



Personal Robotics

[www.fp-robotics.com](http://www.fp-robotics.com)

## Lio - a Multifunctional Robot Assistant in Health Care

ETH Outreach Event, Zurich, February 8<sup>th</sup> 2023

# The F&P Robotics Team brings robots to Health Care...

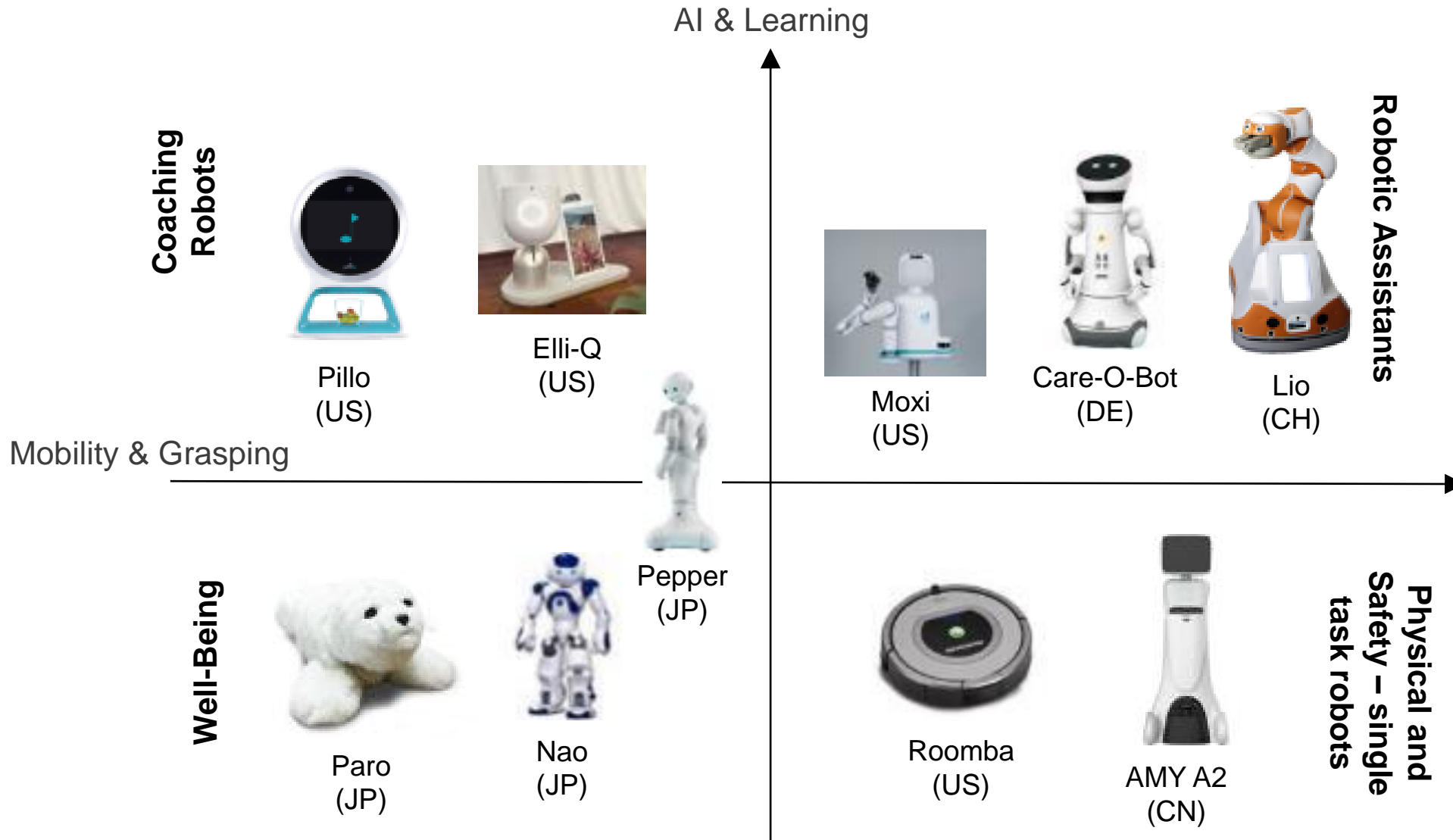


...because there are some challenges to solve!

