Safe and Efficient Robot Collaboration System (SERoCS) for Next Generation Intelligent Industrial Co-Robots

Award number: 1734109

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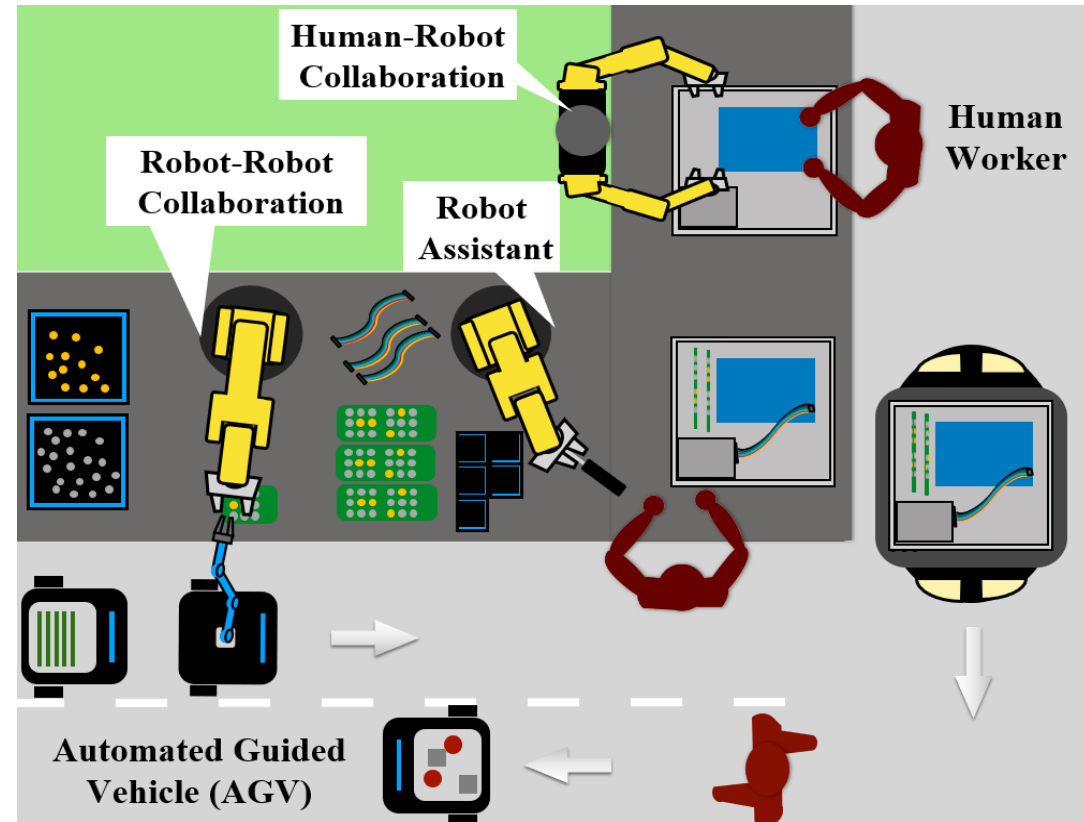Assistant Professor (CMU)   Pi, Professor (UCB)

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Objective

The objective of SERoCS is to enable future smart factories.

C. Liu, T. Tang, H-C. Lin, Y. Jiao, and M. Tomizuka. "SERoCS: Safe and Efficient Robot Collaborative Systems for Next Generation Intelligent Industrial Co-Robots." arXiv:1809.08215.

