

SUMMARY

The industry grows day by day, and new solutions are becoming more and more accessible and cheaper, opening up new paths for development in digital manufacturing. Two of the pillars of Industry 4.0 discussed in this work, Augmented reality and Digital Twins, have shown their immense potential to change the future, especially being combined. Having a massive impact on the industry, enhancing systems, making them more efficient, changing the perception of robot and human interaction, and introducing innovative ways for robot control.

The application proposed in this work served the purpose of improving Motoman GP8 AR UI by adding more functions, such as introducing a new joint panel for direct joint change, adding indicator cues to easily identify which joint user is using and introducing speed control which enhances accuracy and efficiency in robot manipulation using this specific interface. Nevertheless, this work's main task consisted of integrating the Omron TM5-900 robot desktop-based application into AR, adding new interactable UI and functions, creating similarities between the two robots' UIs, and finally integrating the two interfaces in one application. The two interfaces share several functionalities, which makes the concept the same; however, the developed solution throughout the work was dependent on two different robot control interactions, pressable buttons and sliders. Future works will investigate UI interaction efficiency and test them.

The unified application, which is a merge of two Unity3d projects, is one of the first solutions on the market, allowing two robots to be controlled in one scene without any effort from the user; it is an innovation which leads to higher standards; it can serve a purpose in complex systems requiring two robots for the job. All these solutions mentioned above show the system's advantages and create room for future improvement, from choosing more efficient control methods and adding different new functionalities UIs, to the inclusion of new robots in the application, which would lead to improvement of the more complex system requiring multiple robot efforts.

Eventually, developed solutions lead us to a universal way of robot control. The control methods and UI functions can be applied to any robot, giving a boost for development and maximising the system performance by using robot features as advantages and adding

relative functions according to features, which will expand the scope of the developed system.

To sum up this thesis, the proposed solution has the potential to improve efficiency and user experience in different applications in the industry. The proposed AR solutions are easy and direct, as they adopt gesture manipulation input and natural user interface methods. Different sized companies in the robot industry have already approached these solutions, and the number tends to grow in the future, further developing existing methods and optimising robot and human interactions.