- The number of people **over 80 years will double until 2040**
- **250'000 care workers are missing** in Germany & Switzerland



# Lio is a Multifunctional Robot Assistant





Transport

Repetitive Tätigkeiten reduzieren und Arbeitsabläufe optimieren

# Lio contributes to Efficiency, Quality of Life and Health

## Work Support in full-time equivalents (%)



**110%** Total

**+**

Increase well-being and quality of life



**60%**

Activation & Entertainment

**+**

Additional Potential Functions



**160%**

Supportive Functions for nurses

**=**

**330%**

Total Potential per Lio

## Use of assistant Lio to:

1. Increase the quality of life of residents/patients
2. Relieve care personnel from routine tasks
3. Reduce infections and improve health

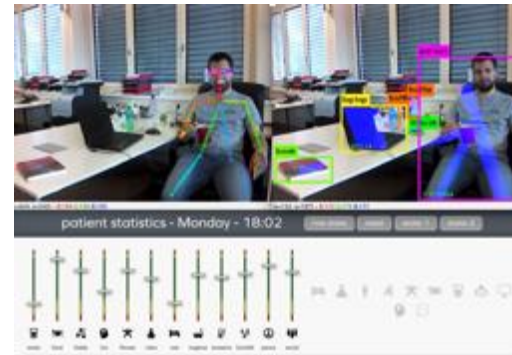
# Core Technology

F&P developed unique IP & technology with enormous potential in emerging robotic growth markets.

