Musculoskeletal conditions are the leading contributor to disability worldwide

3/5 EU workers

1,71 billion people

2 billion euros

Manufacturing is one of the sectors where MSD's are most prevalent

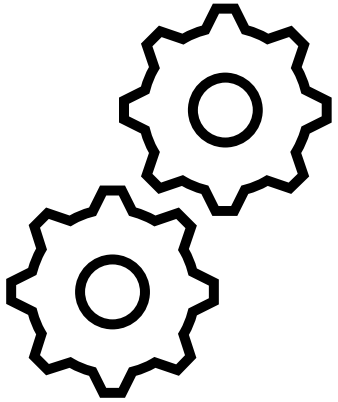
Risk assessment and prevention is key

Risk assessment is the prime way to tackle these issues

Monitoring by expert

High cost

Automated solution



Wearable sensors

Impractical & hindering

Camera-based

Privacy

The International Academy for Production Engineering

35th CIRP Design– Patras – Greece – Apr. 02-04 2025

Enabling Privacy-Aware AI-Based Ergonomic Analysis

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GHENT UNIVERSITY

imec

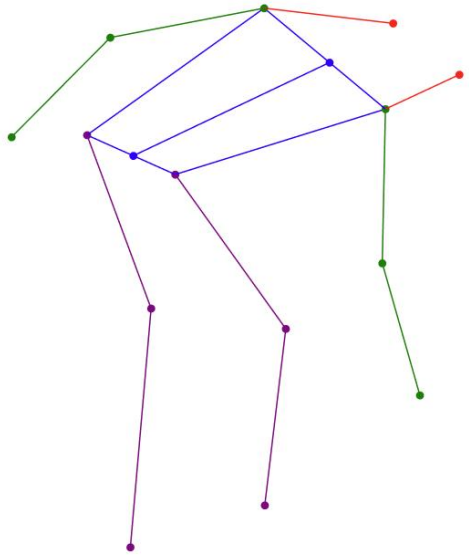
IDLab
INTERNET & DATA LAB

