Berner Fachhochschule
Haute école spécialisée bernoise
Bern University of Applied Sciences

Use of social robots in medical environments and medical informatics teaching

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- Bern University of Applied Sciences | Engineering and Information Technology | Medical Informatics

Social robots – what are they?

www.parorobots.com

A multitude publications

IEEE ROBOTICS AND AUTOMATION LETTERS, V

Lio-A Persona
Intera

Justinas Mišeikis, Pietro C
Frederik Zwilling, Cha

Abstract—Lio is a mobile robot platfor
arm explicitly designed for human-robot
care assistant tasks. The robot has alre
eral health care facilities, where it is fu
assisting staff and patients on an everyda
safe by having full coverage in soft art
well as collision detection, limited speed
the robot has a compliant motion cont
visual, audio, laser, ultrasound and mech
safe navigation and environment underst
setup allows researchers to access raw s
direct control of the robot. The friendl
resulted in the robot being well accep
and patients. Fully autonomous operat
a flexible decision engine, autonomous
recharging. Combined with time-schedu
lows Lio to operate throughout the da
up to 8 hours and recharging during i
of powerful computing units provides
to deploy artificial intelligence and deep
on-board the robot without the need t
to cloud services, guaranteeing compliai
ments. During the COVID-19 pandemic,
to perform additional functionality like
elevated body temperature detection. It
- Safety requirements for personal care
directly tested and deployed in care facil

Index Terms—Service robotics, auto
centered robotics, physical human-robo
in life sciences: biotechnology, pharmac

I. INTRODUCTIO

RECENTLY robots have been ga
the factory floors and entering ur
such as homes, shops and hospitals. Th
vices designed for *internet-of-things (I*
physical robots which are capable of a

ELSEVIER

Full Length Article

Robot-based solution for

Mohammed Faisal [a], Abdullah A
Shaikhah Alenezi [a], Anfal Alsula

[a] *Department of Computer Science & Engineering, Facul*
[b] *Department of Computer Science, Community College,*
[c] *Artificial Intelligence Lab, Department of Computer En*

ARTICLE INFO

Keywords:
Robotics
Artificial intelligence, Alzheimer care
companion robot, Kuwait dialect

1. Introduction

In 1906, Dr. Alois introduced the first
This disorder is characterized by a decline i
loss, and impairment in daily functioning
6.5 million Americans aged 65 and older
disease. According to the World Health C
global prevalence of dementia and Alzh
estimated to exceed 55 million individu
residing in low- and middle-income cou
ported that nearly 10 million new cases
2020, WHO reported that Alzheimer's an

Shalutha Rajap
Idiap Research Instit
Switzerlan

André Schak
EPFL
Switzerlan

ABSTRACT

Shared autonomy can be beneficial in al
robots to refine the robot's behavior an
their needs. However, current methodolog
joysticks or physical pushes to modify ro
may not be feasible for people with reduc
we present our initial work toward voice
implementing a language model which ca
commands to understand the intended c
fine-tuned model, capable of running l
improved efficiency in complex and reali
to recent generative pre-trained transfor

CCS CONCEPTS

• **Computer systems organization** —
professional topics → **Assistive techn**

KEYWORDS

Human Robot Interaction, Shared Auto
Corrections

ACM Reference Format:
Shalutha Rajapakshe, Atharva Dastenavar, An
Senft. 2024. Synergizing Natural Language Tow
omy. In *Companion of the 2024 ACM/IEEE Interna*
Robot Interaction (HRI '24 Companion), March 1
ACM, New York, NY, USA, 5 pages. https://doi.

1 INTRODUCTION

One of the main challenges in deploying r
tic environments is the combination of co
of such environments. Shared Autonomy
human and robot inputs to control a robo
support the deployment of (partially) aut
plete tasks in real environments. While m
and kinesthetic means to provide correcti

Protocol

The Effects of a Humanoid Socially Assistive Robot Versus Tablet Training on Psychosocial and Physical Outcomes of Persons With Dementia: Protocol for a Mixed Methods Study

Sandra Schüssler[1], DR (AM); Julia Zuschnegg[1], BSc, MSc; Lucas Paletta[2], DI, DR (AM); Maria Fellner[2], DI; Gerald Lodron[2], DI; Josef Steiner[3]; Sandra Pansy-Resch[3], Mag; Lara Lammer[4], DR (AM); Dimitrios Prodromou[4], MSc; Sebastian Brunsch[4]; Magdalena Holter[5], MSc; Lorenzo Carnevale[4], MEng; Silvia Russegger[2], DI

