Taking into account the skill level of an operator in adjusting the level of autonomy of a technical system

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Context

The human-machine interaction is a key point for suitable robot integration. Indeed Human-Robot Interaction (HRI) currently receives considerable attention because humans and robots are more and more cooperating in many fields (transport, agriculture, industrial field…). For this purpose, having an efficient repartition task between the human and the robot, both seen as agents, seems important. An efficient repartition could be a dynamic repartition based on the skills of agents regarding the task. The convergence of automated fields together with human sciences allows an adaptation of the machine to the human activity, a leverage of human skills and capacities, and an answer to the human failure. At the moment humans and robots are two entities which can act autonomously and flexibly.

Research question:
❖ *How can they cooperate, while considering the respective performance of each other in a dynamic way ?*
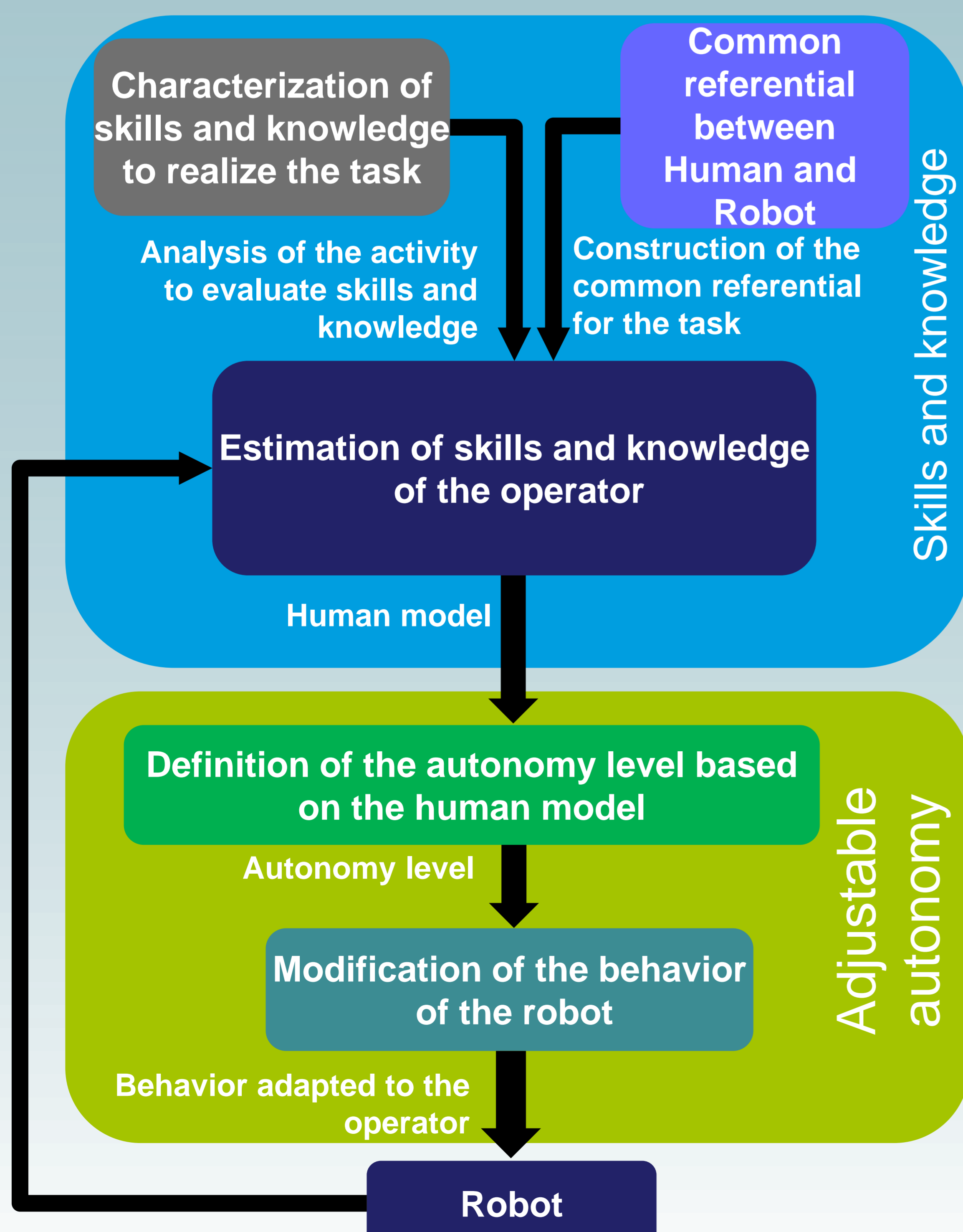
Elements of language:
The activity is the realization of the task based on the skills of the operator. The performance ensues from the activity. When humans and robots are cooperating, the performance is impacted by the autonomy of each agent.

