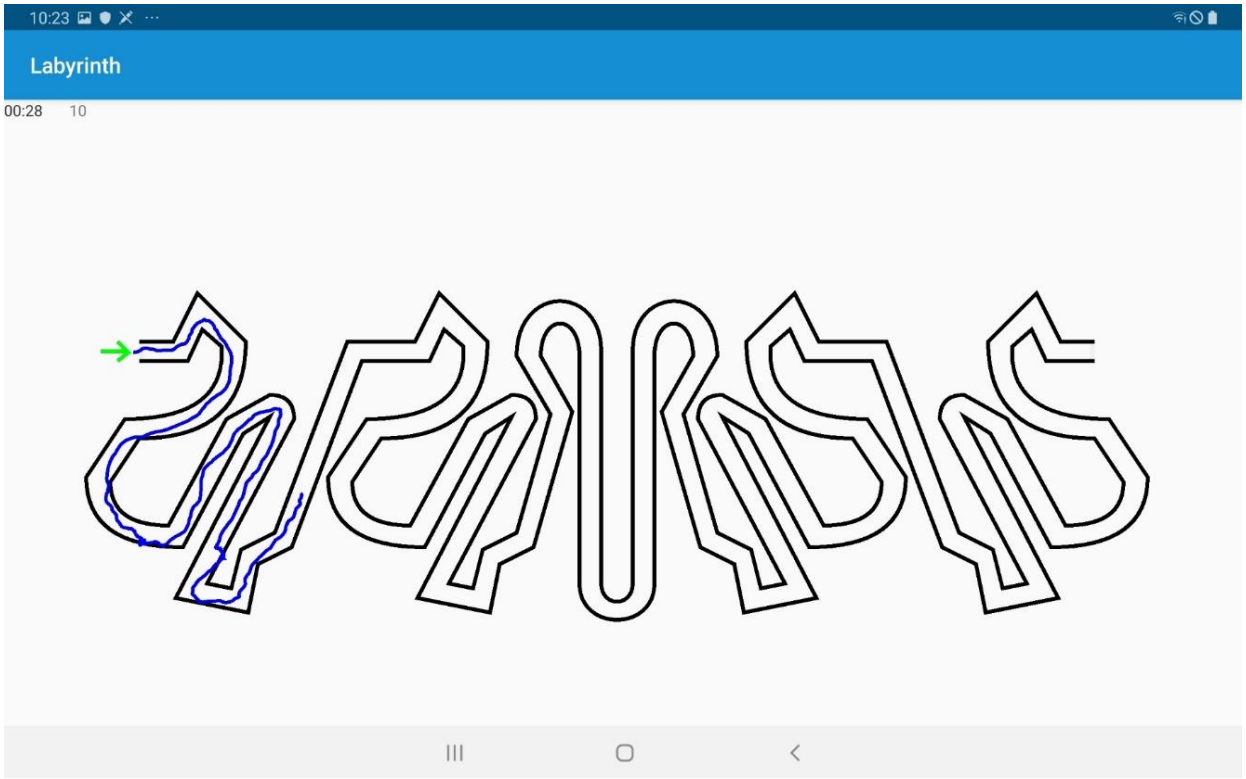


Arrow signals result of previous exercise.