Overview

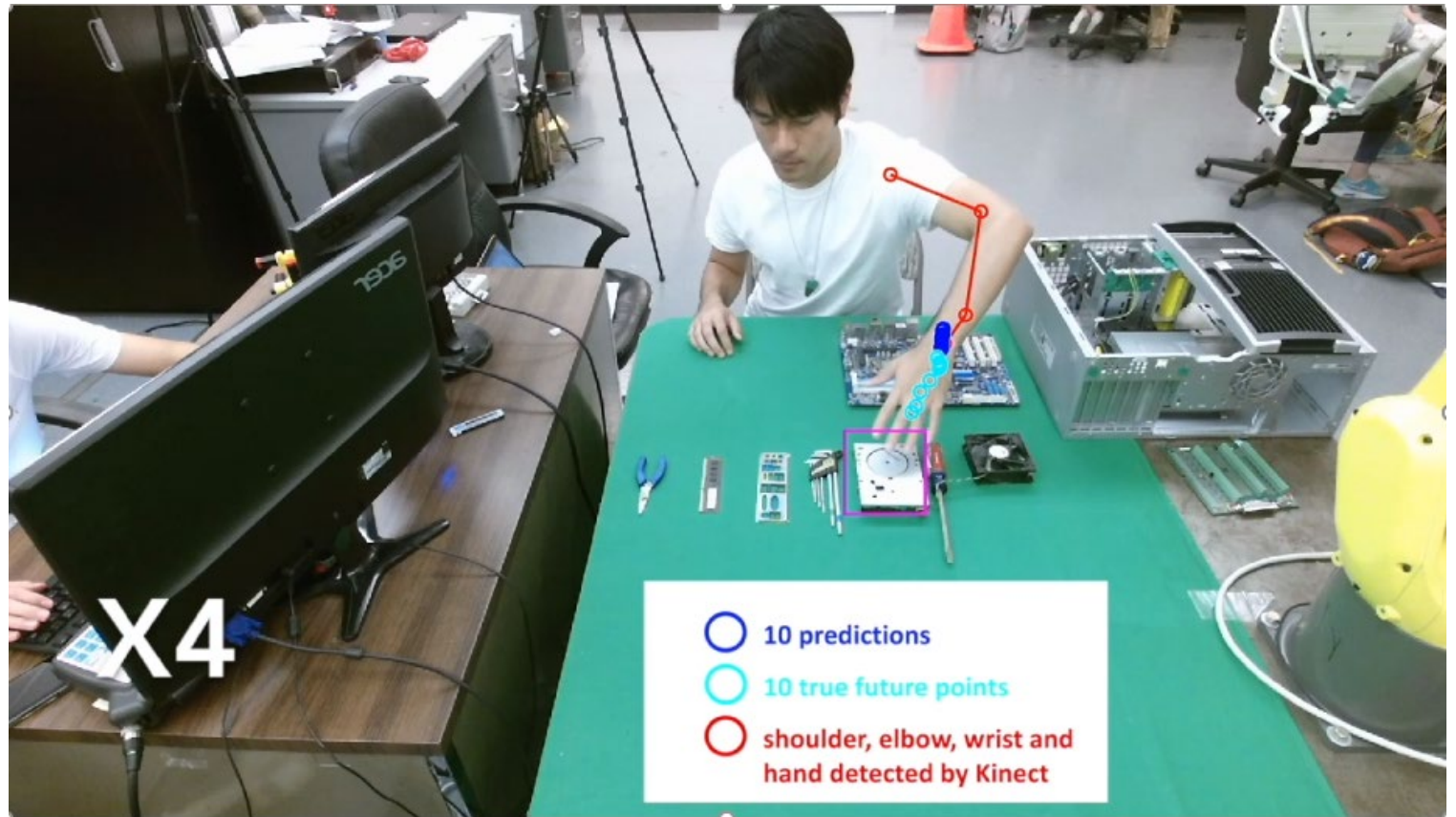## Safe and efficient robot collaboration systems (SERoCS)