FLANDERS MAKE
DRIVING INNOVATION IN MANUFACTURING

Flanders AI Research Program

The goal is to automatically detect high risk ergonomic situations

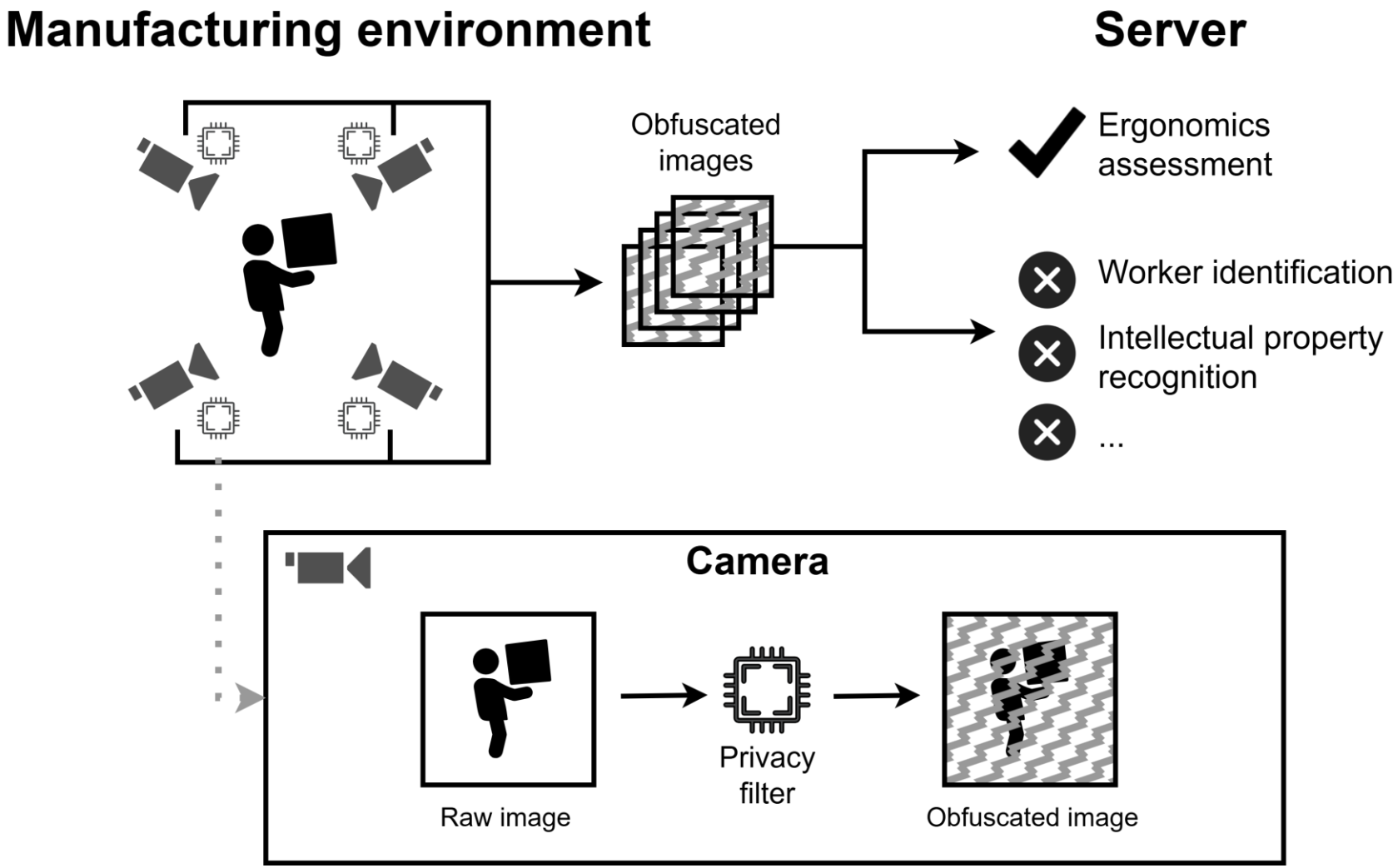
3D Skeleton



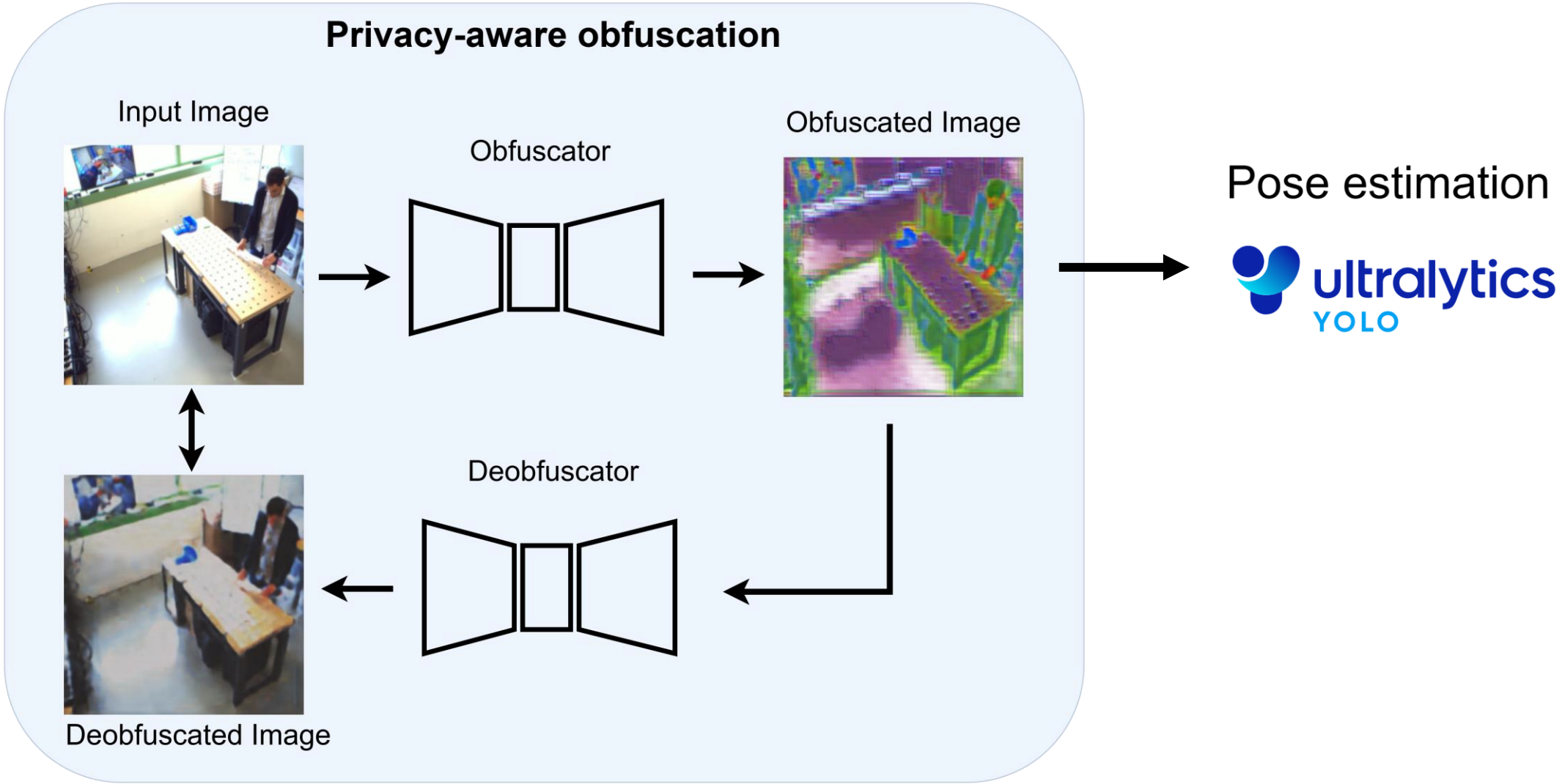
High risk

REBA score: 9

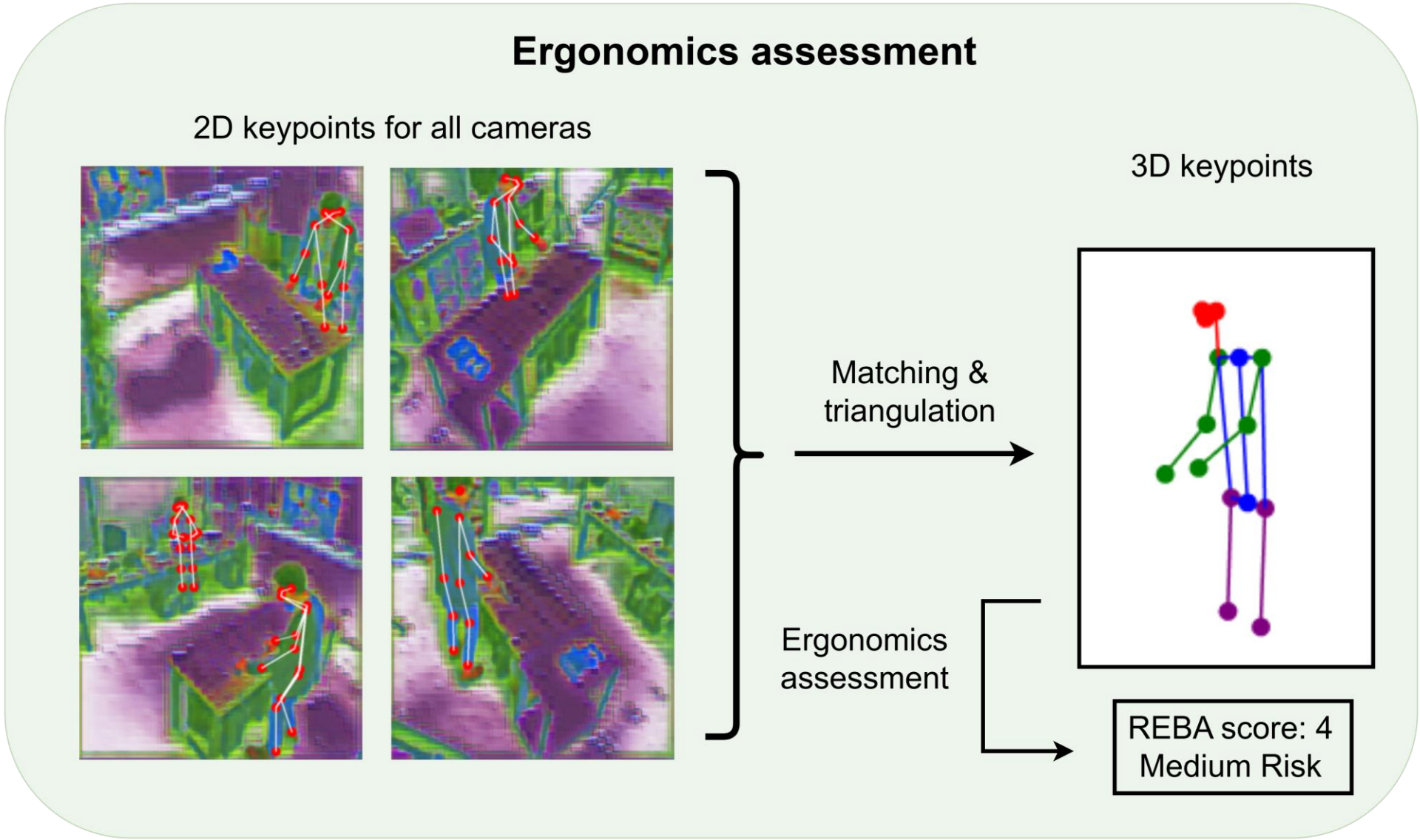
We design a setup with privacy built into the sensors



