

Being safe around collaborative and versatile robots in shared spaces

Case story:

Domain: Manufacturing

From award project: Verification Simulation Tool for Safety

Project beneficiaries: Light and Shadows, GROUPE PSA

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1 Overview

Human-robot collaboration is a technology that disrupts industries at every step of the value chain and is becoming an increasingly important strengthening factor or the innovation capabilities and productivity of factories. This raises new opportunities, but also new challenges.

In this context, safety strategies require several design iterations to reach a tradeoff between productivity and safety. The risk evaluation process is time consuming and complex. Integrators and end-users would benefit from a risk assessment toolkit that facilitates the certification of cobots installations.

The background for this project were to use virtual reality technologies and physical simulation to make it possible to address the work with risk assessment to earlier project stages. The project was centered around a use case provided by GROUPE PSA, illustrating an engine assembly scenario with a cobot, placing the human at the core of design processes thanks to VR technologies.

Successively, GROUPE PSA adopted it for other applications and generalized its use to the entire production chain.

2 Challenges

Traditional workstations with robots are typically designed and built at the integrator company and hereafter installed at the end-user facility. It is a plus that the running production is not disturbed, but it is a minus that risk related to missing or underspecified requirements or unforeseen challenges in the production environment are not discovered until very late. That can in some cases generate unnecessary extra costs and safety related modifications.

Therefore, many companies want to implement a more agile strategy where safety analysis is performed from the design phase, allowing design iterations to get the suitable cobotic workstation, providing both functionality and safety.

The challenge and the path taken in this project is to reinvent and modernize work methodologies by implementing a preview and risk analysis of the workstation upstream, from the 3D models of the project and using immersive technologies.

The standardization community are starting to embrace closer human robotics collaboration. With ISO/TS 15066:2016 we have pain limits associated with transient and quasi-static contact scenarios that may arise from robot applications.

The project has used the limit values and the math of ISO/TS 15066:2016 to provide physical models of which forces a virtual operator would be met with if getting in contact with the robot.

3 Solution

Therefore, Light & Shadows developed a solution which allows building of a virtual replica of the workcell. CAD drawings of the cell and the robotic tools can be imported and collected in a scene. On top of that it is possible to implement safety strategies and simulate collaborative robot behavior and safety parameters.

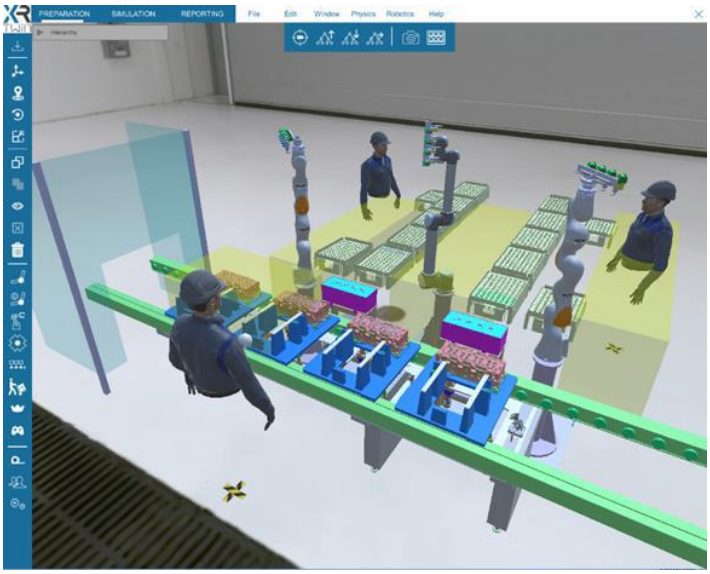


Figure 1 Example of a robotics cell with imported CAD drawings and simulation of moving robots

The end user is immersed in a simulation of a scenario, in virtual or mixed reality. Not only will the software allow operators to become familiar with the interactions between humans and robots in a realistic training environment, but also to assess risks in a safe environment by providing safety analysis tools and reports.