- **Task 1**. Environment Monitoring with Human Motion Prediction

- **Task 2**. Task Planning

- **Task 3**. Safe and Efficient Motion Planning and Control in Real Time
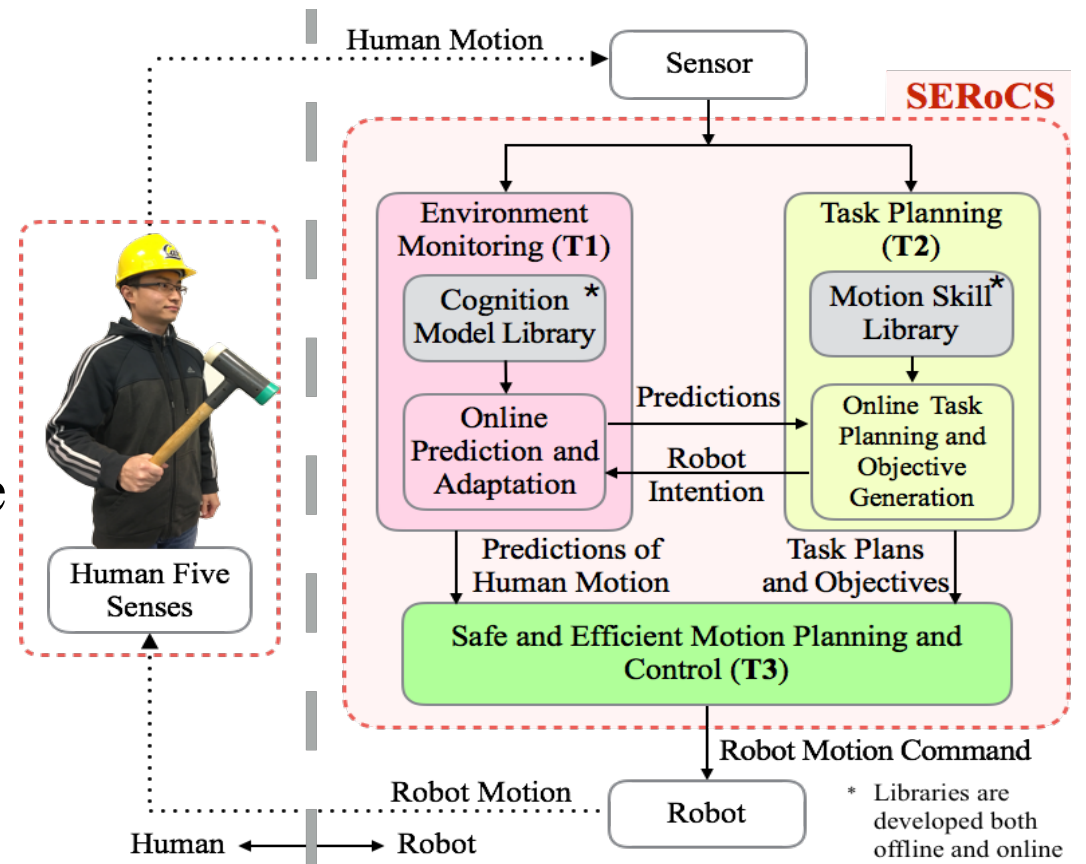
Methods and Results

Task 1. Environment Monitoring with Human Motion Prediction

We developed a semi-adaptable neural network for predicting future human motion. The predictor can adapt to different people.
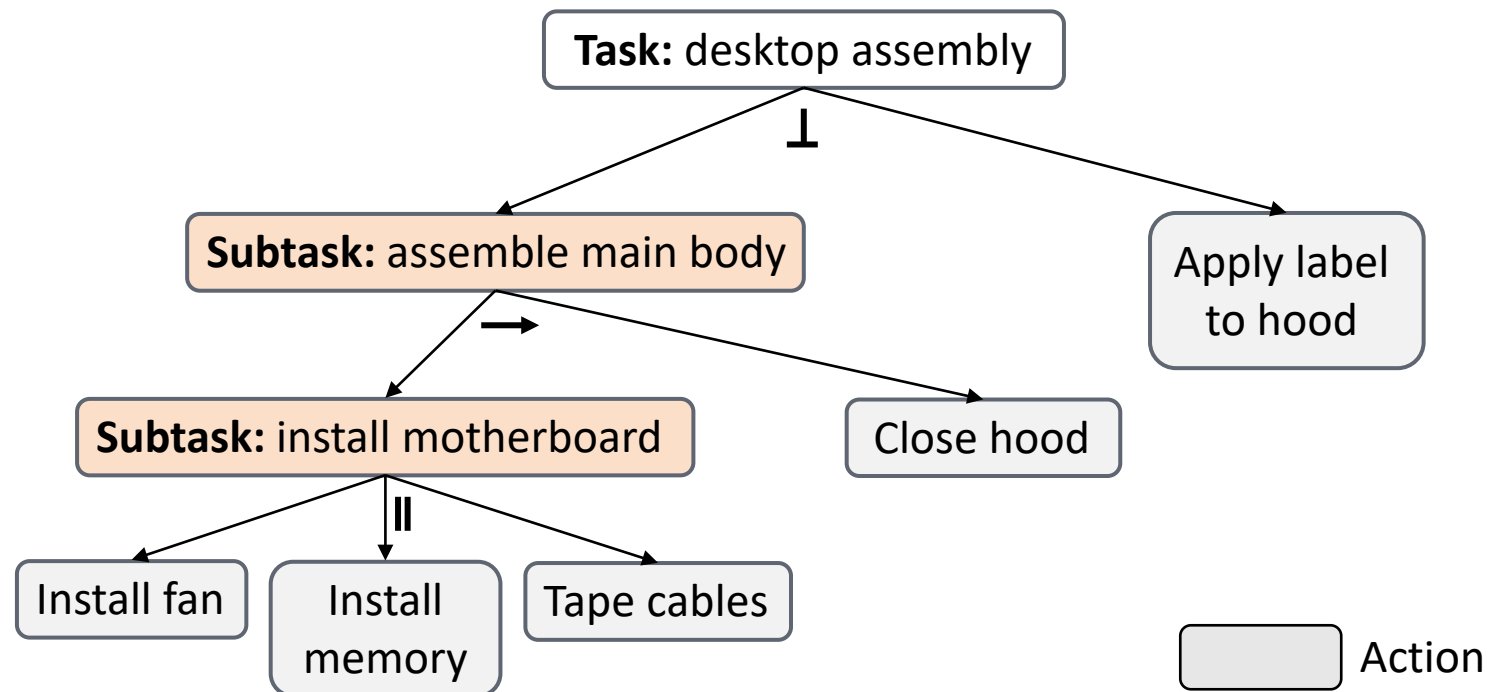

