# Examining the impact of data augmentation for psychomotor skills training in human-robot interaction

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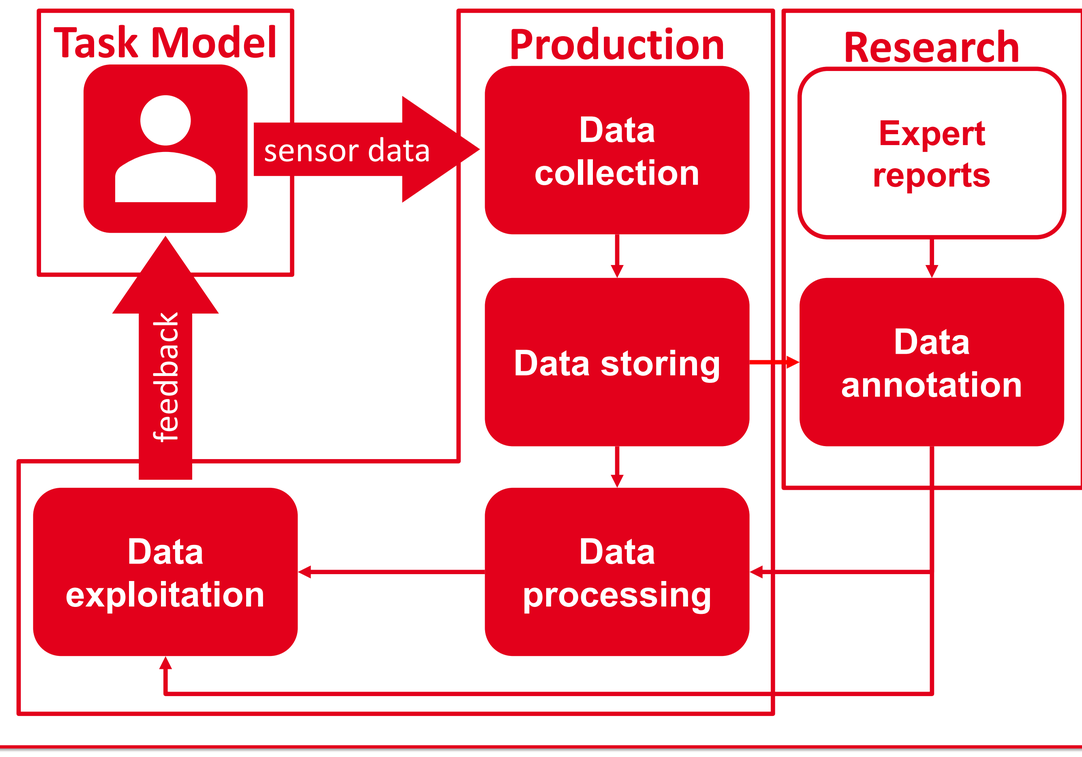
## Introduction

- Human-Robot Interaction describes the physical or virtual interaction between a human and a robot
- Robots differ in form, purpose, and the way they interact with humans
- Industrial robotics has been an exponentially growing business sector
- Training human counterparts is imperative to ensure a safe, faultless, and efficient interaction with industrial robots
- Our aim is to develop a pedagogical framework that is supported by immersive technologies and artificial intelligence to facilitate the psychomotor training of human operators regarding how to interact with industrial robots

