THE IMPACT OF AUTOMATION ON QUALITY AND PRODUCTIVITY IN THE SANDING OF CURVED WOODEN PARTS

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RESEARCH ARTICLE

Abstract
The use of Fanuc robots in the automated sanding process of wood products provides a number of important advantages. First, their high precision allows for uniform finishes that comply with strict technical specifications, thus reducing the scrap rate. Second, the automation of the process contributes to increasing productivity by shortening cycle times and eliminating pauses caused by human error or incorrect positioning of parts.

Keywords: Fanuc, CNC, wood, wood sanding
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INTRODUCTION

The automation of the sanding process of wooden seats and backrests, whether laminated or solid, was implemented based on a careful analysis of the production volume required within the enterprise. The comparison of the automated processing capacity with that of the previously used manual process was taken into account. The automation was designed to streamline production times, reduce human errors and ensure consistent finish quality, thus meeting the productivity and competitiveness requirements of the woodworking factory. (www.finewoodworking.com, www.pro-cnc.ro

MATERIAL AND METHOD

FANUC machines are renowned for their reliability and performance in the field of industrial automation. They are widely used in various industries due to their high precision, energy efficiency and ease of use.

One of the main advantages of FANUC machines is their high reliability, thanks to high-quality components and advanced control technologies. These equipments are designed to operate non-stop, with a long service life and minimal maintenance requirements. FANUC also offers advanced automation solutions, including industrial robots, CNC machines and control systems. These allow for easy integration into production lines, increasing productivity and reducing errors. One of the main disadvantages is the high initial cost. FANUC machines are more expensive compared to other automation solutions, which can be a challenge for small companies or those looking to optimize their budget. More than a simple technological process, this approach reflects the principles of Industry 4.0, in which each piece of equipment becomes a connected component, capable of actively contributing to optimizing flows, reducing costs and increasing quality.

In this context, automation not only replaces manual work, but also redefines the way production is thought and organized, opening up new perspectives for sustainability, traceability and operational efficiency. The grinding process, from a programming point of view, is divided into several subprograms that are called one after the other by a main program. (Ganea, 2000, Ganea., 2009, Derecichei 2013, Derecichei. et al., 2016, Derecichei L. et al., 2018).

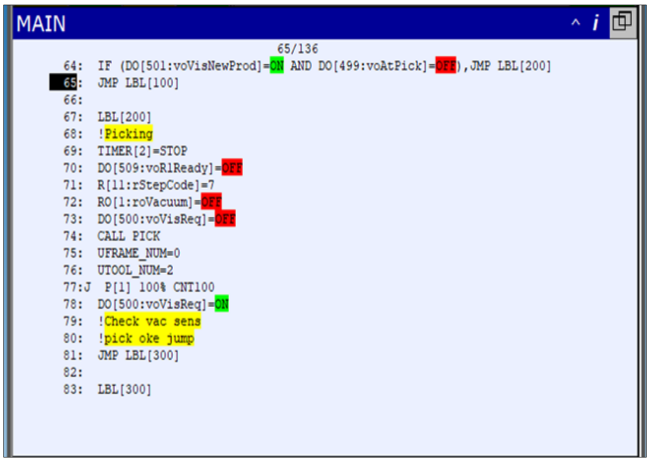

Figure 1 **FANUC robot program_1** (woodworking company, 2025)

RESULTS AND DISSCUSIONS

In this regard, taking into account the number of parts processed / exchanged manually (2000-2500 pieces/7 hours), approximately 320 parts/hour, as well as the various sizes, shapes and weights of the parts, a number of two FANUC robots, model M-10iA/12, were chosen, a robot with 6 degrees of freedom, with a payload of 12 kg, as well as a reach of 1420 mm (figure 2).

Robot programming is done in a language developed by FANUC, TP (teach pendant programming language), which allows, in a simplified way, the transmission of movement/control instructions to the robot via the programming interface. (Derecichei L. et al., 2019, Derecichei et al., 2020).

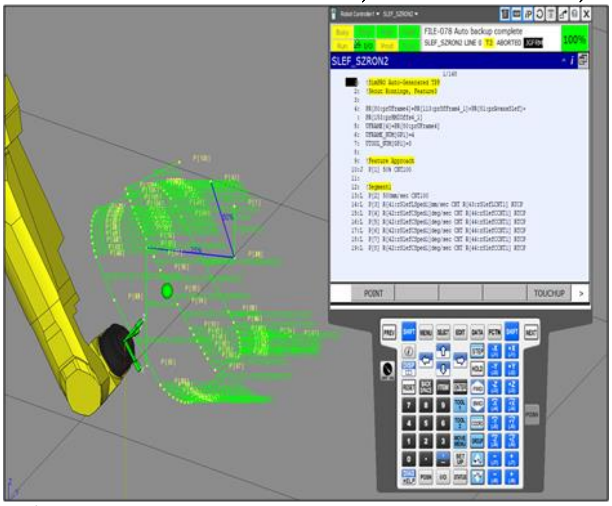

Figure 2 **FANUC robot program_2** (woodworking company, 2025)

Having the 3D CAD drawings of the parts to be processed available, the trajectory of the robots for their grinding could be automatically generated using software developed by FANUC, ROBOGUIDE (for PC/laptop), software that closely simulates the real robot with the virtual one, making the process of taking/memorizing the positioning points of the robots a less laborious and more precise process (figure 3).