We use an adversarial scheme to make a privacy filtered version of images

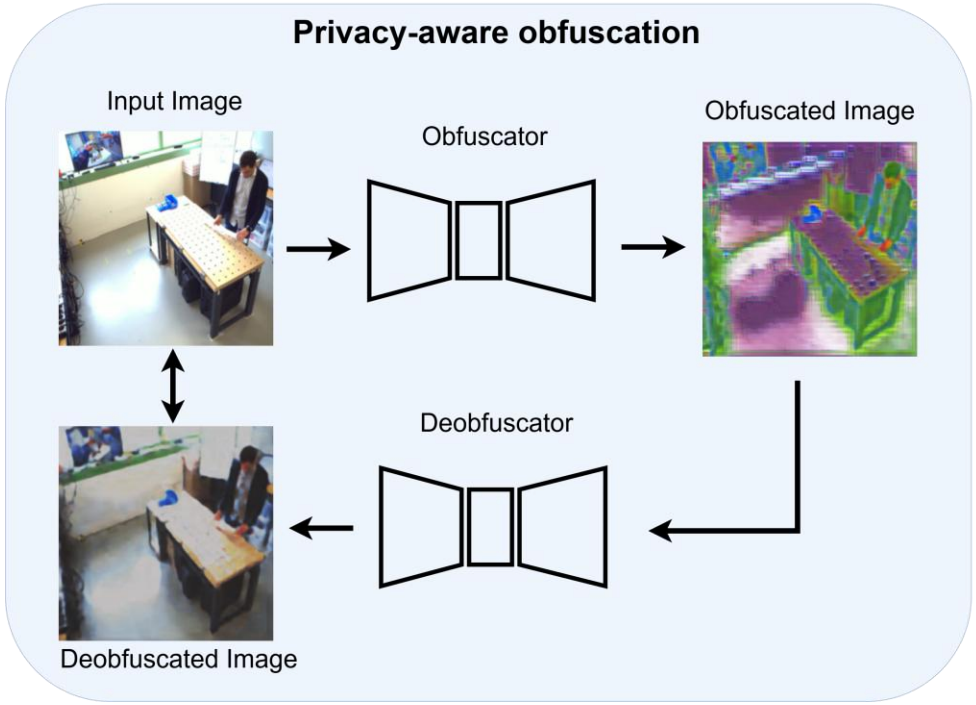


The obfuscated images can be used for an ergonomic assessment



Privacy aware ergonomics pipeline