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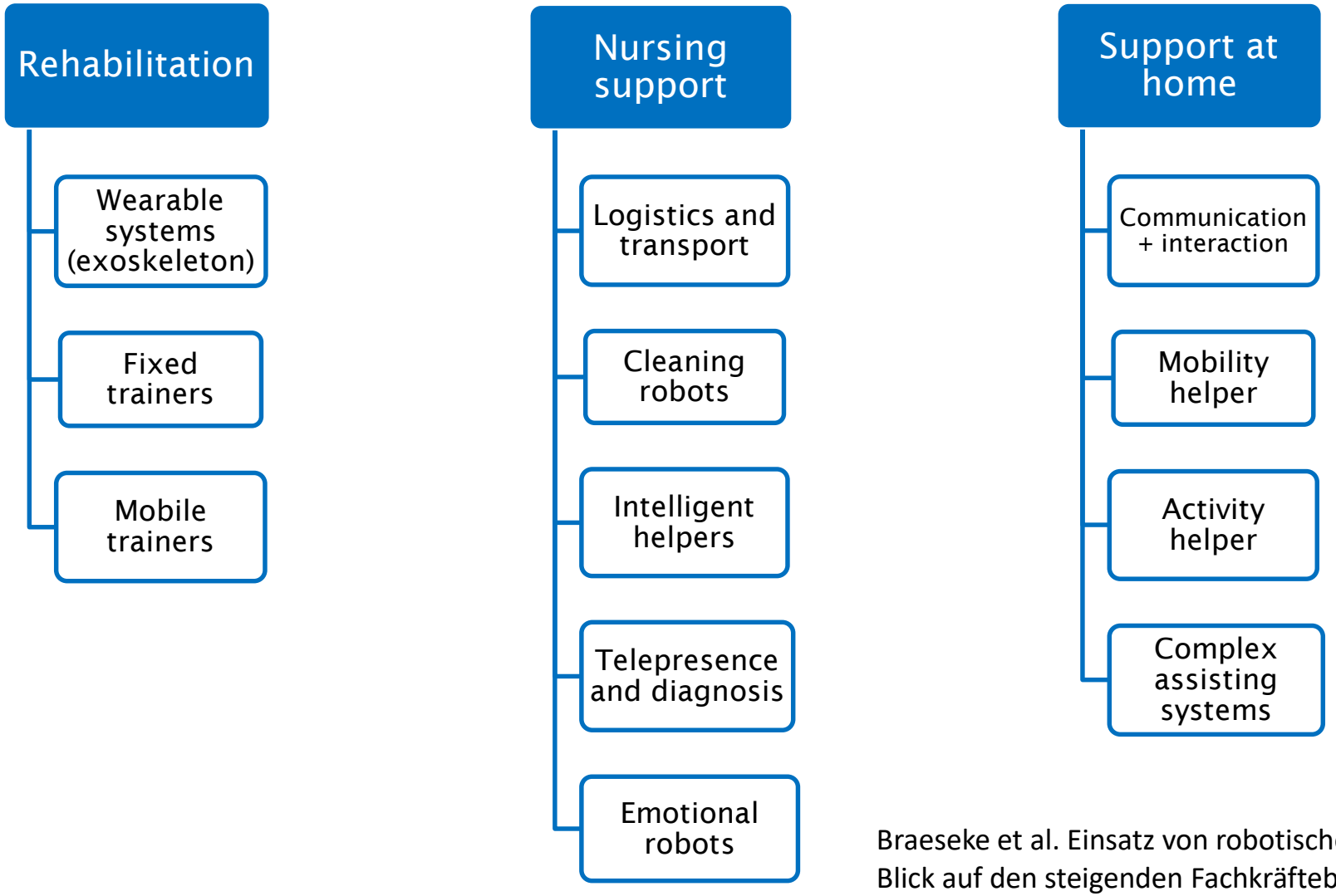
Abstract

Background: New technologies, like socially assistive robots (SARs), may have the potential to support caregivers at home. Still, the evidence for people with dementia in home care is unclear because a lot of studies are performed in a laboratory or institutional setting, and mainly use robots in prototype stages.

Objective: This study aims to explore the effects of the refined, commercially-available, humanoid SAR Pepper combined with a tablet PC–based dementia training program (Coach Pepper) versus an exclusively tablet PC–based dementia training program on psychosocial and physical outcomes of people with dementia living at home, including caregivers and dementia trainers. We hypothesize that Coach Pepper has a more positive effect on the primary outcome motivation (stable or decreased apathy) of people with dementia.

Social robots for



Braeseke et al. Einsatz von robotischen Systemen in der Pflege in Japan mit Blick auf den steigenden Fachkräftebedarf. IGES Institut 2019 Berlin

Some examples – rehabilitation

Walking rehabilitation support tool,

- Kraftanzug, Hersteller: INNOPHYS

Braeseke et al. Einsatz von robotischen Systemen in der Pflege in Japan mit Blick auf den steigenden Fachkräftebedarf. IGES Institut 2019 Berlin

Some examples – nursing support

R.G.R. a. Research. (2015, 17/7). strong robot with the gentle touch. https://www.riken.jp/en/news_pubs/research_news/pr/2015/20150223_2/

Sato et al. Rehabilitation care with Pepper humanoid robot: a qualitative case study of older patients with schizophrenia and/or dementia in Japan. Enferm Clin 2020;30:32–6.

Some examples – support at home

Fischinger et al. Hobbit, a care robot supporting
independent living at home: first prototype and lessons learned. Rob Auton Syst 2016;75:60–78.

Medication Robo-kun, Hersteller: ArtData Corporation

Braeseke et al. Einsatz von robotischen Systemen in der Pflege in Japan mit Blick auf den steigenden Fachkräftebedarf. IGES Institut 2019 Berlin

Use in Education, Bern University of Applied Sciences

Special week goals – core competencies

1. Knowledge

- Understand through own experience
  the connection between knowledge and its practical application

2. Practical Application

- Understand and **use** their **knowledge in practice related tasks** and
  choose adequate methods from different subject areas for realization