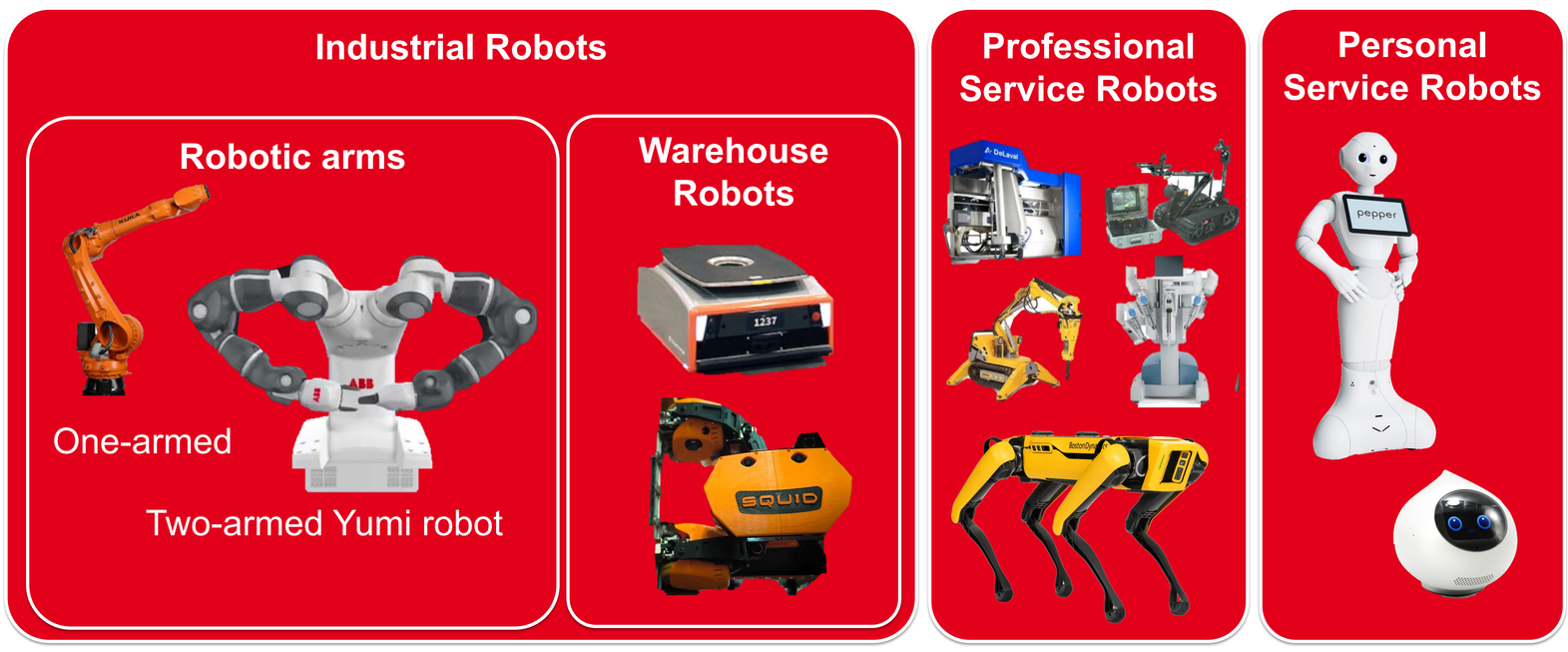
## Research questions

- What are common psychomotor training practices of humans in human-robot interaction?
- What are the common mistakes in handling industrial robots?
- What is the state-of-the-art technological support for psychomotor training of humans in human-robot interaction?
- How can we build the technological support that facilitates the pedagogical framework of human-robot interaction training?

## Simplified Multimodal Learning Analytics Pipeline [1]




## Robots




- Robots can be separated in 3 categories. Each category can be further categorized
- YuMi robot DoF: two arms that each have three degrees of freedom in both direction and rotation

## Research Approach and Methods

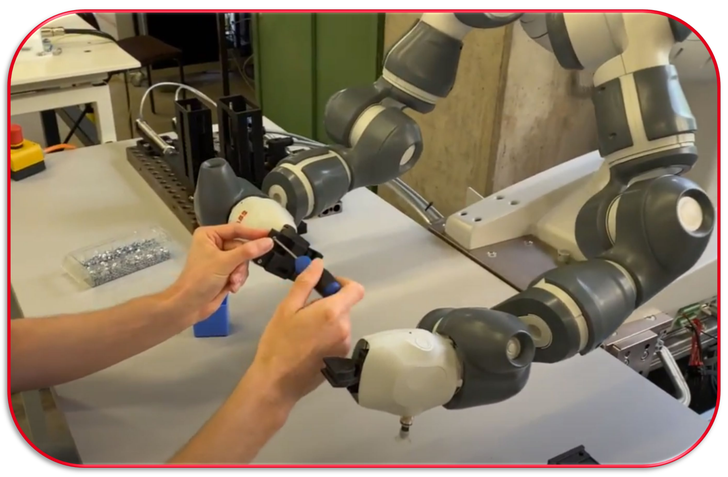
- Collecting common mistakes happening in human-robot interaction
- We will employ Design-based Research that consists of the following steps:
  - Systematic review of the literature
  - Design of a theoretical model (pedagogical/technological)
  - Development and implementation of an immersive and interactive training platform
  - Evaluation of the theoretical model and the immersive learning platform
  - Reflect and enhance the theoretical model and the immersive learning platform

## Study Setup

- In this study, we will use YuMi; a two-armed industrial robot [4]
- We will focus on the task of assembling a product which will be conducted together by YuMi and a human
- Mistakes, efficiency, and safety will be monitored and quantified during the interaction
- We will conduct experiments to evaluate the proposed pedagogical model and the immersive learning platform

