Cognitive Human Robot Interaction Pose Detection and Tracking (PDT)

Overview

The cognitive HRI package supports Human Machine Collaboration (HMC) aiming at combining human flexibility with repeatability of automated factory entities, such as cobots, for improving working conditions while pursuing better performances. So, what does this means, in simple words? There will be an analysis of how a human, a worker, works by using one or more pieces of equipment at the shopfloor. The goal of this analysis is to provide an improved way of working. Let's see the following example: SUPSI and GESTALT provide software packages that monitor specific human attributes in order to detect both worker perceived exertion level (detected by the fatigue monitoring system, FAMS) and posture (detected by the Ergonomic package, PDT). This information is the input for a further decision-making package, the intervention manager, in order to re-organize the working cell for improving worker conditions and getting better performances. So, long story short, based on the example in hand, cognitive HRI improves the working process by improving the worker's physical conditions and vice versa.

Looking at Figure 1 we can see a human worker in a working situation where the task requires lifting both arms above shoulder level. Working and standing like this does not only introduce physical stress to the worker but leads to fatigue which is compensated by the worker with unhealthy body postures. To prevent fatigue and bad postures, the workplace should be re-organized. Here, the working piece can be adjusted in its height where working is much more comfortable for the worker, a good body posture is maintained and workers fatigue is minimized by reducing the physical stress.

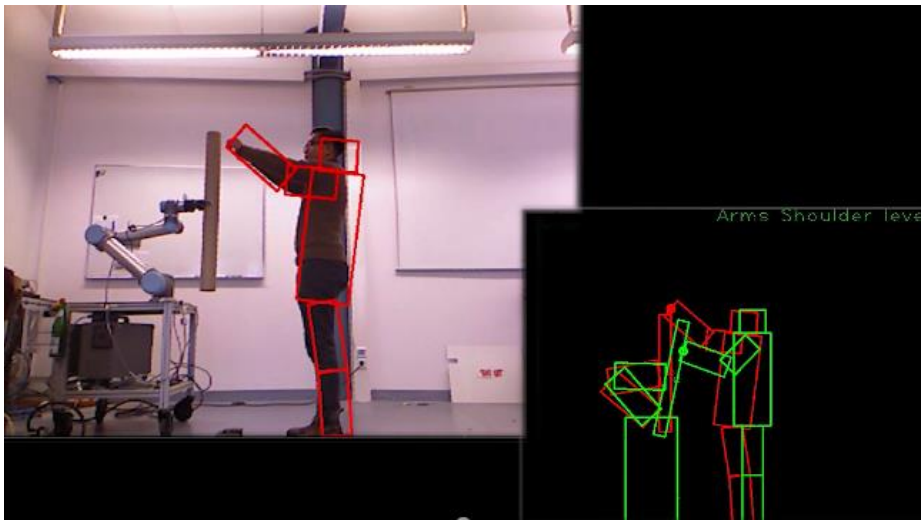


Figure 1: A working situation detected to be unhealthy (red) and its re-organized healthier alternative (green)

Pose Detection and Tracking (PDT)

Occupational ergonomics is a highly relevant issue. Billions of Euros are spent in the EU alone for health compensation caused by Musculoskeletal disorders (MSDs). Tackling MSDs requires an equally high amount of resources as ergonomists need to manually analyze and redesign every process and workplace. Automating the task of human-posture analysis can significantly improve people's health while massively reducing costs. PDT is a module that estimates the workers pose, performs ergonomic analysis and computes an ergonomic score based on camera images of the workers.

By applying image processing algorithms to visual data we are able to compute certain postures key figures, like the angles between arms and upper body, indicating the physical stress level of the observed working situation. Our solution focusses explicitly on a GDPR-compliant implementation, since assessing individuals and working situations with cameras can be felt an invasion of privacy. The resulting, anonymized working posture assessment can then be used to organize the work place in a way that individual adjustments ensure less physical stress and increase the workers health.

Objectives

- Analyze human postures and assess the ergonomics
- This can be used to
    - Improve workers health by reducing physical stress
    - Increase workers satisfaction by re-organizing work according to their needs

Conceptual Overview

- Measure body poses by looking at humans with a RGB-camera
- Apply image processing algorithms to determine body pose information
- Assess key values according to “Ergonomic Assessment Worksheet (EAWS)”
- Re-organize work stations in order to prevent physical stress and fatigue