Crossing Out

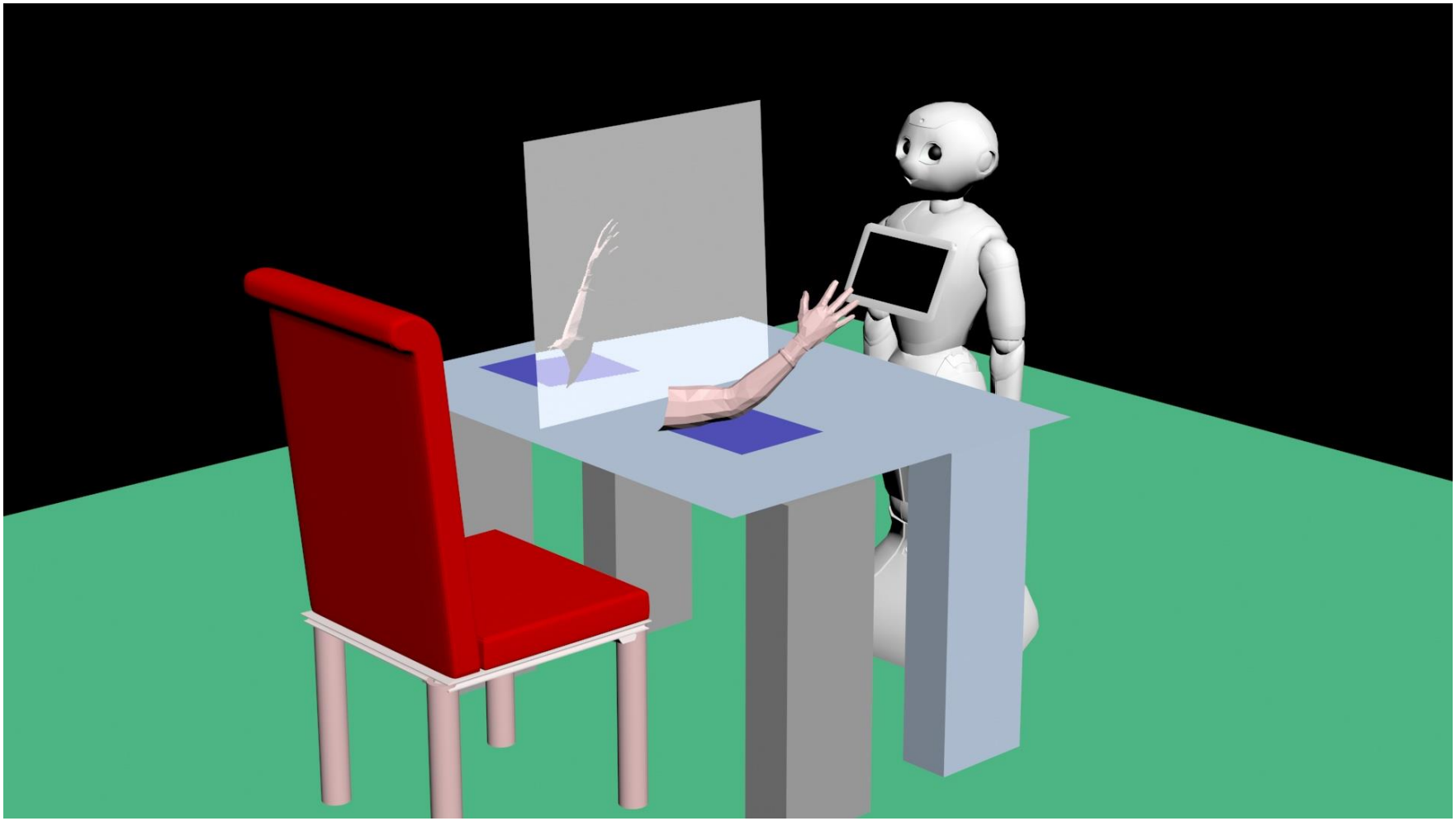
Graph on the Pepper tablet presents a results history.