X4

○ 10 predictions
○ 10 true future points
○ shoulder, elbow, wrist and hand detected by Kinect

Task 2. Task Planning
• Structure of collaborative tasks

To enable task planning, we organized the collaborative task into subtasks, each of which contain actions.
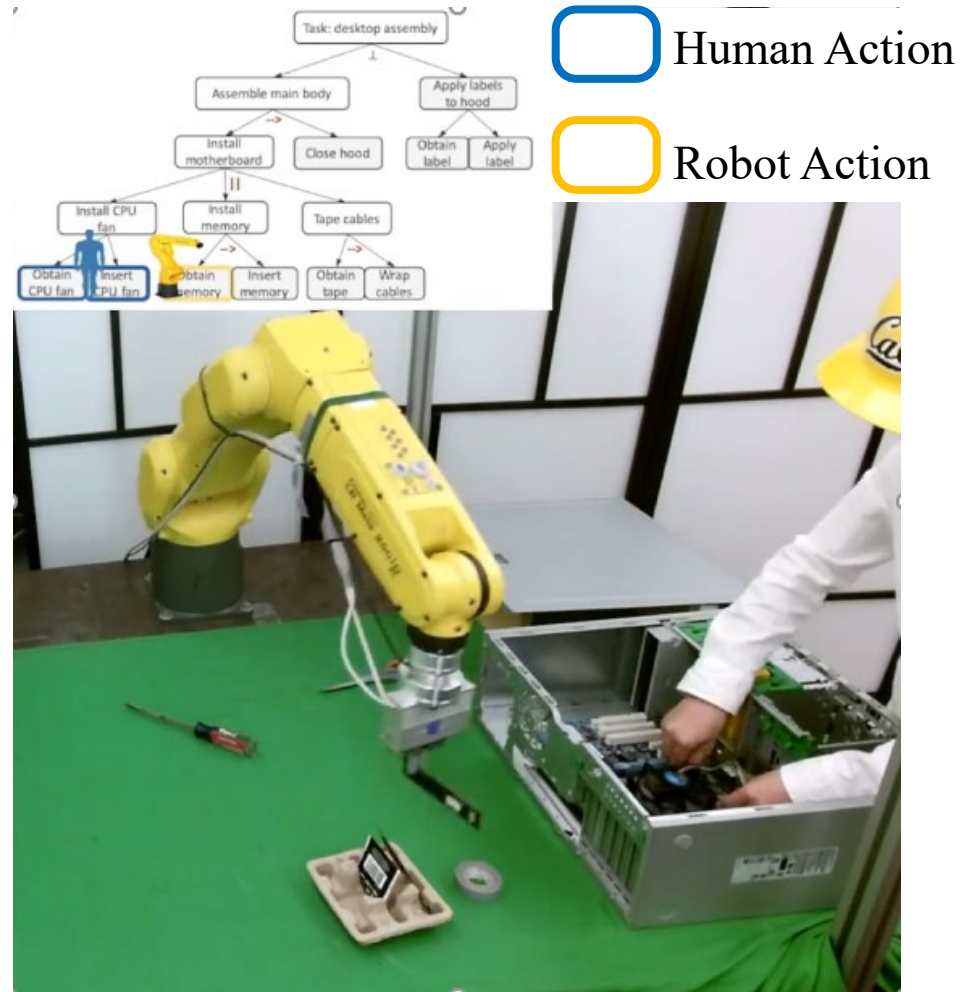

Cheng, Y., Sun, L., & Tomizuka, M. (2021). Human-aware robot task planning based on a hierarchical task model. IEEE Robotics and Automation Letters, 6(2), 1136-1143.