On device

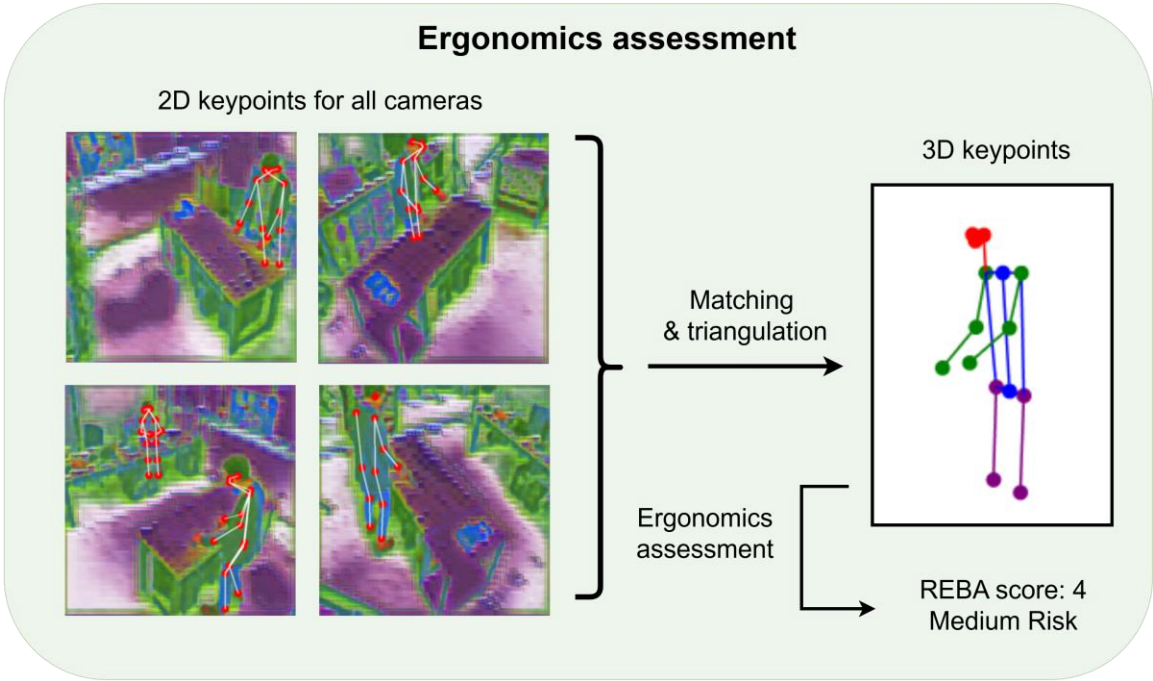


Repeat for all cameras

Pose estimation

ultralytics YOLO

Cloud based



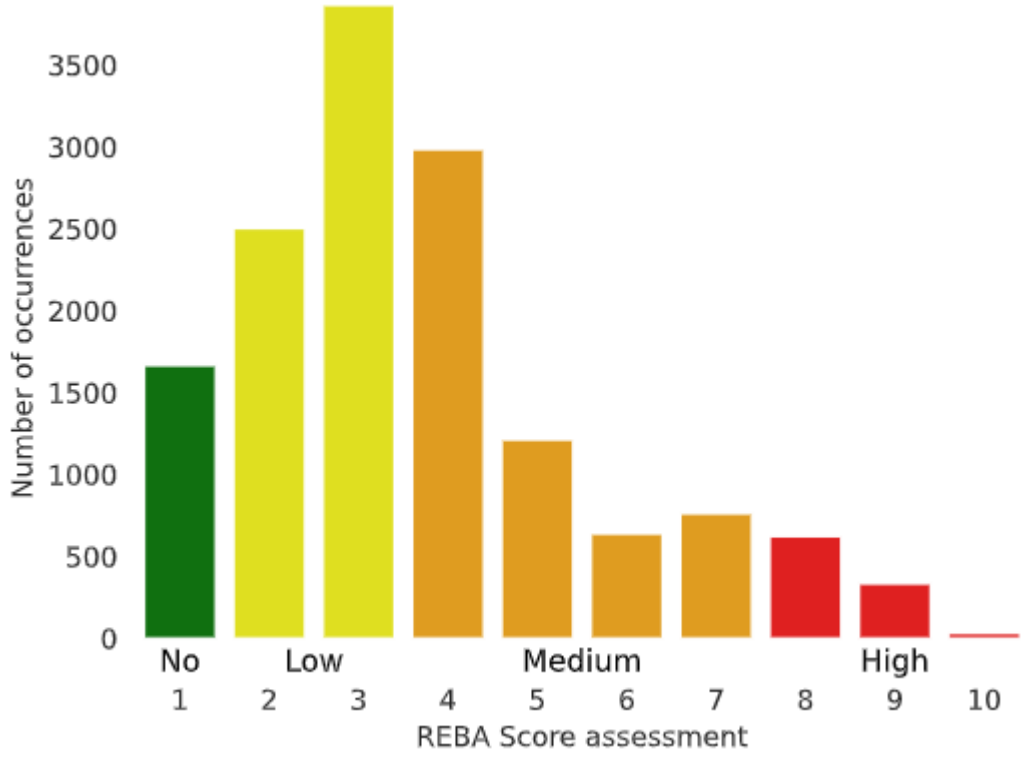
Dataset collection

Workers performing assembly tasks