Labyrinth Training on a Tablet

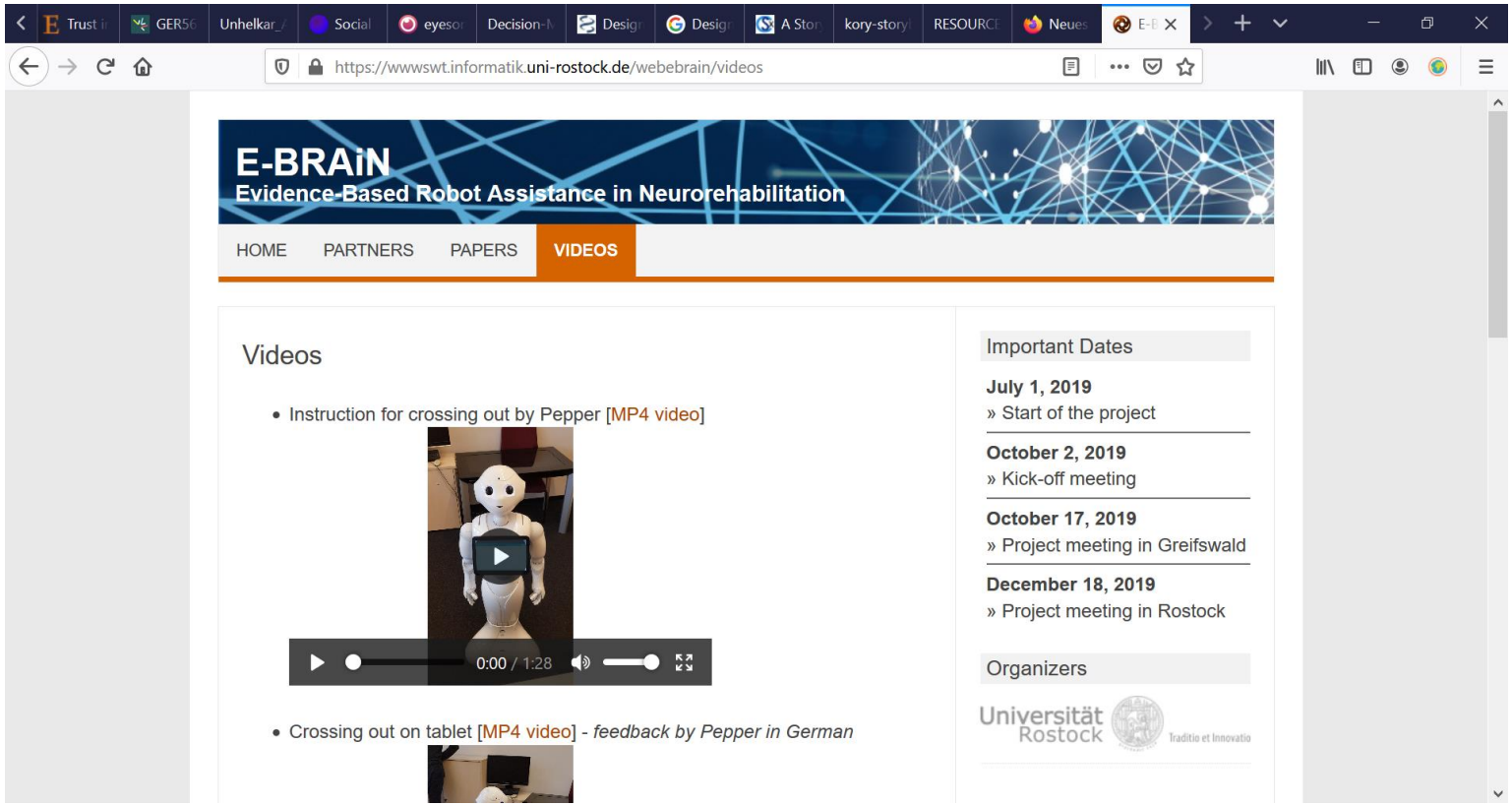


- Errors result in one second penalty – reduced from the time left.
- Result of the exercise is the percentage of the reached path in one minute. It can vary from 0 to more than 100 if a second labyrinth is started

Mirror Therapy Setup



Videos



https://wwwswt.informatik.uni-rostock.de/webebrain/videos/

Research Topics

- Modelling of collaborative activities of patient, supporter and robot.
- Designing a Domain Specific Language (DSL) for the robot.
- Connection of the robot with devices (e.g. Tablet, Smart Phone)
- Code generation for the robot
- Interaction with the robot by gestures or „Tangible User Interfaces“.
- . . .

Challanges

- ***Challenge 1***: How can sentences be formulated to motivate a patient in the right way?
- ***Challenge 2***: What are the important attributes for the user model?
- ***Challenge 3***: Which kind of information has to be presented to a patient when?
- ***Challenge 4***: Specification of a DSL that allows the specification of collaborative activities of humans and robots and additionally the generation of code for robots.
- ***Challenge 5***: For which kind of patients is assistance by a social humanoid robot like Pepper appropriate?

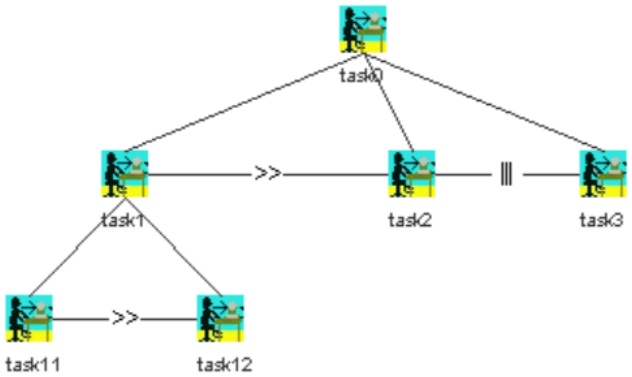
First ideas of attributes for user modelling

1. Personal data (persistent data)
2. Personal therapy data (persistent data)
    - 2.1. personal goals
    - 2.2. medical conditions
3. Exercise-related data (dynamical data)
4. Emotional state data (dynamical data)
5. History of interactions (dynamical data)

- DSL-CoTaL
  - Domain-Specific Language for modelling cooperative tasks
  - Consist of one team model and several role models
  - Code can ge generated to tools like CTTE, HAMSTERS and CoTaSE.

```
role test {
    root task0 = task1 >> task2 ||| task3
       task task1 = task11 >> task12
}
```

