Automated Object Detection in a Collaborative Robot Workspace	
Code:	Rob195
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Industrial partner:	BFH AHB

Context / Problem	Collaborative robots are meant to be flexible and easy to be reprogrammed. For safety, most current systems rely on force or torque sensors to stop any motions if a collision takes place. This approach works reasonably well for human-machine collisions. In a collaborative situation, the robot workspace is dynamic, clutter may obstruct parts of it. This clutter may be tipped over by the robot and pose health risks (e. g. containers with liquids, heavy unstable objects) or lead to unnecessary halts.
Main Goal	Integrate a vision system to detect in real-time unexpected temporary objects in a robot workspace to add an extra layer of safety and reduce downtime. This work foresees using a Fanuc CR35i Cobot at AHB. • Integrate sensors to track objects. • Implement the GPU Voxel algorithm. • Integrate collision avoidance by re-planning the robot motion upon detection of an object. • Integrate a user interface. • Test and validate the implementation.
Goals for extra credit	• Demonstrate the algorithm on a dynamic environment (integrate human detection). • Robust exception handling.
Preliminary study goals	• Write specification, test and validation plan. • Perform a literature review. • Select, order and commission parts for test setup. • Get familiarized with robot system and interface. • Integrate a model of the robot in the collision-avoidance software. • Generate a project plan for the thesis.
Plan / Steps (suggested)	a) Write specification, test and validation plan b) Literature review c) Develop the concepts d) Procure components e) Implement solution f) Test and validate g) Extend and fine-tune the solution

General organization	The students organize themselves. The supervisors are available to provide guidance for analysis, to support decision making and to uphold the client's view. The students shall keep a lab log that allows the supervisors to replicate the results. Weekly meetings will be planned. The students shall prepare each meeting. During the meeting the students shall present: • the work done in the previous week • the results achieved • the topics to be discussed • the questions that require an answer • the decisions that need to be taken
Deliverable Documents	At the end of both works a report shall be delivered. The report shall follow the guidelines given in *Redaktion eines technischen Berichts* and *Richtig zitieren und referenzieren* of the Micro and Medical Technologies Division, available in the Intranet and on Moodle. Word and Latex templates are also available.
Preliminary Study	A report in PDF format shall be delivered. The report consists usually of about 25 pages without counting the appendices. The report shall contain the outcome of the work done as well as the goals and work plan for the thesis.
Bachelor-Thesis	A report in PDF format shall be delivered. The report consists usually of about 50 pages without counting the appendices. • The first page is given by the BFH-TI – refer to the format in the Intranet. All thesis-relevant data shall be placed on the roboticsLab git project repository.
Defense	The Bachelor Thesis shall be evaluated by an external expert. For this purpose, the students shall present their work (20 minutes) and respond to the experts' questions.
Grading	The work will be evaluated based on 4 criteria as documented in *Bewertung der Bachelor-Thesis* of the Micro and Medical Technology division.
Other	The students will receive hardware, software, documentation, relevant publications and intellectual property rights documents from the supervisors.

Dates	The following dates are given:
Preliminary Study	Begin: Monday, 2019-02-18 **Submission of Report: Monday, 2019-05-06, 08:20**
Bachelor Thesis	Begin: Monday, 2019-05-06 **Submission of abstract for the «Book»: 2019-06-05** **Submission poster on Moodle (upload): 2019-06-21** Tech Day: 2019-06-28 **Submission of Report: 2019-07-02, 12:00** Defense: until 2019-07-18 Diploma ceremony: 2019-09-20