3. Problem solving

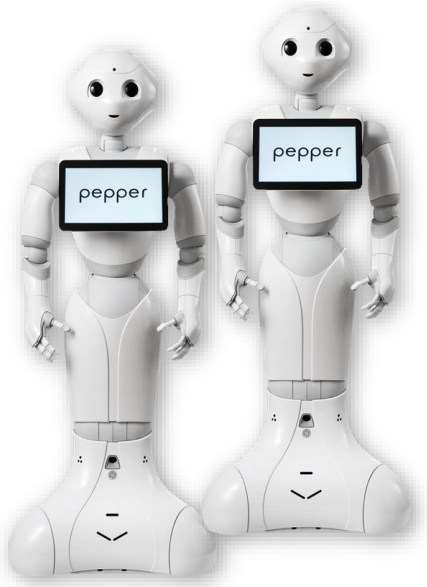
- Judge and **solve problems in a practice-oriented task** which utilizes learned methods

Students‘ special week

- interact with physical hardware instead of PC/tablet
- interact with physical sensors – feel and move / listen and talk
- interact with Camera, LIDAR etc
- get a feeling for future robot opportunities

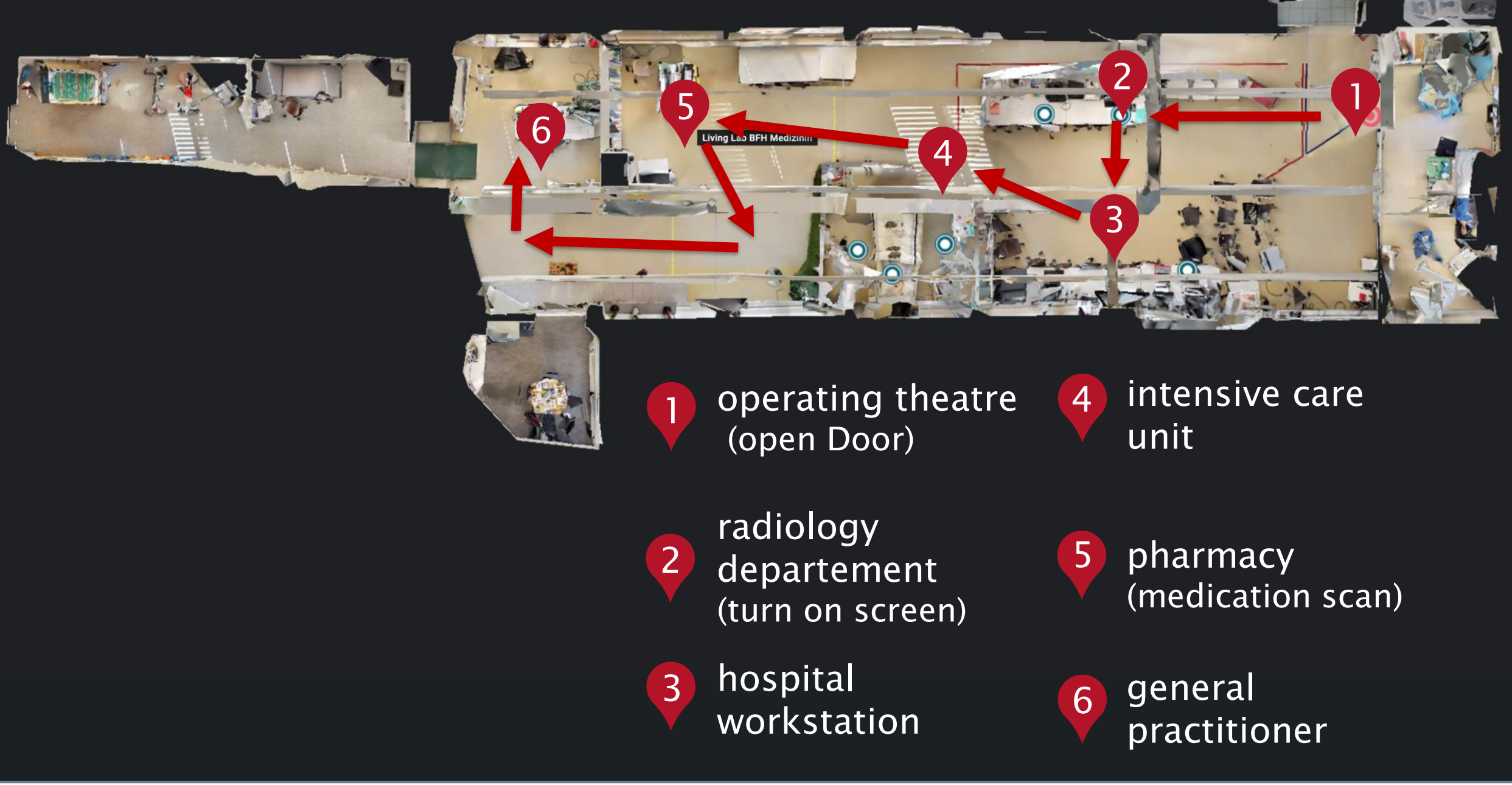
➔ **develop an own use case**

4x Cruzr 1S



2x Pepper 1.8a

4x tēmi



- Our medical informatics lab

One very intensive week

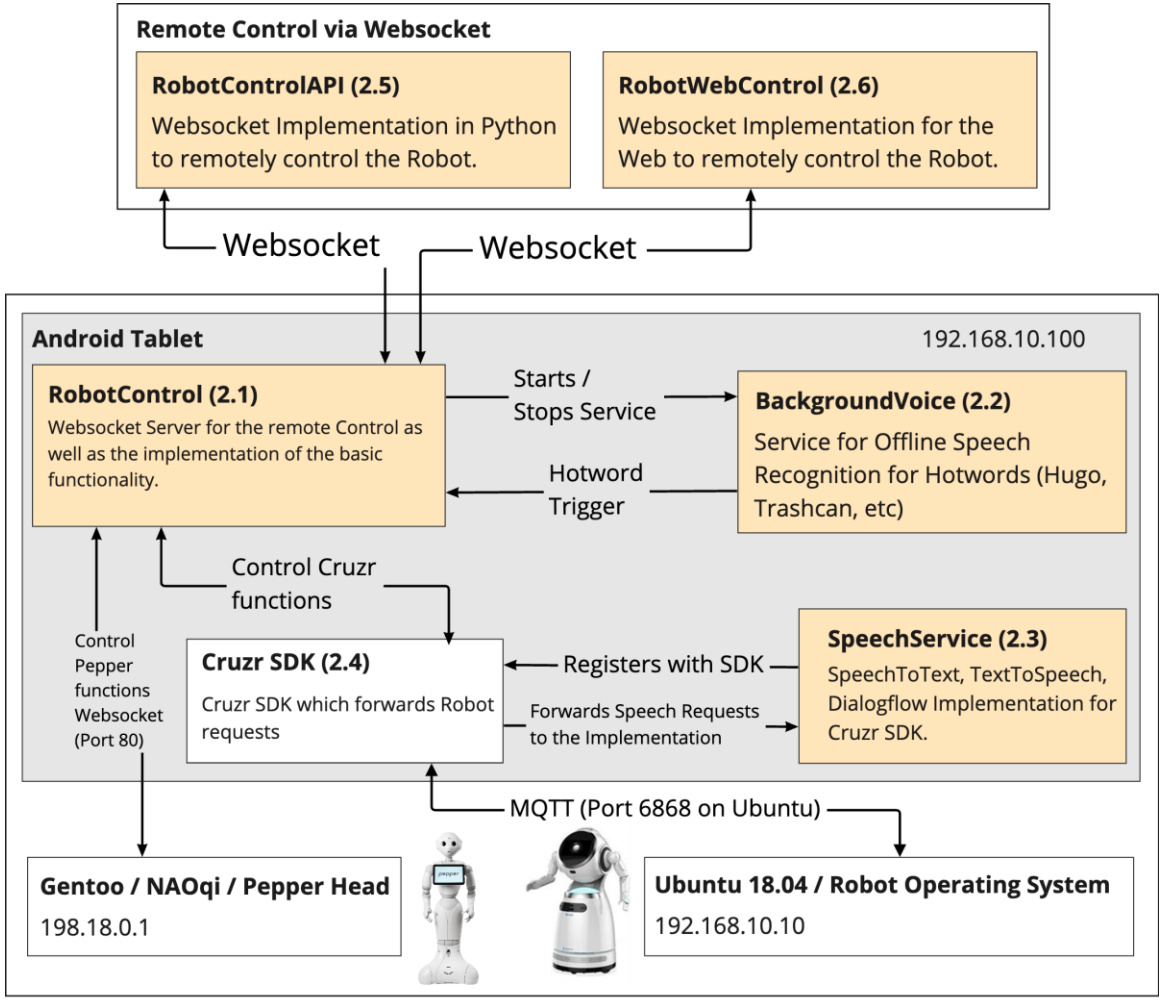
	Monday	Tuesday	Wednesday	Thursday	Friday
08.30-10.00	introduction plan for the week	external presentation NLP in Swiss German	robotics lab of BFH	external presentation social robot use	2 step code review: groupwise and with teacher