## 1) Robotic Hardware Platform



## 2) Applied Artificial Intelligence



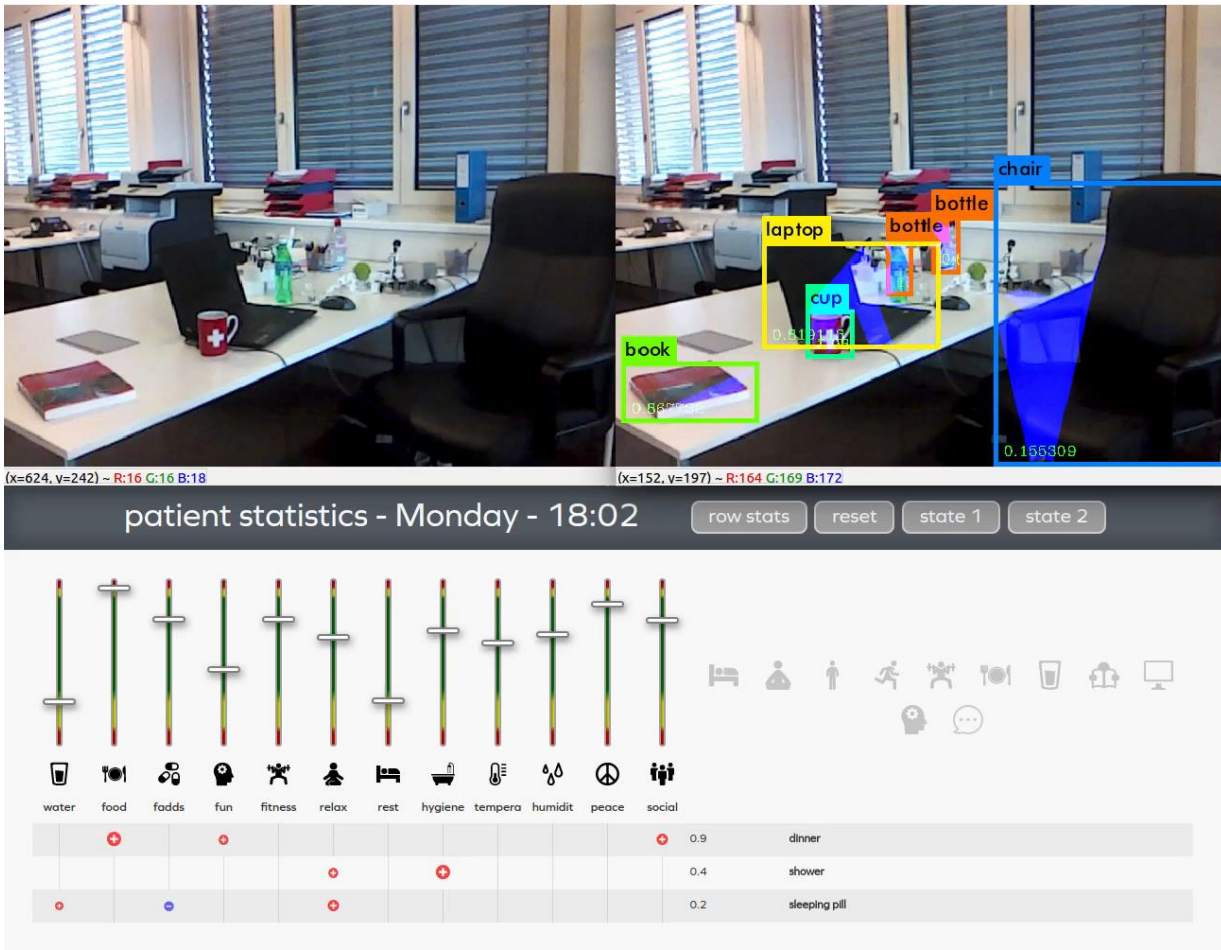
## 3) Robot Operating System myP®



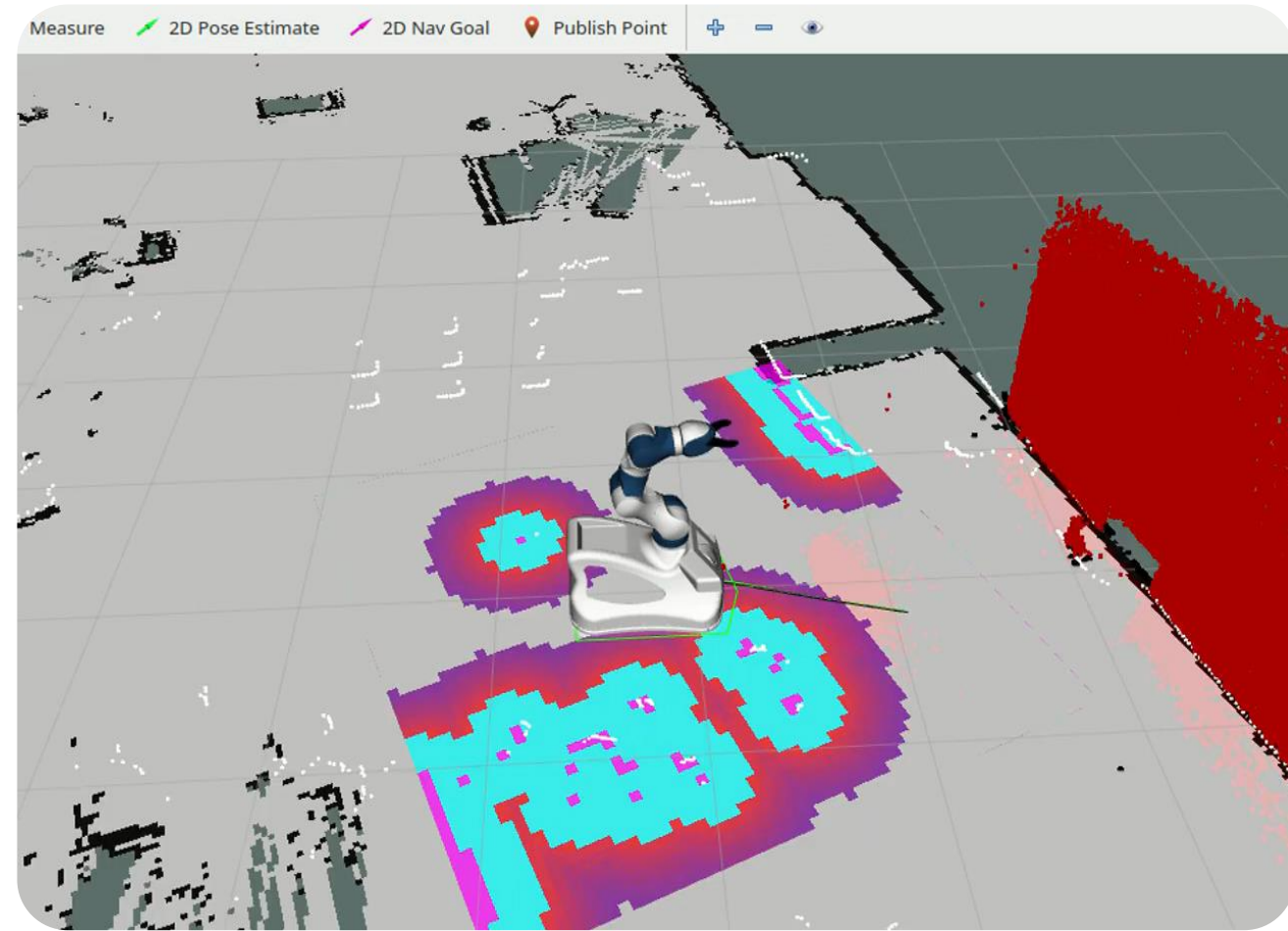
## 4) Safety & Personality



# Key Fields of Research and Development



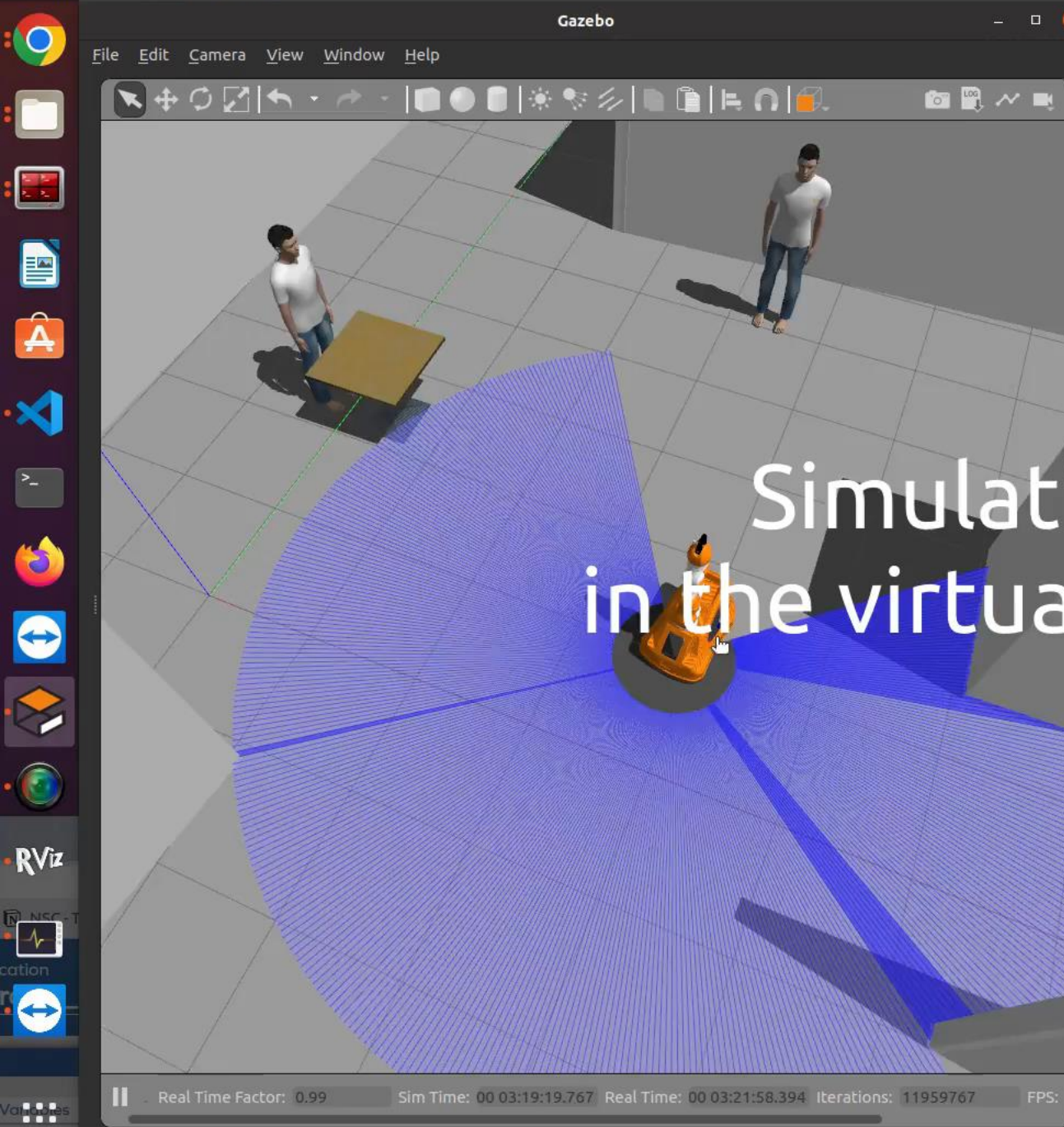
Situation Awareness



Navigation







# Simulation of Lio in the virtual Zihlschlacht



A 3D simulation of a door in a virtual environment. The door is a grey rectangular block with a handle on the right side, set within a grey frame. The floor is a dark grey grid. The background is a plain grey wall. The text is centered in the middle of the scene.

Lio learns to open a door in Simulation  
via  
Reinforcement Learning algorithm: PPO



Steps: 1

Real Time Factor: 0.99

Sim Time: 00 00:23:46.150

Real Time: 00 00:24:24.888

Iterations: 1426150

FPS: 62.47

Reset Time

# UX Research is of Key Importance






Stable  
at the heart  
of the  
