Digitisation of Collaborative Human-Robot Workspace

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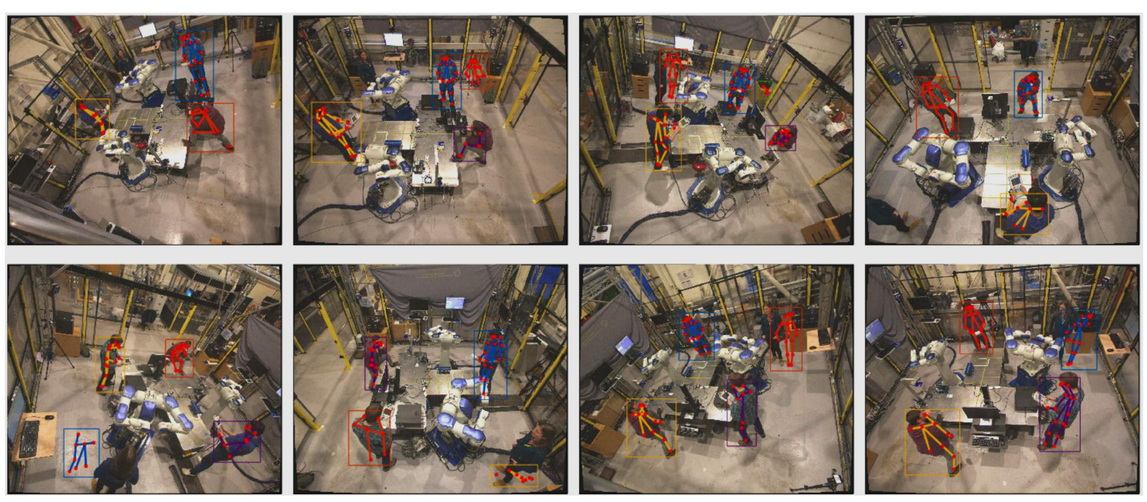
1. Introduction

Productivity and competitiveness in manufacturing rely on efficiency in collaborative human- robot workspaces. A challenging obstacle to greater efficiency is the need for real-time awareness of the manufacturing environment. This study investigates the possibility of real-time 3D pose estimation of people in a manufacturing environment. A distributed system is proposed that utilises multiple 2D RGB cameras from different viewpoints and state-of-the-art deep learning computer vision algorithms for human pose estimation. Through experimental analysis of the system, the trade-off between latency and accuracy when tracking people is determined.

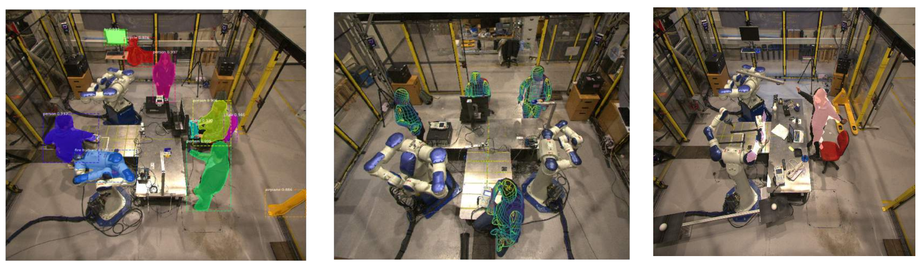
2. Vision AI applied to Manufacturing

4 State-of-the-art algorithms were evaluated. They were tested to determine their performance in a manufacturing environment. All the algorithms successfully detected people or objects. However, they also all made mistakes.