Scientific questions:
✓ **With the analysis of the activity of an operator, can we define his level of skills and knowledge regarding the task?**
✓ **How can they a priori and dynamically with an automated process be assessed ?**
✓ **How can we adapt a priori the behavior of a robot to the estimated level of skills and knowledge?**

Method

Characterization of skills and knowledge to realize the task

Common referential between Human and Robot

Analysis of the activity to evaluate skills and knowledge

Construction of the common referential for the task

Estimation of skills and knowledge of the operator

Human model

Skills and knowledge

Definition of the autonomy level based on the human model

Autonomy level

Modification of the behavior of the robot

Behavior adapted to the operator

Adjustable autonomy

Robot

Characterization of skills and knowledge to achieve the task:
➢ Knowledge about technology and task
➢ Know how to realize the task
➢ Know how to cooperate with the robot
➢ Situations awareness of the operator
➢ Trust in the robot and himself

Common referential between Human and Robot:
➢ Robot capacities to realize the task
➢ Indicators to compare robot capacities and human skills
➢ Construction of patterns

Estimation of skills and knowledge of the operator:
➢ Analysis of the activity of the operator
➢ Estimation of the indicators used in the common referential
➢ Comparison with the pattern
➢ Determination of operator model

Definition of the autonomy level based on the human model:
➢ Autonomy level defined according to the autonomy of the robot
➢ Definition of the autonomy level depending on human model

Modification of the behavior of the robot:
➢ Activation of the robot functions based on the autonomy level
➢ Adaptation of the function based on the human model
➢ Interaction adaptation to improve the performance

Current works:

Analysis of the activity of an operator when achieving a picking task in complex situations . As a first step, this analysis is made with image processing to create indicators. Then, the previous indicators will be transposed to the robot capacities. This work is implemented on ROS.
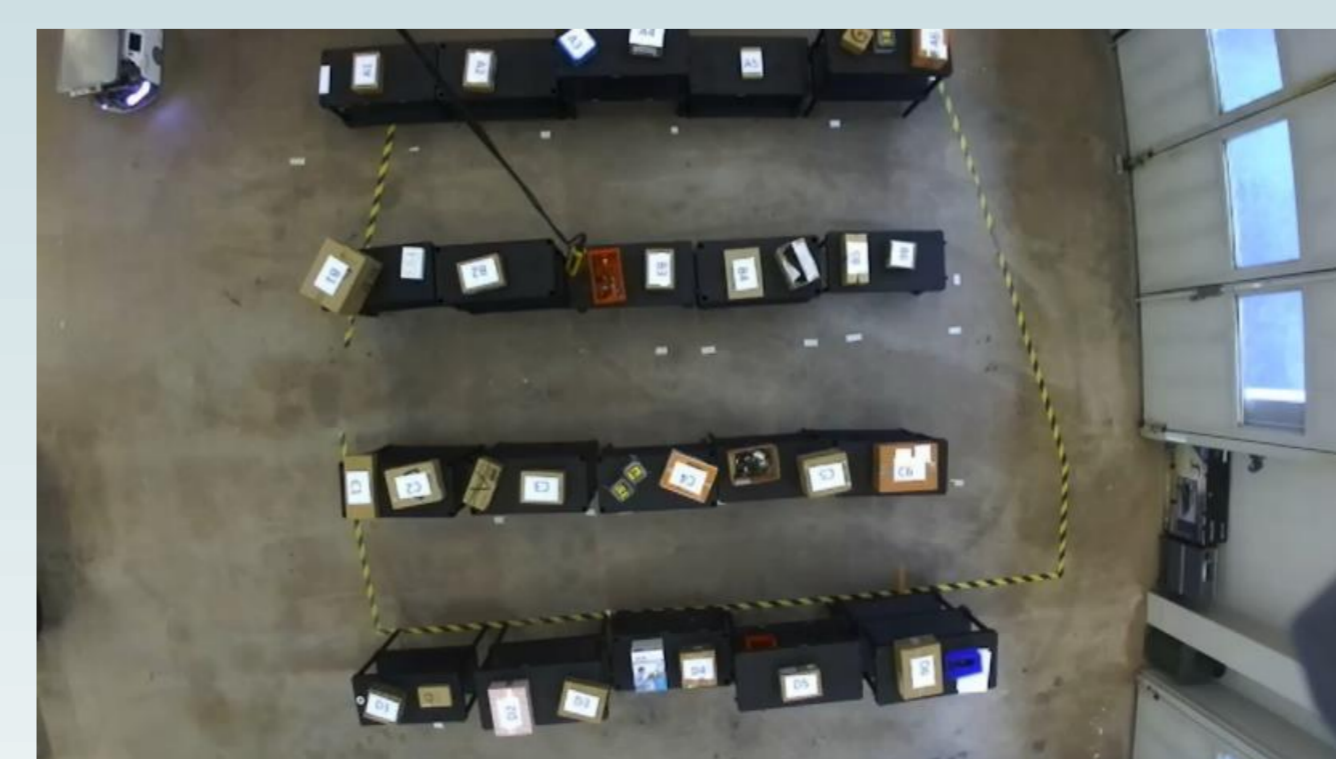
Picture of the picking area

Robot used for experimentation