University  
of Cambridge

LOVE IN  
ACTION



# Lio-A Personal Robot Assistant for Human-Robot Interaction and Care Applications

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**Abstract**—Lio is a mobile robot platform with a multi-functional arm explicitly designed for human-robot interaction and personal care assistant tasks. The robot has already been deployed in several health care facilities, where it is functioning autonomously, assisting staff and patients on an everyday basis. Lio is intrinsically safe by having full coverage in soft artificial-leather material as well as collision detection, limited speed and forces. Furthermore, the robot has a compliant motion controller. A combination of visual, audio, laser, ultrasound and mechanical sensors are used for safe navigation and environment understanding. The ROS-enabled setup allows researchers to access raw sensor data as well as have direct control of the robot. The friendly appearance of Lio has resulted in the robot being well accepted by health care staff and patients. Fully autonomous operation is made possible by a flexible decision engine, autonomous navigation and automatic recharging. Combined with time-scheduled task triggers, this allows Lio to operate throughout the day, with a battery life of up to 8 hours and recharging during idle times. A combination of powerful computing units provides enough processing power to deploy artificial intelligence and deep learning-based solutions on-board the robot without the need to send any sensitive data to cloud services, guaranteeing compliance with privacy requirements. During the COVID-19 pandemic, Lio was rapidly adjusted to perform additional functionality like disinfection and remote elevated body temperature detection. It complies with ISO13482 - Safety requirements for personal care robots, meaning it can be directly tested and deployed in care facilities.