A physics engine, called XDE, is used for simulating of object trajectories, forces and distances is based. This realistic, yet virtual, experience makes it possible to anticipate and simulate robot movements to estimate the dangers of collisions with the operator, but also to ergonomically analyze the operator's postures.

The aim of the software is to lower the barrier for integrators, end-users and employee representatives to comply with the requirements of ISO10218-2:2012 and ISO/TS15066:2016. It is now possible to deal with application standards required to guarantee safety assurances: the adequate distance between robot and human, the maximum safe speed and force of robot movements.

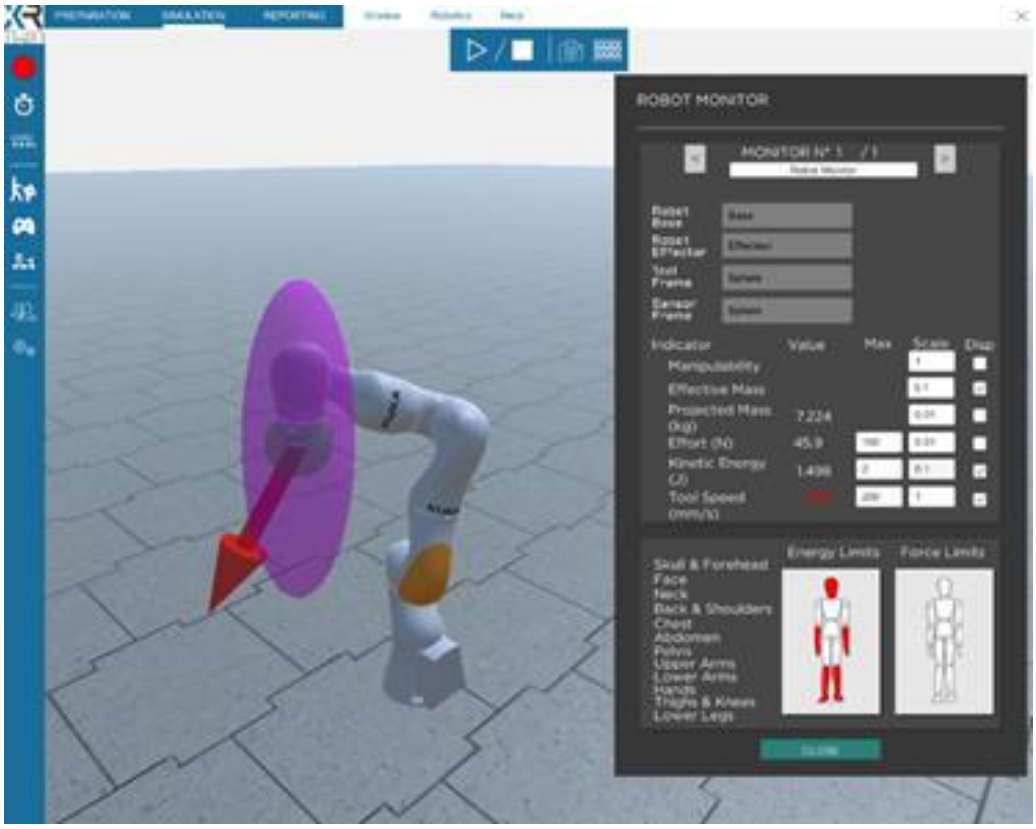


Figure 2 Example of body regions which would be subject to pain (shown in red) if hit by the moving robot

4 Considerations

The project provides a foundation of the human-robot interaction design methodology and is a concrete reference for industry wishing to solve their digital innovation and transformation needs.

The change in mindset from the late risk assessment to an early can be supported by tooling. The technology is adaptable to various industries and sectors such as aeronautics and all companies that produce parts in general, and for different purposes, whether for training or communication.

As the area of collaboration between man and robot becomes more unified, virtual reality and mixed reality are part of the solutions that will break down the barriers of this interaction. This will help to support the objectives of industrial companies in their strategies to reduce risks and optimize the design of workstations for flexibility, efficiency, productivity, and agility.