What is needed

- RBG-camera
- Docker-capable runtime environment

System Architecture

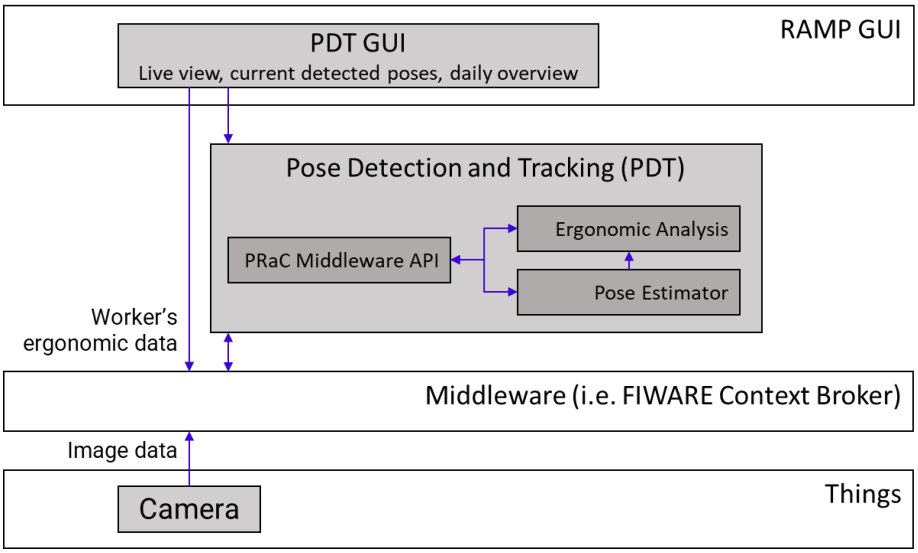


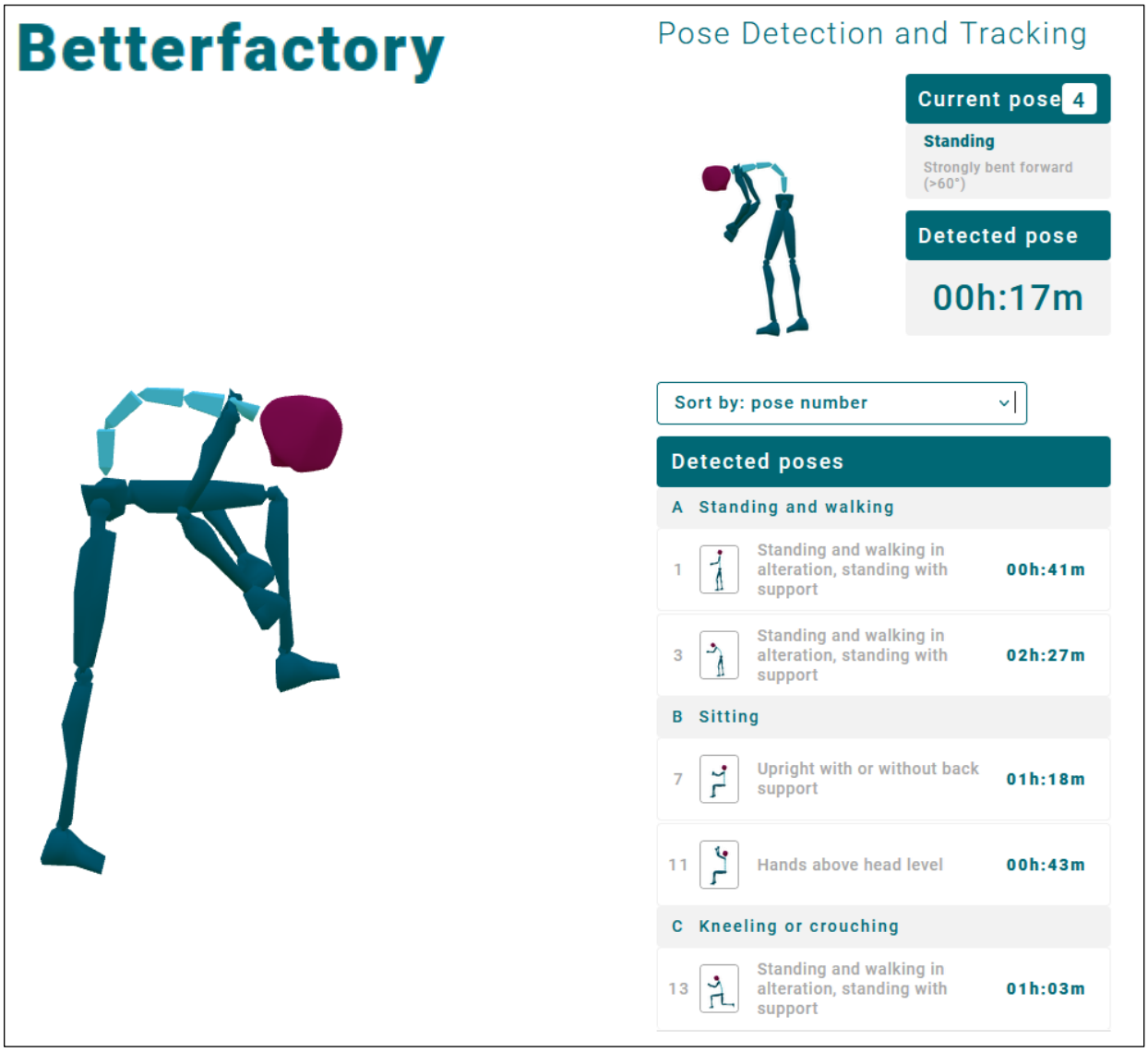
Figure 2: System Architecture

The module can be run stand-alone as can be seen in the system architecture and is deployed using several docker containers. By using a middleware we are able to share the analyzed ergonomic data with other modules like the “Fatigue Monitoring System” (FaMS) from SUPSI to get an overall worker and process assessment.

Supplementary Material

- Demo-Video of PDT: https://www.youtube.com/watch?v=nsiKBBFwPtg
- Our Article about pose estimation: https://www.gestalt-robotics.com/technology-modules/pose-estimation

GUI Example



Left: Live view. Upper right: Current detected pose. Lower right: Daily ergonomic overview.