OpenPose



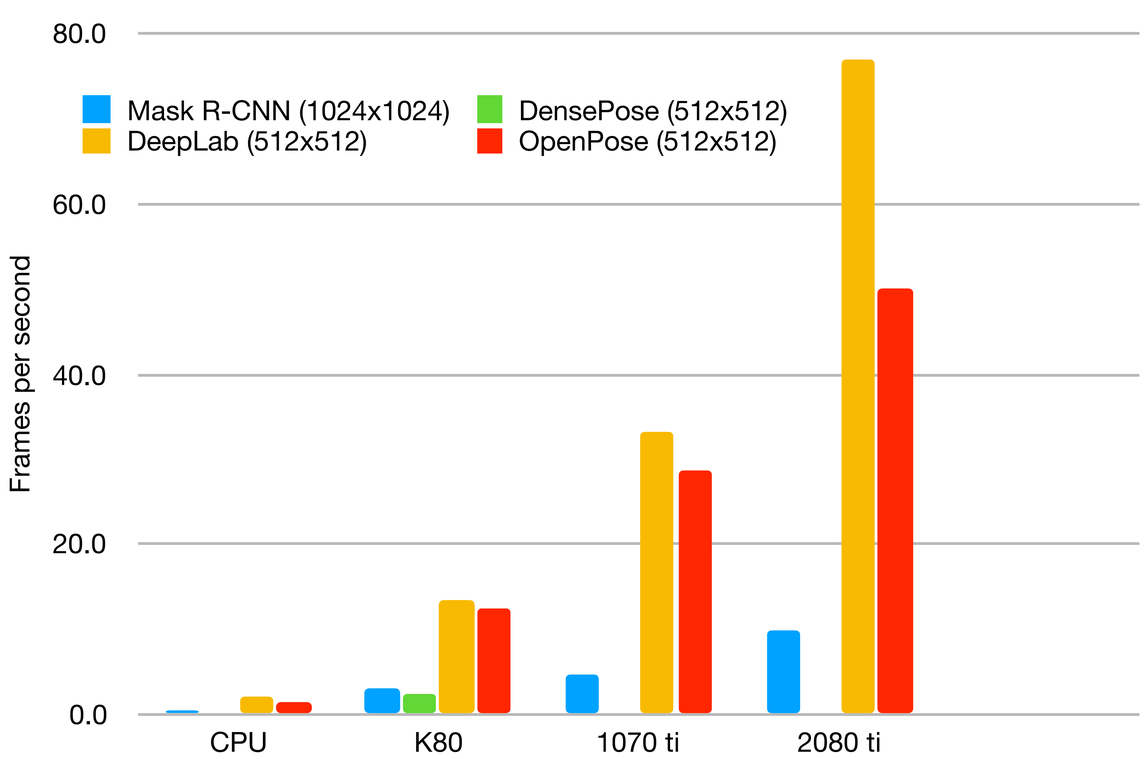
Mask R-CNN **DensePose** **DeepLab**



3. Hardware performance comparison

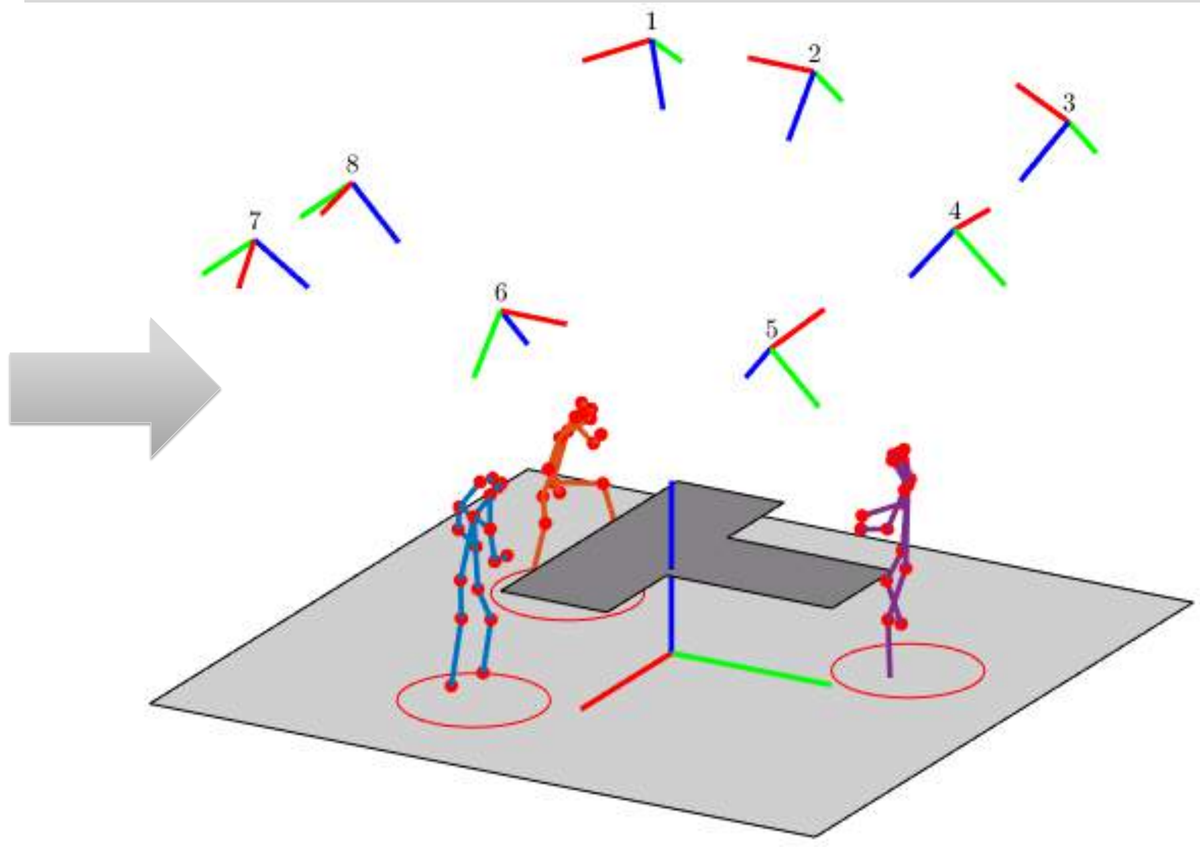
Each algorithm was evaluated on a range of processors.

- 20x increase in speed from CPU to GPU.
- Algorithm efficiency and image size are critical for speed.



4. Data fusion for fast & robust 3D tracking

Applying OpenPose on 8 RGB cameras and applying a triangulation step results in fast and robust tracking of people in 3D space



Robust skeletal reconstruction

5. Conclusions and Outcomes

This feasibility study investigated the possibility of real-time digitisation of 3D manufacturing environments from a set of 2D standard RGB cameras. The key findings were:

- Advanced algorithms and hardware were evaluated in a manufacturing environment.
- Current state-of-the-art algorithms do not recognise uncommon objects that might be important features in a specialised manufacturing environment.
- Near real-time 3D tracking of humans, without markers, in an industrial environment is feasible.
- GPUs are becoming faster over time.
- In future, more complex and accurate algorithms will also run in real-time.

6. Future Work

- Create dataset for industrial objects (expensive)
- Train models to detect industrial objects
- Deploy to embedded devices

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