

# Digital ICU : Robust Realtime Multiperson 3D-Skeleton Tracking under Occlusion in Intensive Care Unit

## General Info

Contact Person: Ee Heng Chen

Contact Email: eeheng.chen@tum.de

## Project Abstract

Patients in the Intensive Care Unit (ICU) are continuously monitored by clinicians for any signs of early clinical deterioration. Currently, this monitoring is done with the help of electronic medical devices (i.e. bedside-monitor) that measure the vital signs of patients continuously and alert clinicians whenever the vital signs are outside a predefined normal range. However, such monitoring could lead to a high rate of false-positive alerts due to the movement (action) of patients affecting the vital signs measurement (artifacts). A possible solution is to build an intelligent patient monitoring system that incorporates action recognition in the ICU to reduce artifacts and false-positive alerts. Besides this use case, such a system can also be used to identify patients that are in need (i.e. falling down, struggling to stand up) and notify clinicians to help them. Furthermore, the recognized action can serve as an additional source of information in the patient protocol, which can be used to improve patient health analysis.

This project aims to bring the aforementioned benefits of action recognition to aid clinicians in the ICU by developing a skeleton-based action recognition module for use in an intelligent patient monitoring system. To achieve this, a robust camera-based 3D skeleton tracker is needed to obtain the 3D skeletons needed for the action recognition. The tracker must be able to deal with subjects leaving and entering the field of view of the camera (patients and clinicians moving around the ICU) and track different subjects (clinicians and patients) under a high degree of occlusion (patients being covered by a blanket or a large patient gown). Developing a robust 3D skeleton tracker will be the main goal of this project.

## Task Description

- Literature review on SOTA works working on camera-based human pose (skeleton) estimation [1].
- Develop an algorithm to simulate “occlusion”, i.e. masking out the “legs” in an image to simulate the case where only the upper body is visible.
- Develop a 3D skeleton tracker that gives the best trade-off between robustness (in terms of occlusion), accuracy, and speed.
- Develop an evaluation metric to evaluate the “occlusion robustness” of the tracker.
- Optionally: Extend the robustness to include subject reidentification, i.e. same subject that reappears in the field of view of the camera.
- Write and present about the work that is done.

## Technical Prerequisites

- Intermediate or advanced programming experience with Python3. (C++ is a plus)
- Optional: Experience using the following libraries: OpenCV, Scikit-learn, Pytorch, Tensorflow.

## References

[1] CAO, Zhe, et al. Realtime multi-person 2d pose estimation using part affinity fields. In: *Proceedings of the IEEE conference on computer vision and pattern recognition*. 2017. S. 7291-7299.