Global Capstone Projects with Chalmers, Penn State and Volvo

Smart Oil-filter mounting tool for robot use in assembly

Background:
Collaborative robots are entering the market rapidly. Applications for these kinds of robots are often intended to be the same kind of mounting/de-mounting operations as today are performed by humans. That implies that tools used for those operations shall sometimes be used by humans and sometimes be used by the collaborative robots. This will require a complete new type of control and sourcing of actuators in the tools as well as also addressing quite complex ergonomic questions.

Task:
This is about develop a functioning prototype of a mechatronic tool for grasping and lifting new Volvo D13 oil filters from a pallet and mount (enter thread and spin on, no tightening) them. The tool shall have a removable battery, powering an on-board computer for control and communication, an electrical motor and potentially, a grasping device.

General requirements
- Light weight
- On-board battery able to handle 600 operations per 10h. 10 sec. between 3xbursts, 3 minutes between operations. Easy to replace. Secure any back-up functionality when changing battery.
- On board electrical motor (e.g. stepper or servo)
  - Rev 1deg/sec – 5400deg/sec
  - Mounting torque >= 5Nm, +/-10%
- Holding torque >= 70Nm
  - On board computer
    - able to control the motor and grasping device
    - able to work with Robot Operating System V2 (i.e. ROS2)
    - “Logging functionality”
  - Preferable a modular socket arrangement (3/8”) but fixed socket for Volvo original filter is OK
  - RSP (de-mountable) connector to the robot

On board SW shall be able to softly control the motor at a speed range of 0.5deg/sec up to 5400 deg/sec. Ability to do 1 deg/message from supervisory computer, or take a continuous speed until a certain torque is detected (by the on board computer). i.e. when the filter surface hits the engine filter bracket surface.

Intended operation:
- Robot moves to a position where the tool can grasp the filter
- Tools grasp the filter
- Robot is moving the filter to the mounting position at the engine (engine is up-side down)
- Robot/tool/supervisor computer is softly entering the filter on the thread
- When threads are entered, the tool spins on the filter until it touch the surface (e.g. torque > 1Nm)
- The tool apply a holding force/torque, while the robot is applying the tightening torque (25Nm)
- Tool release the filter.
- Two more filters to be mounted.

**Deliverables:**
- CAD design
- Technical specification.
- Validation test specification, verification plan & Test report.
- A functional prototype.

**Students:**
The project is in cooperation with Pennsylvania State University (Penn State). The project team will consist of three ME students from Chalmers and three ME students from Penn State

**Volvo Contacts/Supervisors:**
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**Målgrupp:**
TKAUT, TKMAS, TKELT, TKDAT, TKTFY

**Gruppstorlek**
Tre studenter från Chalmers och tre från Penn State
(Projectet kan ej fördubblas)

**Antal grupper:** 1 grupp för det här projektet