Division of Systems and Control
Department of Electrical Engineering, E2
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DORA - Dexterous Robot Assistant

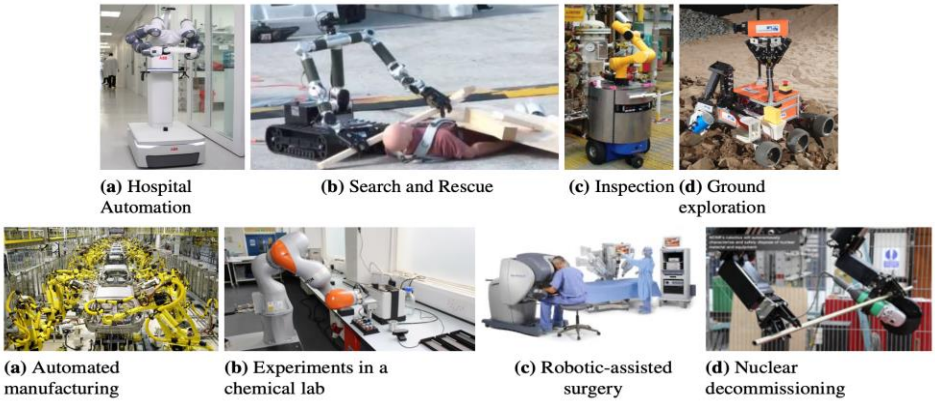

Figure 1: Example applications of robotic manipulation used in real life ranging from assembly to surgery.

Background

We envision robots being able to help humans on a daily basis by autonomously performing a large variety of complex tasks such as cooking food, cleaning houses, taking care of elderly and ill people, as well as replacing humans at dangerous and tedious jobs in industrial environments. The need for robots in our daily lives becomes especially evident in the context of the recent pandemic, as robots can reduce the human contact and risk of transmission of infection also being able to work non-stop 24 hours a day. There is a large number of applications where robots can be employed without human intervention, ranging from nursing, delivery, cleaning and disinfection to manufacturing of complex products in industrial environments. Nowadays, robotic systems are already successfully used in a variety of real-life applications, such as automated car assembly, moving goods in warehouses, packing food, and even assisting surgeons (see Fig. 1). However, there still exist major scientific challenges preventing us from fully integrating robots in our daily life. Currently, traditional robots used in industry perform their assignments in cages and are heavily dependent on hard automation that requires pre-specified fixtures and time-consuming programming and reprogramming performed by experienced software engineers, making the system not re-usable for a new task without a human expert re-programming in detail every movement of the robot. Furthermore, they operate in very well-structured environments with little to no uncertainty involved, and often a human operator is needed to control or tele-operate the robot (such as, for example, in the case of robotic-assisted surgery or sorting and manipulating dangerous materials as in nuclear applications). To operate in natural environments that are unstructured and not specifically engineered for robots, such as, for example, our homes, they will need to autonomously understand the world around them, perform actions safely, learn new skills, and adapt to changes in the environment and humans' behavior.

Description and Goals

In this project we focus on building skills for an autonomous robot to achieve given tasks. We consider various different robotic tasks, e.g. pick and place objects (see Fig. 2). We can potentially start working in a simulation environment using Python programming language, e.g. Pybullet, Gazebo potentially using ROS. We consider building key primitive skills for accomplishing complex tasks, e.g. detecting, locating objects and picking them to achieve various goals. We have a mobile manipulation platform that runs with basic functionalities, we plan to extend the skills of this robot in terms of navigation and grasp planning.

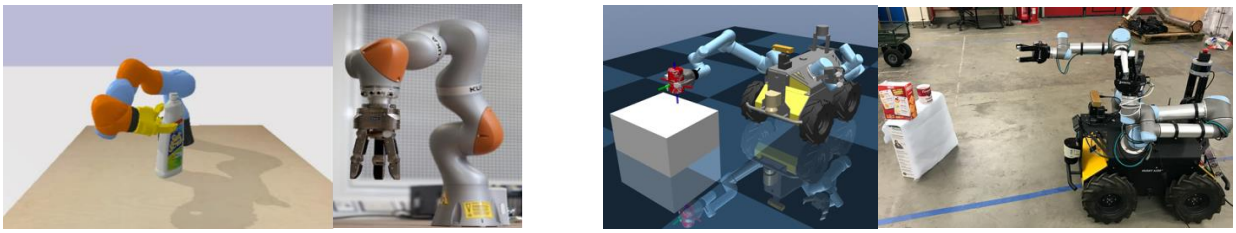

Figure 2: Example robot setups in simulation that correspond to real robots.

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