Methods and Results

Task 2. Task Planning

We utilized this structure to enable task planning to let the robot perform the best action to assist the human worker given the worker's current action.
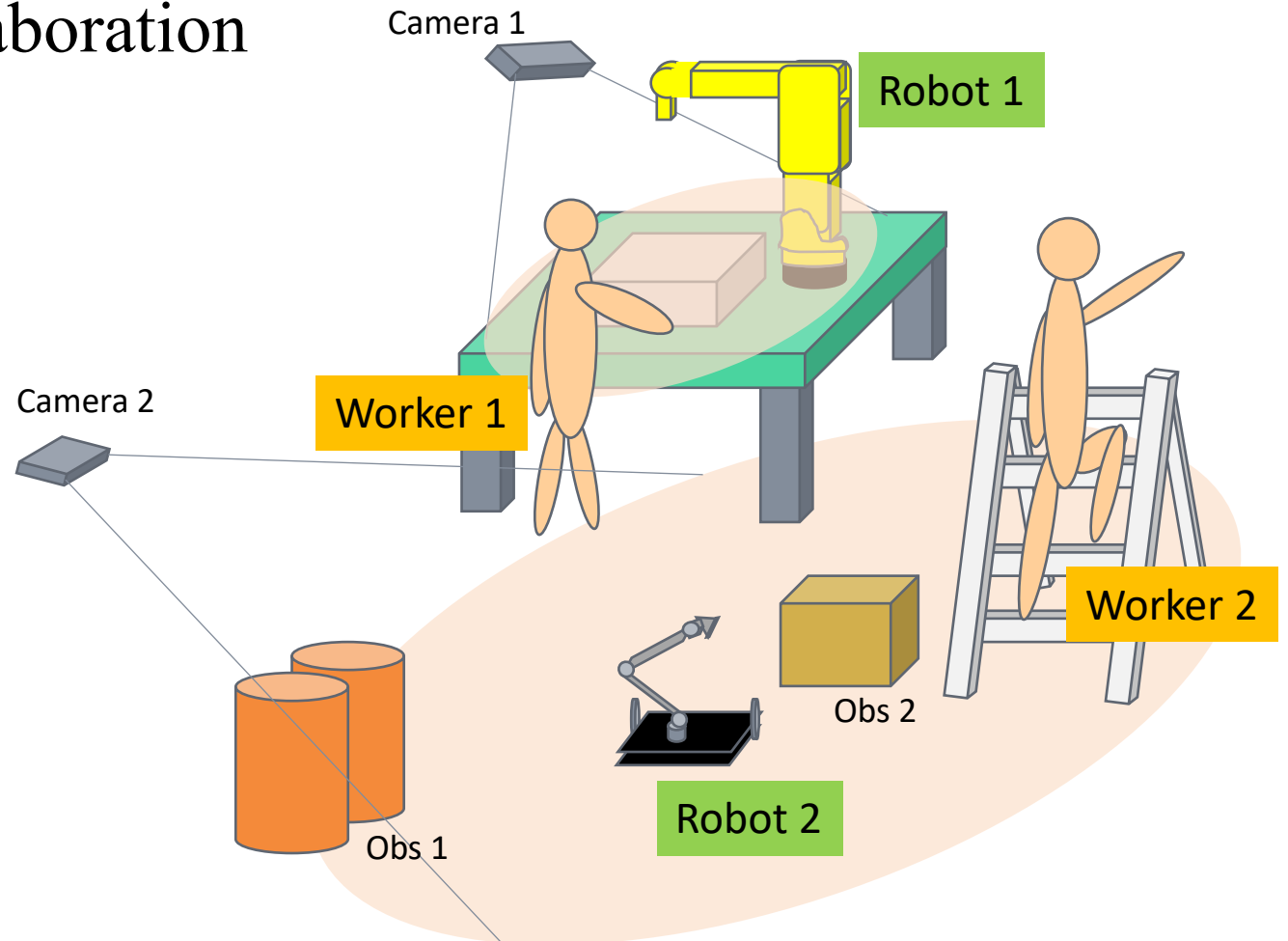
Task 3. Human-Robot Collaboration

For Task 3, we developed an optimization-based motion planning algorithm for the robots. In our demo setup, we have two robots and two human workers.

- The first camera captures Robot 1 and Worker 1 performing computer assembly

- The second camera captures Robot 2 fetching the tape for Worker 2 from Worker 1.

Methods and Results

Task 3. Human-Robot Collaboration

This demo shows how the two robots assist the two human workers.

Robot 1: Labeling

Robot 2 Planning

Robot 2: Fetching tape from human

Obs 2

Obs 1

Camera 1

Camera 2