10.30-12.00	**teaching:** how to code with robot control API	**teaching:** codestyling and GIT language in and out	**teaching:** servo movement, OpenAI	**programming:** freestyle competition	code review **competition** best presentation
break					
13.00-17.00	**programming goal:** use case defined robot talks first sentences and moves with map	**programming goal:** robot recognizes drug and tells details language recognition and speech intermediate review	**programming:** freestyle competition	**programming:** freestyle competition make movie	**competition** best presentation deliver final presentation and video

RobotControl

- a generic interface for multiple robots
- primary programmming language for students is python

requirements

- IntelliJ IDEA
- Android SDK
- ADB (Android Debug Bridge)
- Gradle 4.2.2



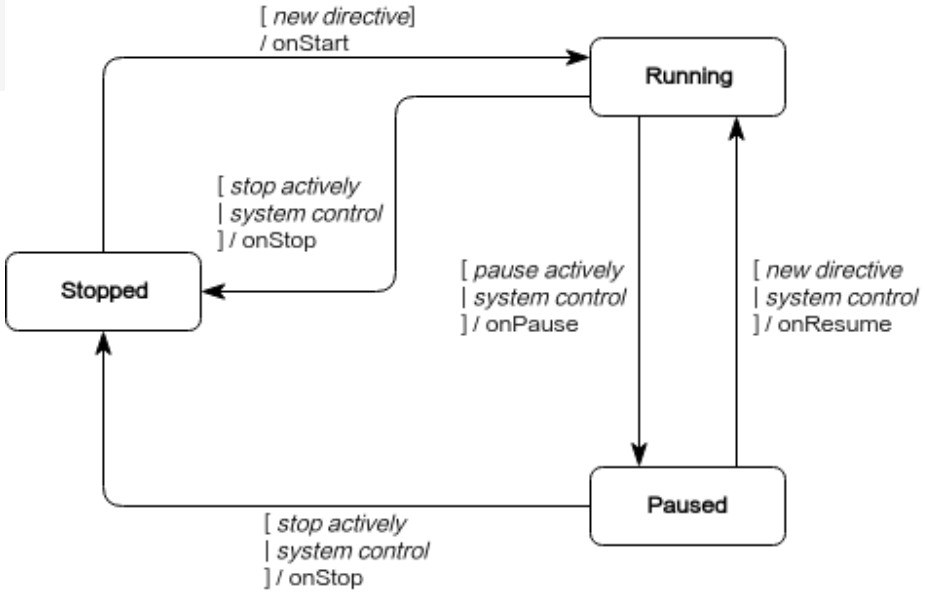
Glauser et al: How can social robot use cases in healthcare be pushed – with an interoperable programming interface. BMC Med Inform Decis Mak. 2023 Jul 11;23(1):118.

