# Project title: Cobots Video Training Method

**Team names: BJJ**
**Team types: Research team (R-team)**
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## Executive Summary

A collaborative robot or cobot is a robot intended for direct human-robot interaction within a confined space, or in close proximity. In contrast with traditional industrial robots, cobot applications emphasize human-robot cooperation and interaction. As a research group, we see the potential of it solving problems in a broad user setting. For example, help automate unergonomic tasks such as helping people move heavy parts around or machine feeding in industrial environments. In the public space, it can also function as an information robot like a service robot. With the help of computer vision, our goal is to achieve level four collaboration defined by IFR. For which the robot is able to perform responsive collaboration, specifically the robot responds in real-time to human movement.

While cobots show promising potential to be implemented in a variety of fields and scenarios, current cobots' training methods still rely on human physical interventions. To teach a cobot to learn movements, a human operator would need to manually move the cobot step by step, which is prone to be inaccurate and to be laborious. To apply cobots on a large scale, a more autonomous training method would be essential.

Unlike the traditional learning which requires physical demonstration by dragging the manipulator, in our method, workers only need to manually move a standardized " cube" to teach the robot. This cube will have QR codes printed on every surface. A camera will be used to detect the trajectory of this "cubic box" based on 3D reconstruction using six QR codes. The instructor will move this box in the desired pattern for the robot to learn.

By applying our CV method mentioned above, we will be able to break the limitations in training or programming our robot. All we need to do is either playing the videos or demonstrating the movement in front of the camera. In either way, the robot will learn the 3D trajectories that can be used under different scenarios like warehouses or construction sites. This saves a lot of time in programming and tuning the robots and will become a more convenient way in robot training in the future.

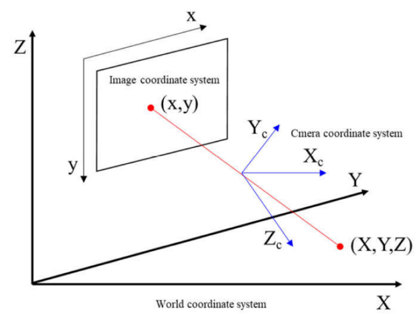


Figure 1. Conversion relationship between three-dimensional spatial coordinates and two-dimensional planar coordinates

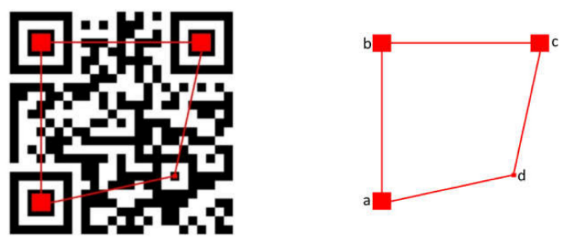


Figure 2. Coordinates of vertices within the QR code

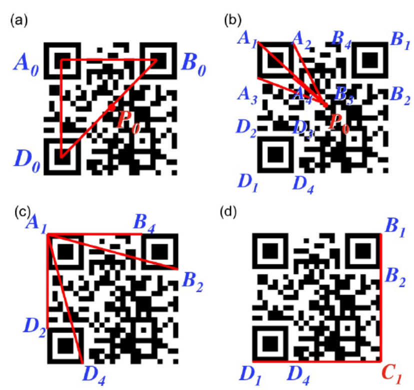


Figure 3. QR Code Recognition Steps

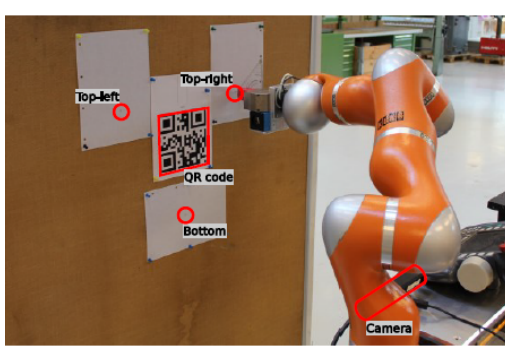


Figure 4. QR code calibration