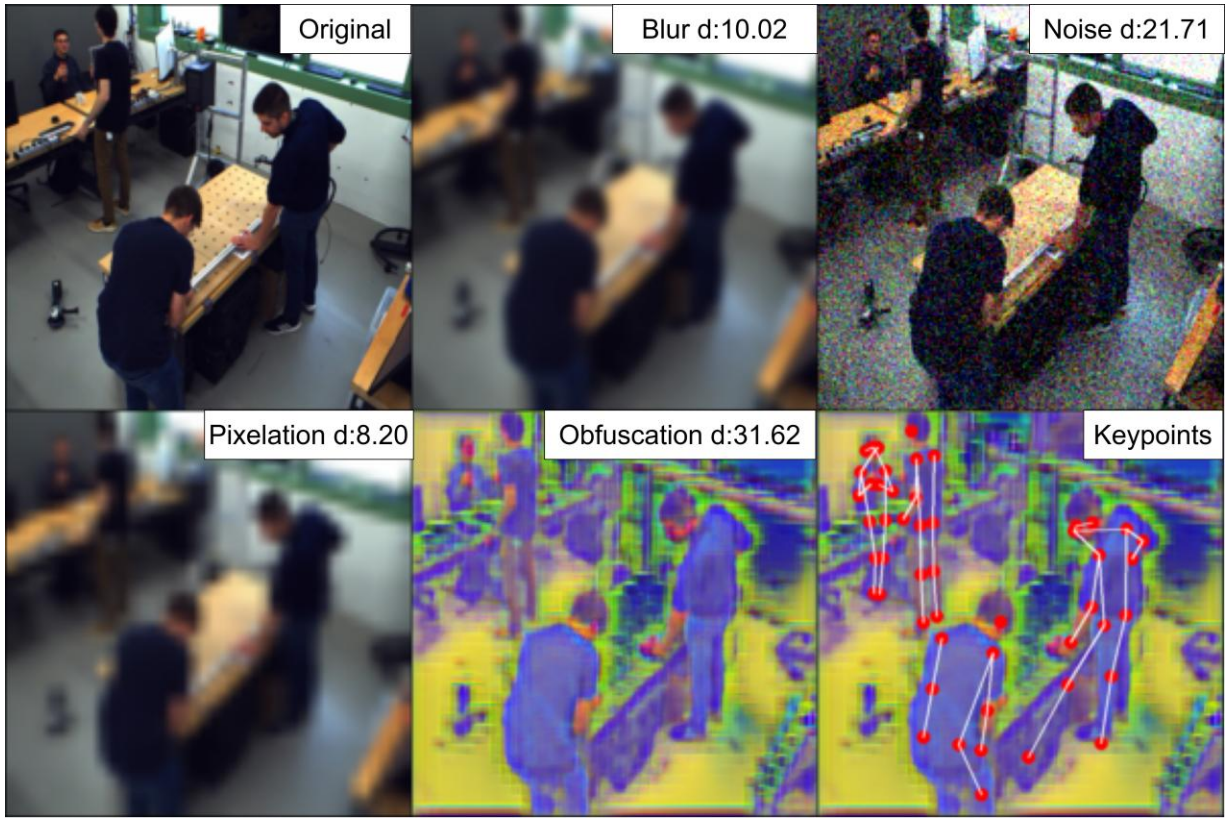
Adopting high risk poses

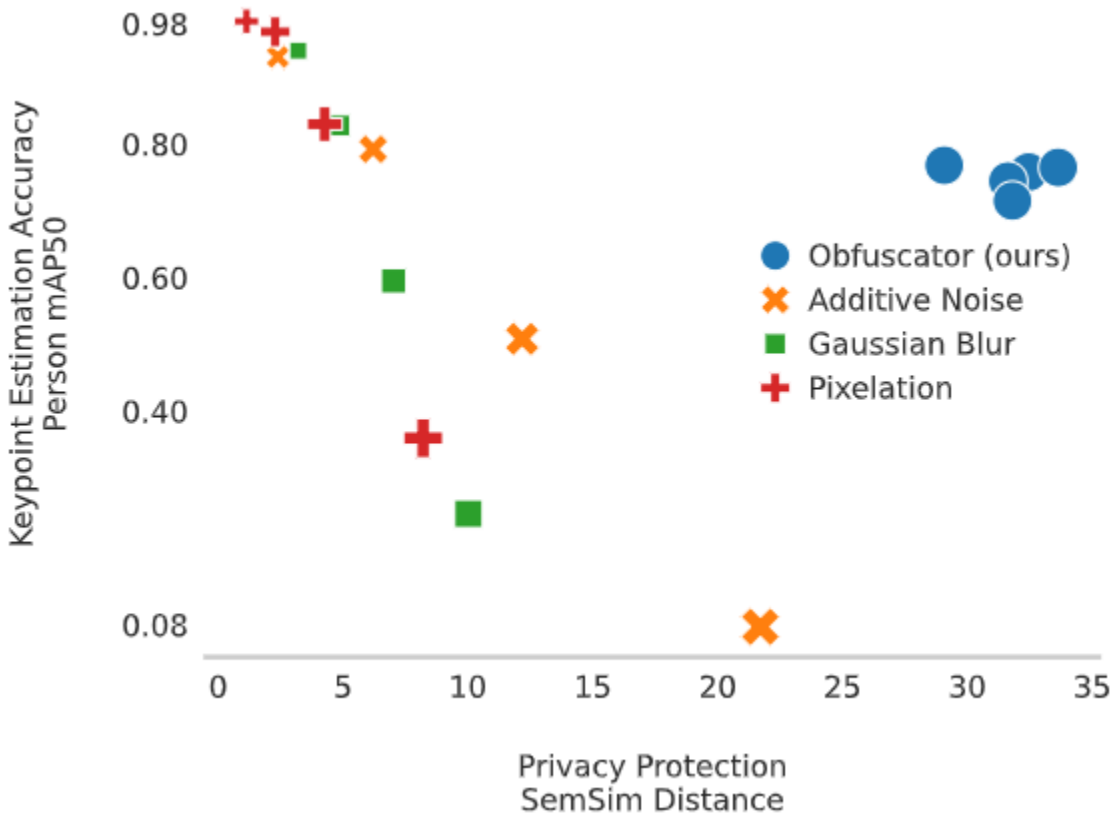
- fetching components from drawers
- bending over a table
- picking up tools from the ground