Make the robot say „Hello“

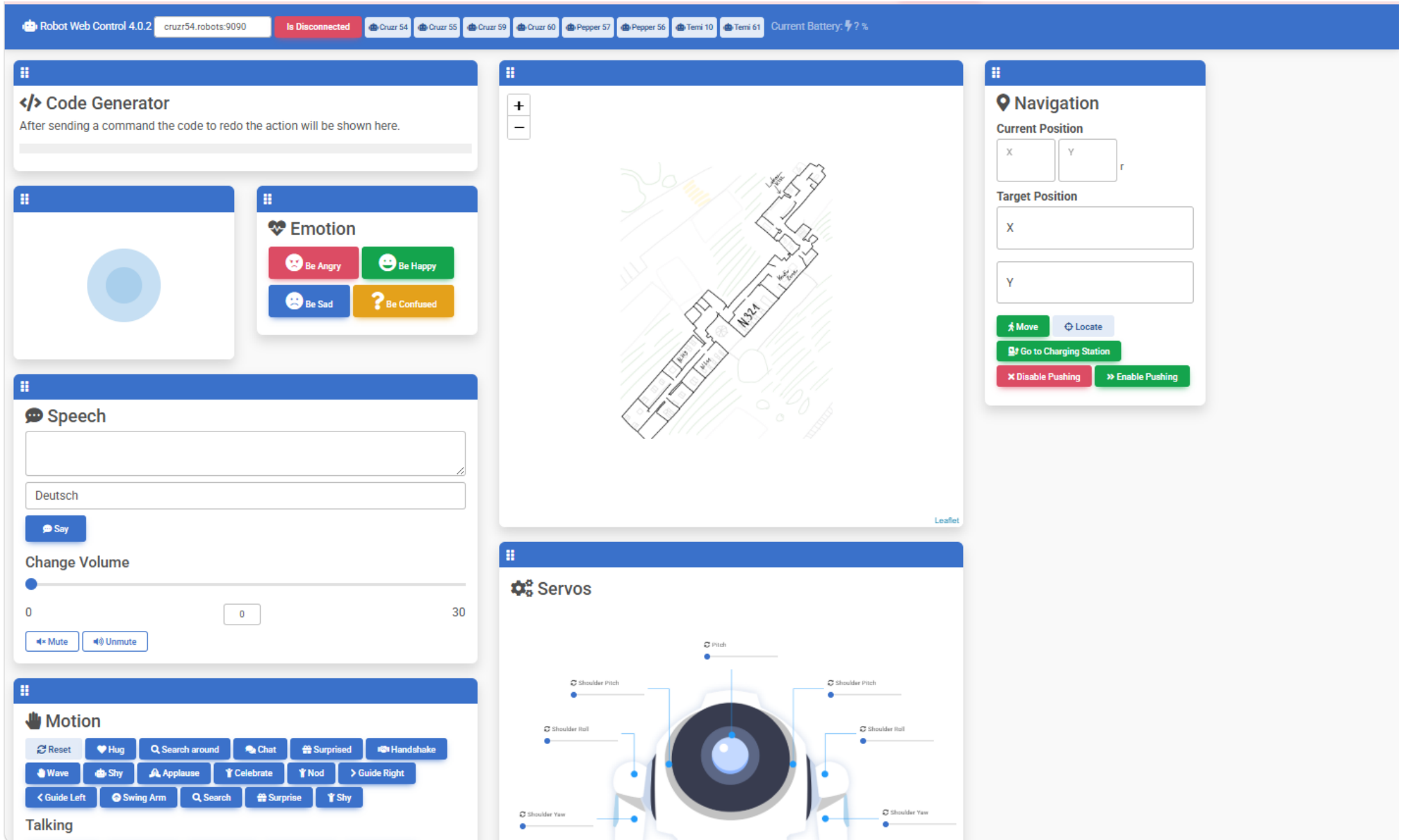
```java
public class MainActivity extends AppCompatActivity {
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);

        SpeechManager speechManager = Robot.globalContext()
                .getSystemService(SpeechManager.SERVICE);
        speechManager.synthesize("Hello");
    }
}
```

Robot generic „skills“

```
1  public class TimerSkill extends RobotSkill {
2
3      @OnDirective(action = "timer.indicator")
4      public void timeIndicate(Directive directive) {
5          //Get the current time
6          SimpleDateFormat simpleDateFormat = new SimpleDateFormat("yyyyMMdd HHr
7          String timeStr = "Now is: " + simpleDateFormat.format(new Date());
8
9          //use the voice service to broadcast the time
10         SpeechManager speechManager = getSystemService(SpeechManager.SERVICE)
11         speechManager.synthesize(timeStr);
12     }
13 }
```



