Towards No-Code Collaborative Robotics: Intuitive Environment Calibration Method

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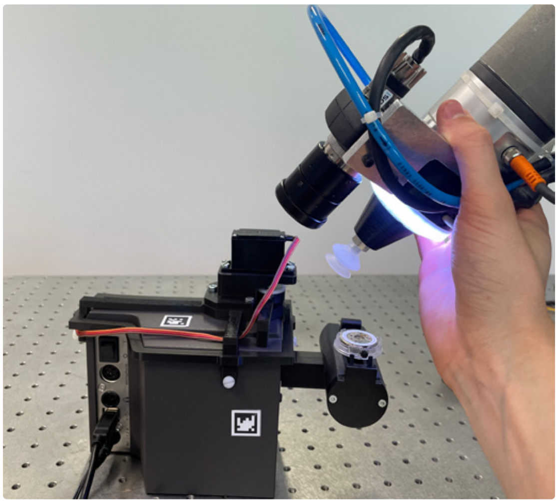
Manufacturing processes are becoming increasingly flexible, with shop floor workers quickly adapting to changes in production. The use of collaborative robots promises to assist workers in strenuous and repetitive tasks. While no-code interfaces are being developed to simplify programming, calibrating the cobot in a dynamic environment is still a complex and time-consuming task. Simplifying this step would greatly improve the usage of cobots in industrial settings.

Context

Industry 4.0 brings new challenges by having among its goals a production characterized by flexibility and adaptability. Shop floor workers are a very versatile resource, who adapt quickly to new processes and changes in the production line. Collaborative robots (cobots) with built-in sensors and safety features allow workspace sharing and promise to assist workers in strenuous, repetitive, or dangerous processes.

Motivation

Shop floor workers are experts in the production processes to be performed. They would be the best suited person to integrate cobots into manufacturing processes, due to their task expertise. However, their skill set lacks knowledge in robotics and programming. Innovative no-code interfaces are being developed to make cobot programming easier and more intuitive. These still require parameters derived through an accurate calibration of the cobot in its environment. This process includes defining the location of actuators, sensors, and tools to manipulate the product. It is currently a complex and time-consuming activity not suitable for novices.



Cobot hand-guiding to a watch quality control device.

Approach

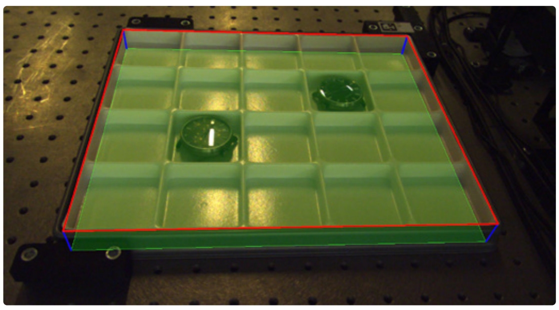
Calibrating a robot‘s environment relates to defining a model of the real world around it. The approach used relies on manually guiding the cobot towards the objects to be calibrated. A vision-based method uses a camera rigidly mounted near the cobot‘s tool. This allows to estimate the position of fiducial markers attached to the objects through image processing algorithms. The model of the cobot‘s surroundings is thus defined at run-time.

Results

The camera parameters and main transformations matrices are calibrated within minutes. The procedure is supported by a user friendly web-browser interface, along with visual feedback on the gripper. The developed Python framework allows trajectory generation by kinesthetic teaching and displays the calibration results through augmented reality. The approach has been validated developing a watch quality control application.

Outlook

In future work, the versatility of the method developed should be evaluated by installing the system in an industrial setting and asking shop floor workers to calibrate the environment for a variety of production processes. Their feedback would be used to improve the method and to integrate it in a no-code programming interface.



Calibration of a watch storage pallet using augmented reality as visual feedback.

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