DSL-CoTaL



CTTE

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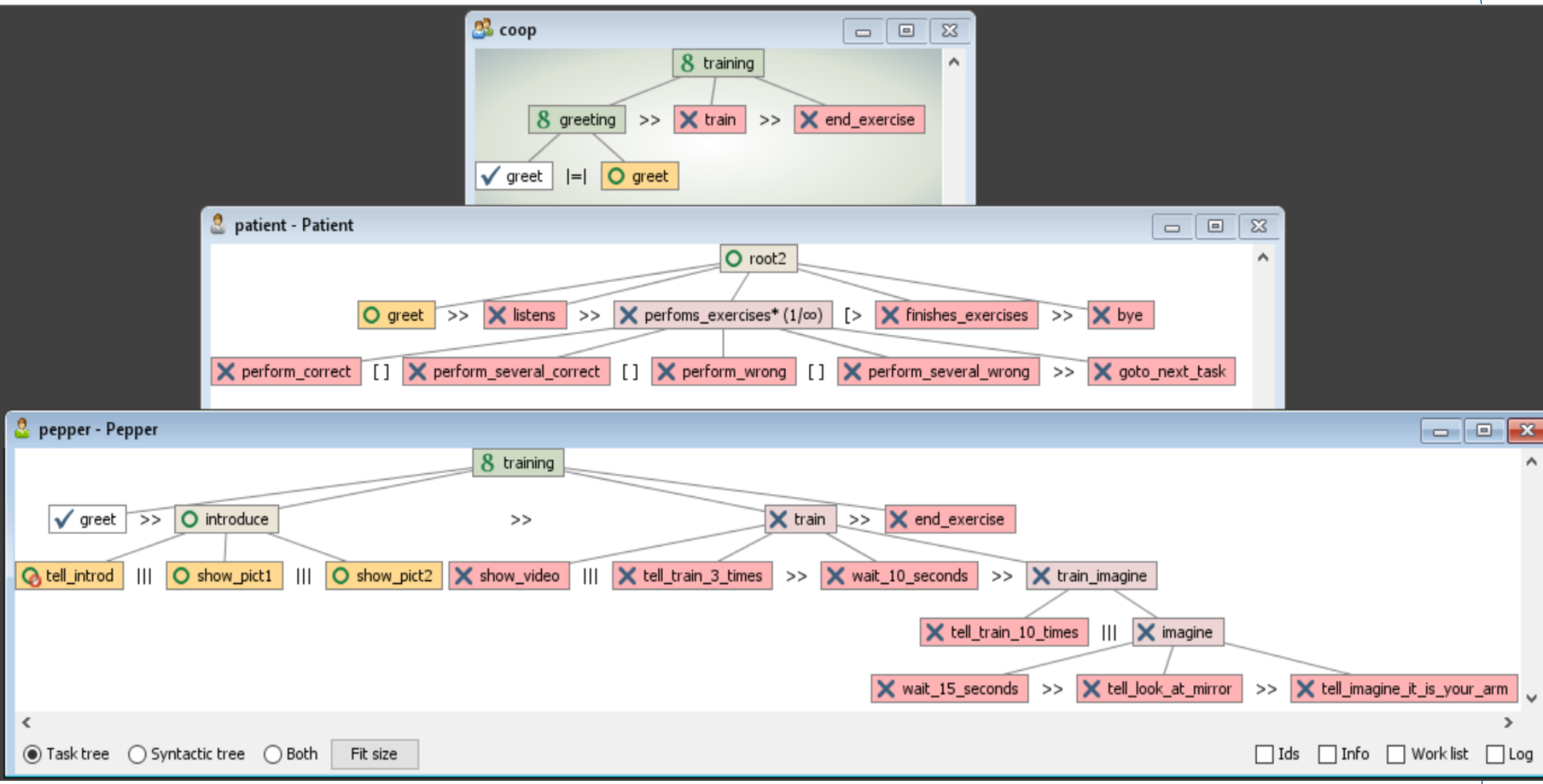
Animated team and role models



Pepper-DSL-CoTaL Specific Language Constructs

- say(Text)
- say_loud(Text)
- blink_with_eyes(Seconds)
- raise_left_arm
- raise_right_arm
- move_ahead(Centimeter)
- turn_right
- turn_right(Degrees)
- turn_left
- turn_left(Degrees)
- turn_back
- sleep(Seconds)

Picture_definitions

P1: ”C:\pictures\pic1”
P2: ”C:\pictures\pic2”
P3: ”C:\pictures\pic3”
…

Video_definitions

V1: ”C:\pictures\vid1”
V2: ”C:\pictures\vid2”
V3: ”C:\pictures\vid3”
…

Challanges (addressed)

- ***Challenge 1***: How can sentences be formulated to motivate a patient in the right way?
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Hints would be appreciated!

ACKNOWLEDGMENTS

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Thank you very much for your attention.