Web Control


Robot Web Control 4.0.2
cruzr54.robots:9090
Is Disconnected
Cruzr 54
Cruzr 55
Cruzr 59
Cruzr 60
Pepper 57
Pepper 56
Terni 10
Terni 61
Current Battery: ? %
Code Generator
After sending a command the code to redo the action will be shown here.
Emotion
Be Angry
Be Happy
Be Sad
Be Confused
Speech
Deutsch
Say
Change Volume
0
0
30
Mute
Unmute
Motion
Reset
Hug
Search around
Chat
Surprised
Handshake
Wave
Shy
Applause
Celebrate
Nod
Guide Right
Guide Left
Swing Arm
Search
Surprise
Shy
Talking
Leaflet
Servos
Pitch
Shoulder Pitch
Shoulder Pitch
Shoulder Roll
Shoulder Roll
Shoulder Yaw
Shoulder Yaw
Navigation
Current Position
X
Y
r
Target Position
X
Y
Move
Locate
Go to Charging Station
Disable Pushing
Enable Pushing

Special week examples

On command:

- robot reads drug barcode
- communicates with external Swiss pharmacy system
- returns AI enhanced and
- patient understandable
- drug usage information

Robot acts as

- AI enhanced therapeutic advisor
- receives oral complaints
- processes these with AI
- does patient triage

Special week examples

Robot

- helps with physiotherapy exercises

Special week examples

Experimental work with armed robot

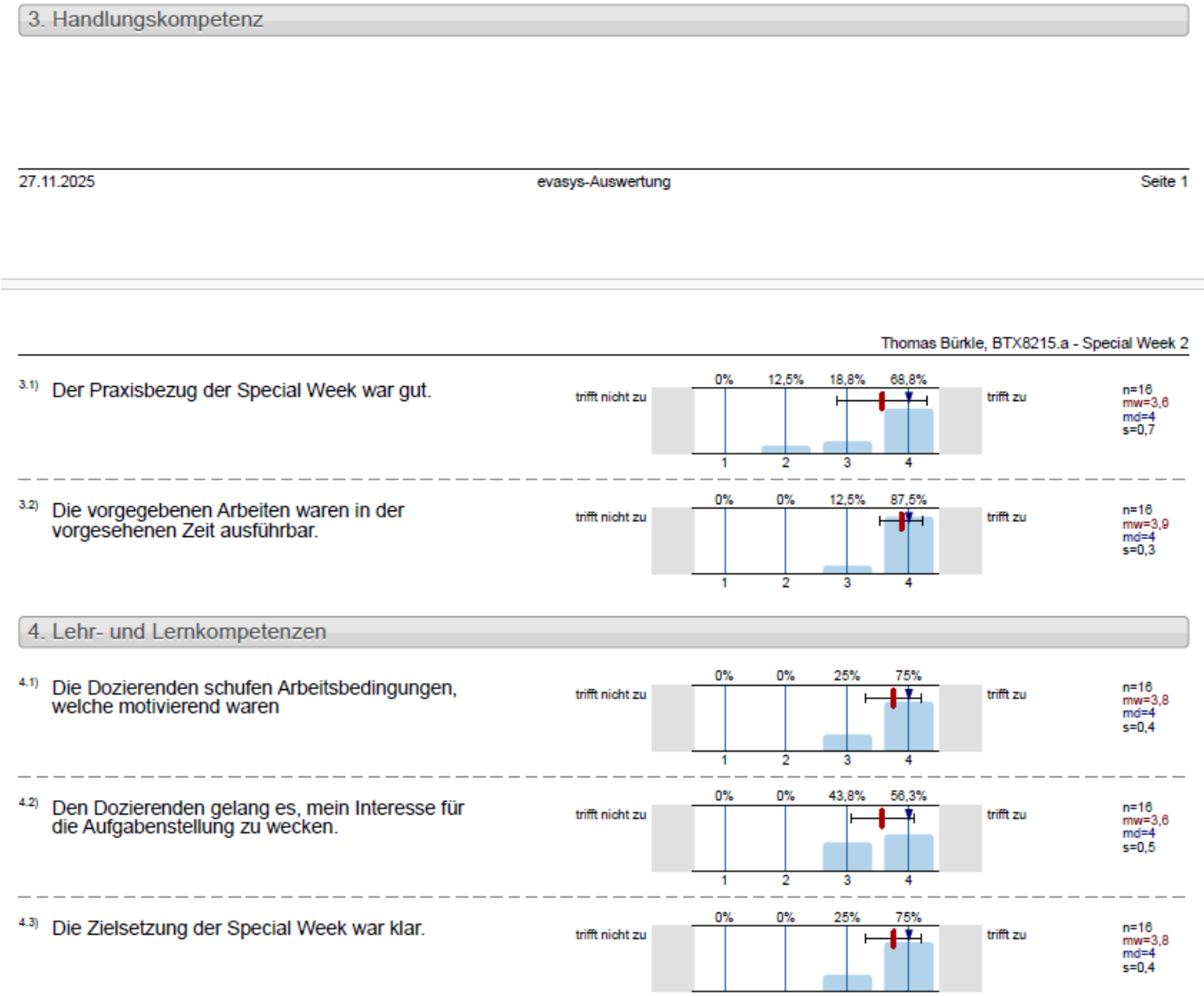
- selects drug and
- should fetch it (for a nurse)