REBA score distribution



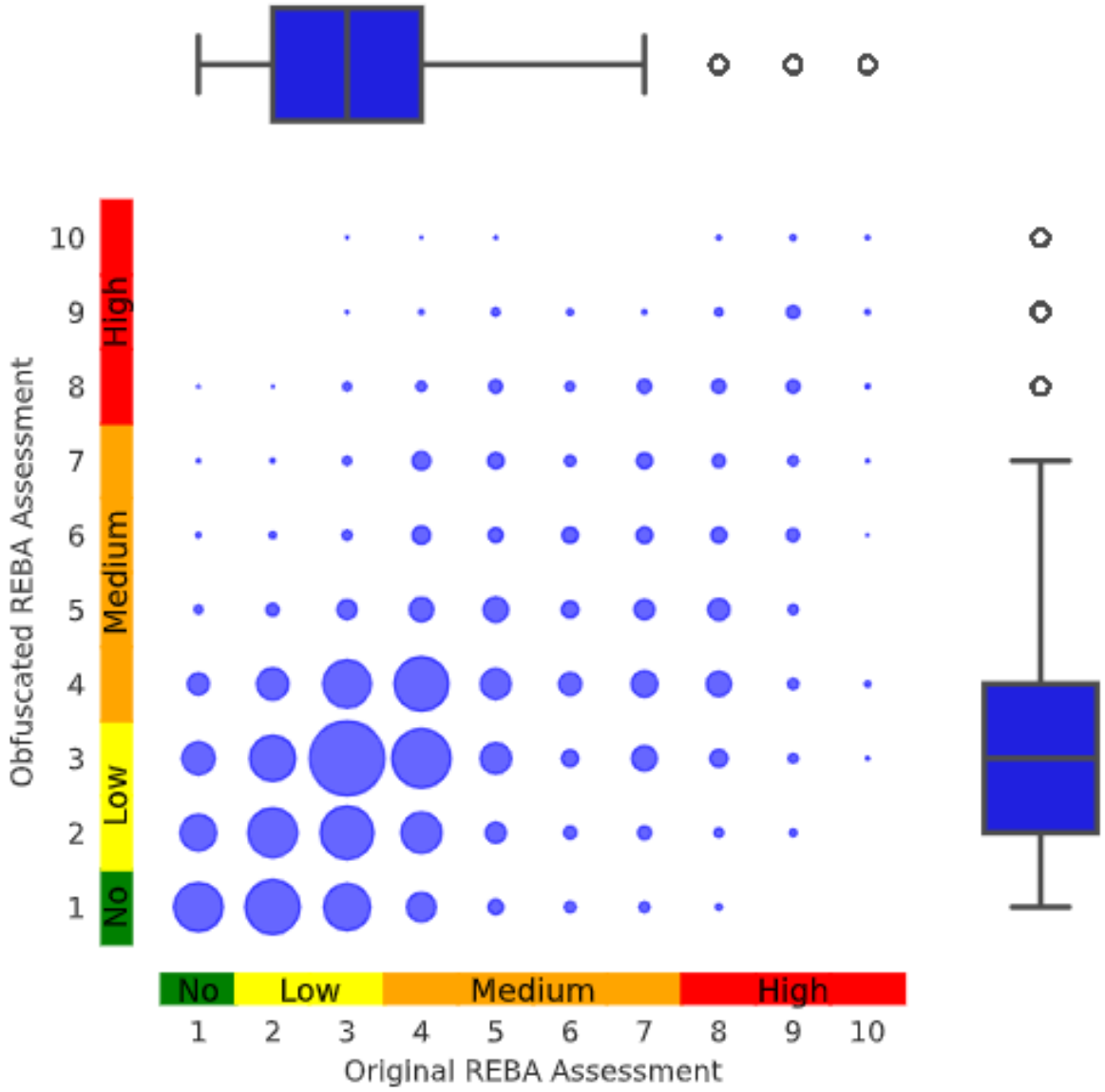
We provide a better privacy-utility tradeoff than standard obfuscation techniques