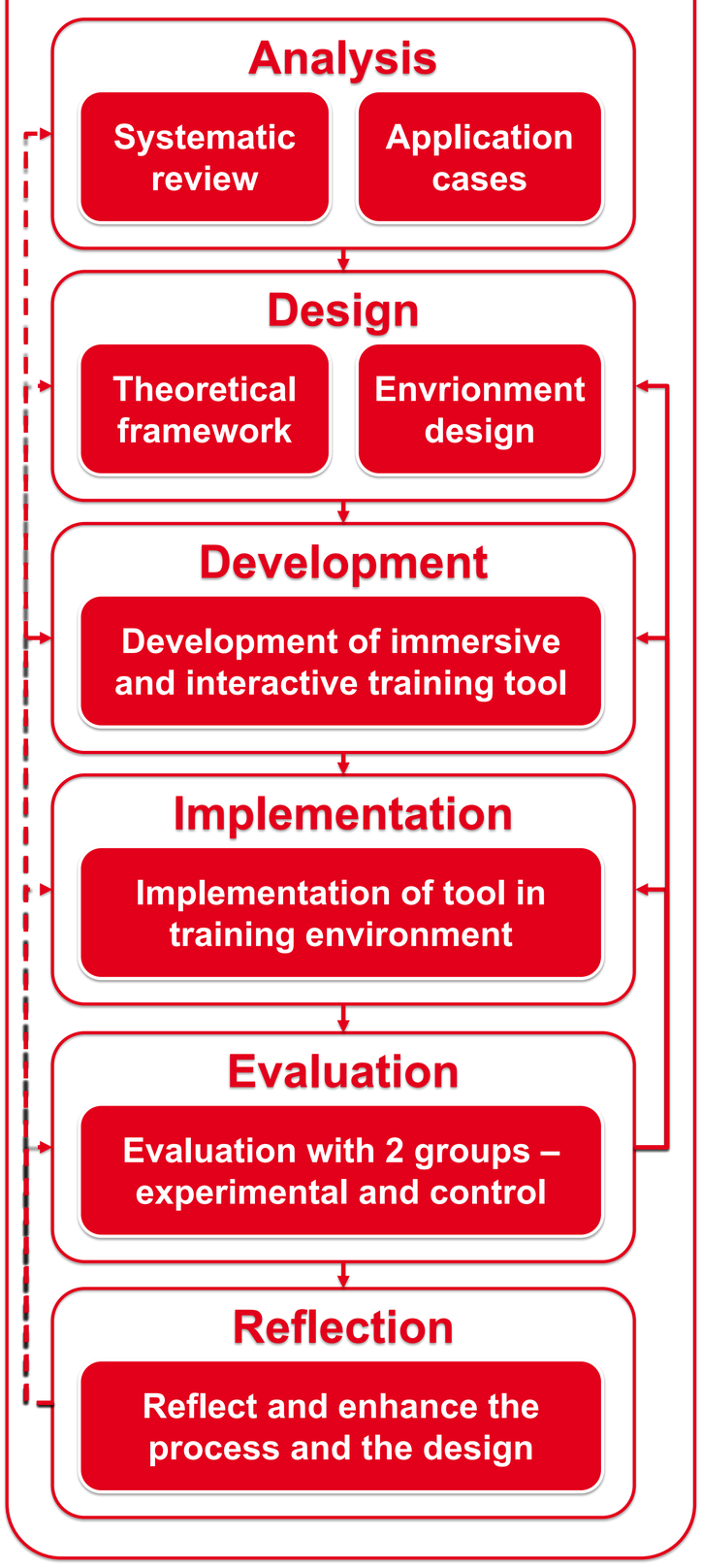
## Conclusions

- ML model detects and categorizes activities and steps in an assembly task
- Using data augmentation to detect human-made mistakes
- Using this detection to give feedback to the human and act accordingly



Assembly task with YuMi robot – MILKI-PSY [5]

## Design-based research [2,3]




## References

[1] After the model of: Di Mitri, Daniele & Schneider, Jan & Specht, Marcus & Drachsler, Hendrik. (2019). The Multimodal Learning Analytics Pipeline.

[2] T. Amiel, T. C. Reeves, Design-based research and educational technology: Rethinking technology and the research agenda, Journal of educational technology & society 11 (2008) 29–40.

[3] M. De Villiers, P. Harpur, Design-based research-the educational technology variant of design research: illustrated by the design of an m-learning environment, in: proceedings of the South African institute for computer scientists and information technologists conference, 2013, pp. 252–261.

[4] https://new.abb.com/products/robotics/collaborative-robots/irb-14000-yumi

[5] https://milki-psy.de/

## Research Paper