Evaluation 2025

Good values for

- action-related competencies
- learning and behavioural skills

- plus some more



3. Handlungskompetenz

27.11.2025 evasys-Auswertung Seite 1

Thomas Bürkle, BTX8215.a - Special Week 2

3.1) Der Praxisbezug der Special Week war gut.
trifft nicht zu | 0% | 12,5% | 18,8% | 68,8% | trifft zu
1 2 3 4
n=16 mw=3,6 md=4 s=0,7

3.2) Die vorgegebenen Arbeiten waren in der vorgesehenen Zeit ausführbar.
trifft nicht zu | 0% | 0% | 12,5% | 87,5% | trifft zu
1 2 3 4
n=16 mw=3,9 md=4 s=0,3

4. Lehr- und Lernkompetenzen

4.1) Die Dozierenden schufen Arbeitsbedingungen, welche motivierend waren
trifft nicht zu | 0% | 0% | 25% | 75% | trifft zu
1 2 3 4
n=16 mw=3,8 md=4 s=0,4

4.2) Den Dozierenden gelang es, mein Interesse für die Aufgabenstellung zu wecken.
trifft nicht zu | 0% | 0% | 43,8% | 56,3% | trifft zu
1 2 3 4
n=16 mw=3,6 md=4 s=0,5

4.3) Die Zielsetzung der Special Week war klar.
trifft nicht zu | 0% | 0% | 25% | 75% | trifft zu
1 2 3 4
n=16 mw=3,8 md=4 s=0,4

Bürkle et al. Using Robots in Medical Informatics Education. Stud Health Technol Inform. 2022 May 25;294:765-769.

Use in practice – A must-have ?

