Software Development for Collaborative Robotics

Luca Dematté - Diego Oniarti

18/12/2025

Contents

1 Introduction and selected topic

Our idea originates from a real world scenario that is close to us. **Fig.1** shows the lathe present in one of our fathers' workshop.
The lathe is equipped with an automatic bar feeder which pushes the material in to be processed and a tray to store the brass bars. The bars need to be periodically loaded into the bar feeder by hand. This task is usually performed by two operators since the bars are approximately $3m$ in length and any bend in the material could render them unusable.

Our project proposal is a robot that would aid an human operator in the task of loading these rods into the machine. The human will lift the rods from one end while the robot arm holds the other.

2 Main Features

In this section we will describe in more detail the order of operations. The actions are illustrated visually in **Fig. 2**

Activation The robot should stand in an idle state whenever the human is not in the proximity of the bar tray. It should then activate when it detects the human approaching the tray and showing intent to load the feeder.

Recognizing the human's intent The robot should use its camera to recognize when the human is starting to lift one end of the bars (which will be taken an handful at a time) and grab the other.

Matching the human's movements The robot should use its torque and force sensors to respond to the human's movements, moving accordingly to keep the rods level.

Releasing the bars The robot should be able to recognize when the human is releasing the bars into the feeder and do the same before returning to an idle position.

3 Software components

Control We will use an impedance/admittance controller from the FZI repository to control the movement of the robot.

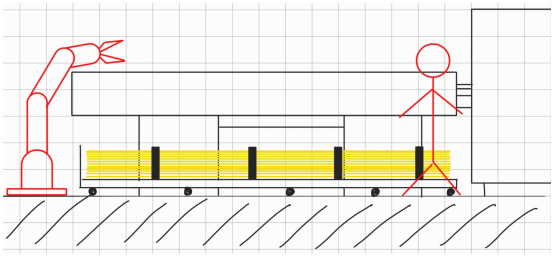
Interaction To second the human movement we will simply monitor the force and the torque on the end effector and operate accordingly.

Safety As stated in the report the robot will have power and force limiting, Speed and separation monitoring, and an emergency stop.

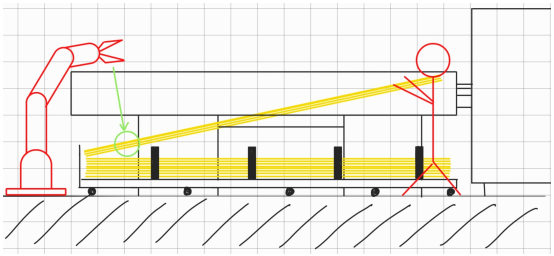
Task Planning The task the robot should perform is easily divisible into discrete phases that should be performed in sequence, so we believe the best approach would be a finite state machine. Hence we consider the use of the yasmin library.

Motion planning The robot would use simple spline interpolation to reach the bars and then switch to compliance.

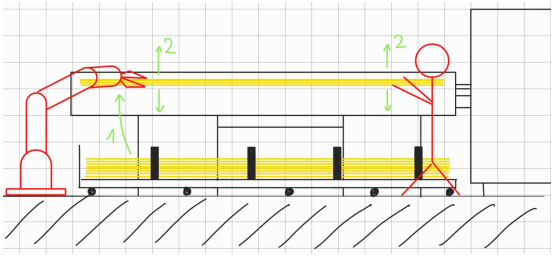
Figure 1: The lathe and the brass bars



(a) Robot idle



(b) Robot recognizing the human intent



(c) Robot following the human

(d) Robot and human loading the feeder

Figure 2: Main features