**Index Terms**—Service robotics, autonomous agents, human-centered robotics, physical human-robot interaction, automation in life sciences: biotechnology, pharmaceutical and health care.

## I. INTRODUCTION

RECENTLY robots have been gaining popularity outside the factory floors and entering unstructured environments such as homes, shops and hospitals. They range from small devices designed for *internet-of-things* (IoT) applications to larger physical robots which are capable of autonomously navigating

Manuscript received February 24, 2020; accepted June 15, 2020. Date of publication July 7, 2020; date of current version July 15, 2020. This letter was recommended for publication by Associate Editor J. Son and Editor Y. Choi upon evaluation of the reviewers' comments. This work was supported by F&P Robotics AG. (Corresponding author: Justinas Mišeikis.)

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This article has supplementary downloadable material available at <http://ieeexplore.ieee.org>, provided by the authors.

Digital Object Identifier 10.1109/LRA.2020.3007462

in indoor and outdoor environments, sharing the workspace with people and even interacting with them.

Given the issue of ageing population and shortage of medical and nursing staff in many countries, this naturally leads to attempts to use robotics and automation addressing this problem [1], [2]. For example, in Switzerland, the number of people over 80 years of age is expected to double from 2015 to 2040 [3]. It will result in nearly triple nursing costs for the Swiss healthcare sector.

Furthermore, healthcare employees are experiencing severe working conditions due to stress, underpayment and overtime. For example, Between 8% and 38% of health workers suffer physical violence at some point in their careers [4]. A possible staff shortage of 500'000 healthcare employees is estimated in Europe by the year of 2030 [5].

Care robotics is not an entirely new field. There has been significant development in this direction with robots ranging in a number of categories. Starting with *mobile robots with manipulation capabilities*, one of the best known robots is *Pepper* by *SoftBank Robotics*. It was created for interaction and entertainment tasks. It is capable of voice interactions with humans, face and mood recognition. In the healthcare sector *Pepper* is used for interaction with dementia patients [6]. However, despite having two arms, *Pepper* is not designed to manipulate objects as a core functionality.

A *WALKER* by *UBTECH* is a bipedal robot with focus on walking capabilities including going up and down the stairs. It can manipulate objects, however exact capabilities and limitations have not been defined publicly [7].

The *Care-o-bot 4* by *Unity Robotics* and *Fraunhofer IPA* is able to recognise faces, provide daily news and handle objects [8]. Despite the initial focus on the healthcare market, the existing applications are limited to pilot projects only, which current applications focused on shopping centers.

*REEM-C* and *TIAGo* robots by *PAL Robotics* are ROS-based research robot platforms, which could be used in the healthcare sector. They have been used in a number of research projects, however no permanent healthcare deployment is known [9].

One more healthcare oriented robot is *Moxi* by *Diligent Robotics*. Compared to previously described robots, the focus of *Moxi* is not interacting with people, but rather lies in the logistic of hospitals. The robot can deliver medical samples, carry laundry, bring supplies and greet patients [10]. It uses a mobile platform, arm, gripper and an integrated lift to adjust its height. *Moxi* is mostly capable of completing the tasks in an

## From IEEE to Globi



### Muskeltraining

Auch in Altersheimen werden Roboter eingesetzt. Einer von ihnen ist «Lio». Er besteht aus einem Roboterarm, der sich dank Rädern frei bewegen kann. Mit ihm lassen sich verschiedene Muskeltrainings etwa für die Schultern, den Rücken oder zur Stärkung der Arme durchführen.

# We are looking forward to working with you!

- Lio is active in 10+ health care facilities and will go out to many more in the future
- F&P offers different Versions of Lio for Real Life Applications and Research
- R&D collaborations are key to F&P in terms to further develop the product and generate insights from a technological but also psychological aspect
- Lio fits the new Category “Robotic Assistant” for Cybathlon 2024 perfectly
- Let’s keep in touch!