REBA score assessment before and after

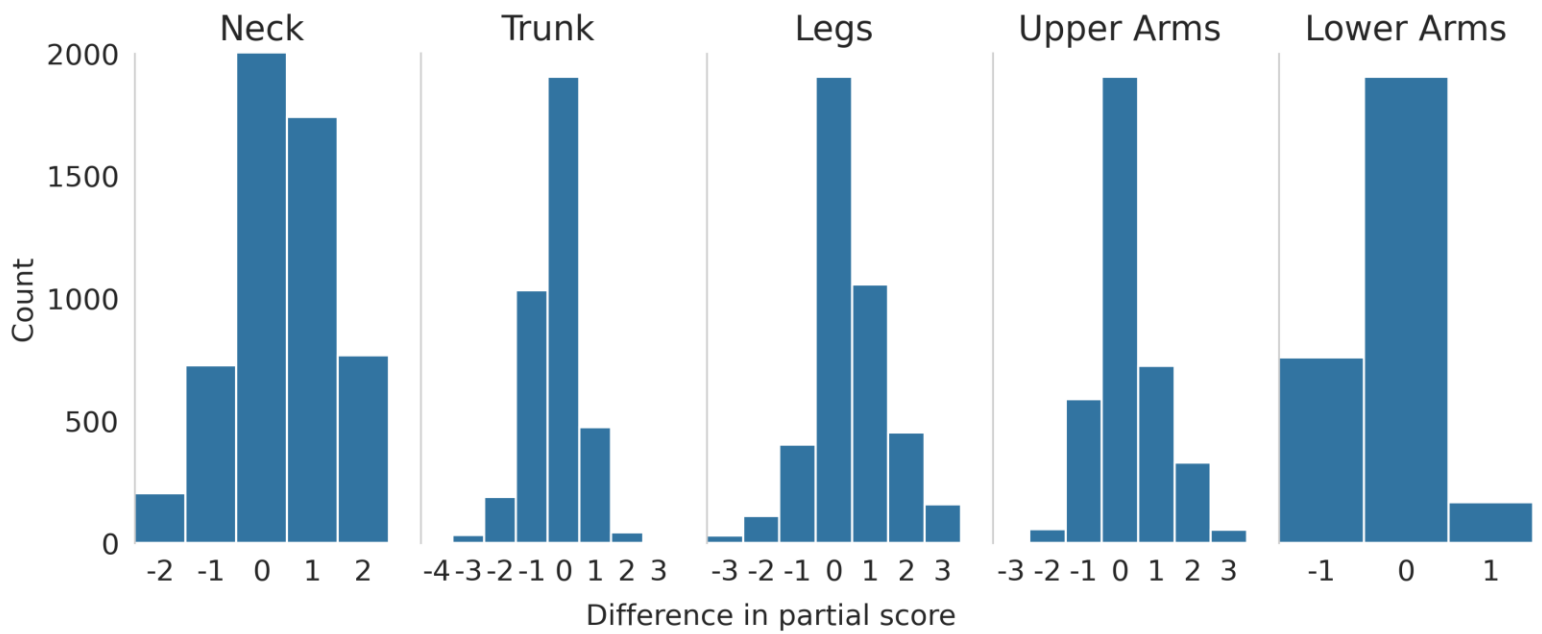
High risk REBA scores see higher fluctuations between obfuscated and original assessment



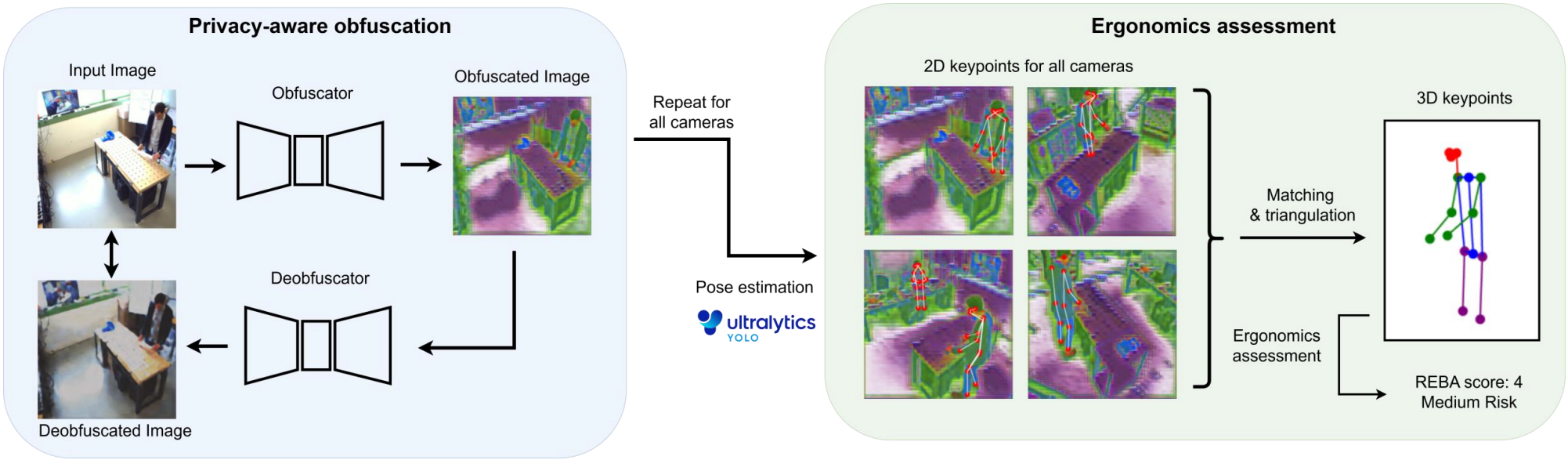
We can observe the difference in partial scores

Mainly no to small changes in partial score

Neck has a higher rate of error



Conclusion & future works



Involving IP sensitive aspects in the privacy protection

Increasing performance for high-risk situations

Doing extra privacy verification checks

Testing edge compatibility