A nursing home in Biel/Bienne

Stimulating mental activities

- Storytelling
- Puzzle
- Quiz
- …

A nursing home in Biel/Bienne

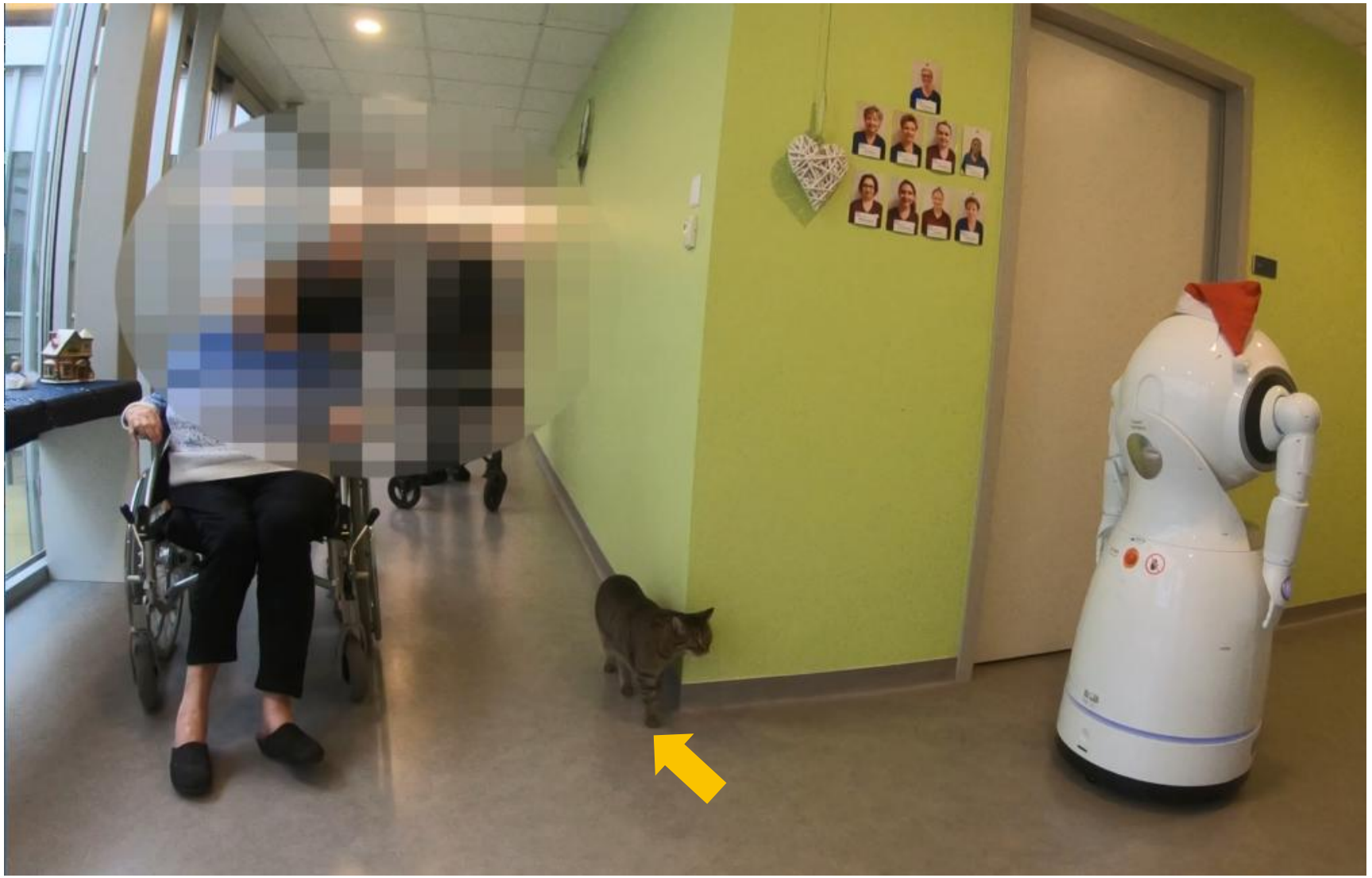
Sing along

A nursing home in Biel/Bienne

Mobilisation

Encouraging Mobility on the Ward

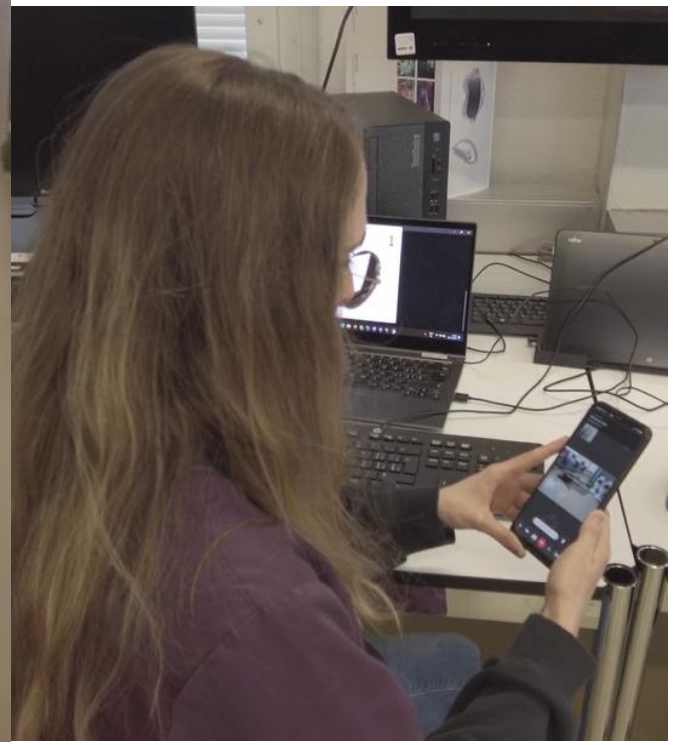
Walking on the Ward



Fall detection

Triggered from HIS

- robot moves in hospital hallway (at night)
- recognizes fallen person with AI trained model
- sends alarm to nurse
- enables direct communication with patient
- writes patrols and events back to HIS



Fall detection: HIS interface

Code segments for potential HIS interface (JSON/FHIR)


```
"resourceType": "Procedure",
"id": "patrol-20240524T134806701Z",
"status": "completed",
"contained": [
    {
        "resourceType": "Location",
        "id": "123",
        "identifier": [
            {
                "system": "http://my-labor-location.system.ti.bfh.ch",
                "value": "Position(x=3.407163, y=-3.24595, yaw=1.402652, tiltAngle=8)"
            }
        ],
        "status": "active",
        "name": "Location"
    }
],
"category": {
    "coding": [
        {
            "system": "http://loinc.org",
            "code": "28570-0",
            "display": "Procedure Note"
        }
    ],
    "text": "Patient am Boden"
},
"code": {
    "coding": [
        {
            "system": "http://lep.ch/fhir/CodeSystem/LEP-Classification",
            "code": "I_12356"
        }
    ],
    "text": "Alarm an installierter Apparatur kontrollieren und quittieren, z. B. Patientenrufglocke oder Monitoralarmanlage."
},
"text": {
    "status": "generated",
    "div": "<div xmlns='http://www.w3.org/1999/xhtml'>Patrol completed on route Position(x=3.407163, y=-3.24595, yaw=1.402652,
},
```


Pfyffer et al Development of an Assistance Robot for Fall Detection and Reporting in Healthcare. Stud Health Technol Inform. 2025 May 2;325:23-26.

Our Colleagues: Cybathlon Zürich 2024

G. P.

- tetraplegic since 2009
- bicycle accident
- triceps surgery
- can pinch something between thumb and fingers
- lives in own appartment

https://cybathlon.com/en/cybathlon-2024/results?discipline=5153&event=5267

A side effect

A bit of promotion for robotics

tēmi in a box

- Interaction with the tablet
- User can
  - look videos – what is social roboting
  - do a quiz
  - interact with a patient simulator

More than 2000 interactions per week

Finally

Learnings: use in education

Some interesting usecases

- fall detection
- diagnostic advisor / triage – But: Medical Device Regulation
- maybe: assisted documentation during ward round

Not reliable today with our hardware

- fetching things such as a drugbox for nurses
- pushing a door opening button
- using an elevator by pushing buttons or IoT interface
- Carrying things around
- pushing a cart

Learnings: use in institutions

People react positive to robot

- especially when simple “face expressions” exist
- language in- and output works comparatively well (on external sources)
- some navigation and patient-education use cases have been established

Current status limits benefits

- door opening and door closing? – patient rooms w/o automated doors
- switching floors? – elevators not IoT enabled
- walking robots look crude and have no facial expression
- fetching things – movements slow
  Other transport systems well established (e.g. pneumatic tube system)
- sensitive patient data – onsite AI processing required

➔ what is the additional value compared to a (wall mounted) tablet PC?

Most interesting use cases

Maybe those where impaired patients may profit?

- helpers for paralysed patients
- maybe helpers for blind persons
- cases where no other alternatives exist yet

What to expect

1. hardware will become better and cheaper
2. many efforts to make programming easier
   (but often proprietary)
3. potential combination with VR
4. specialized systems (cleaning, transport) may be more successful
5. combination with locally hosted AI

Any questions?

Special thanks go to

- Robin Glauser
- Christopher Meier
- Sang Il Kim