As an organization of the grinding cell, a number of three lanes was agreed to serve the automated grinding process. Thus, a central lane was allocated for feeding the parts intended for processing to the robots, by means of an operator, and two lanes for evacuation, used alternatively depending on the part intended for processing. Additionally, a number of three photocells were used at the ends of the lanes, to stop the parts either under the robot positioning chamber on the central lane, or to stop them from falling from the two evacuation lanes. (Lucaci et al., 2016, Lucaci, et al., 2024).

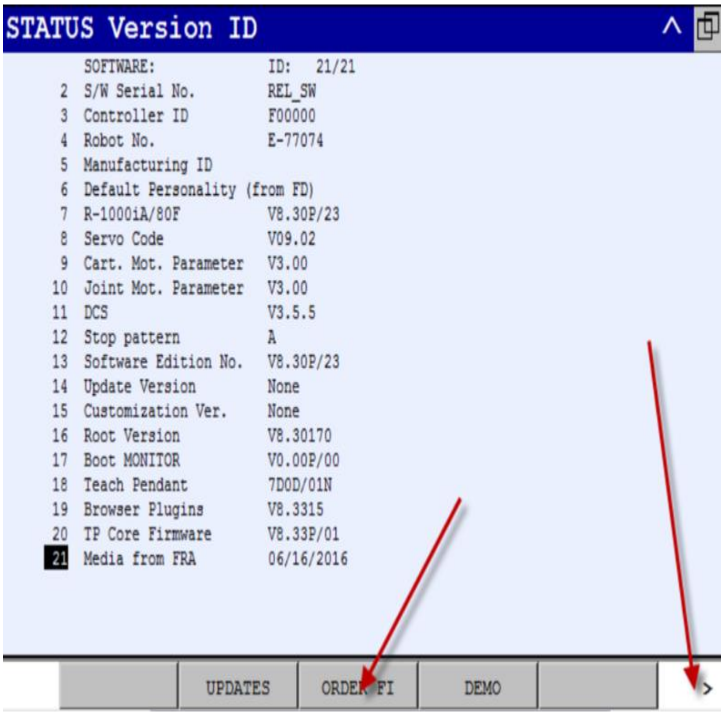

Figure 3 **FANUC robot program_3** (Fanuc, docs.pickit3d, 2025)

Also, to facilitate the start-up of the robots, the selection of parts and the start of the production process, a human-machine interface (HMI) was chosen. This allows the operator to access the functions listed above, in order to carry out his work in the most accessible and simple way possible within the automated grinding cell. (Derecichei L. et al., 2018, Derecichei et al., 2020, www.popularwoodworking.com)

Regarding the central strip pick-up process, FANUC's iRVision 2D software package (together with the compatible camera) intervenes, which ensures correct pick-up and compensation, in case of differences from the initially learned pick-up point, to ensure an accurate grinding trajectory of **the reference.**

An infrared ringlight lighting system and an infrared light filter were used to pick up the part to eliminate as much natural light as possible.

The system calculates the position of the part by providing the X, Y position and the rotation around the Z axis (up/down), it cannot provide information about the height of the part or the rotation around the X or Y axis. (Derecichei et al., 2022, Derecichei et al., 2023)

In the case of backrest-type parts, the system may have problems correctly recognizing the X and Y values if the rotation in space of the part is greater than 90 degrees compared to the learned model - example the images (figure 4, 5):

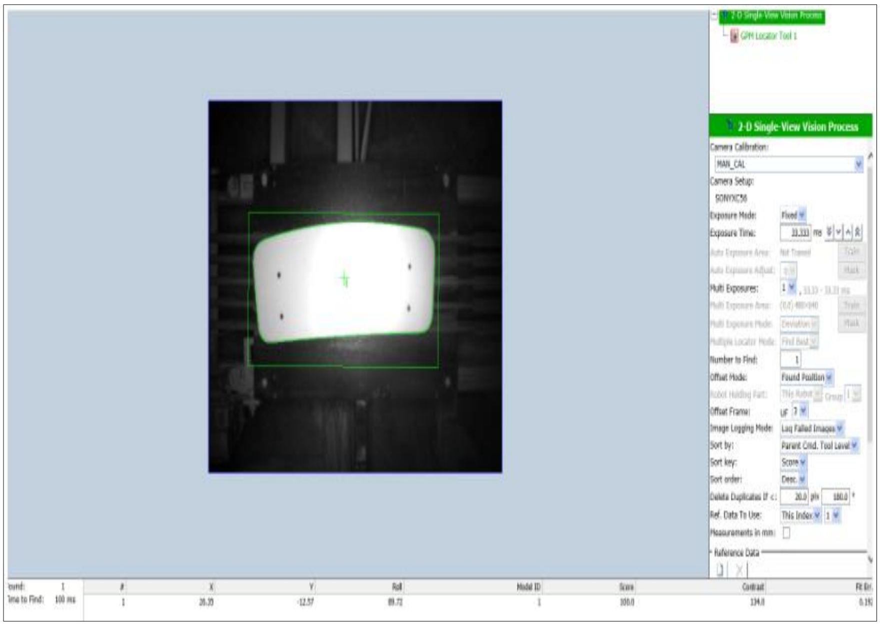

Figure 4 **FANUC robot program_4 (woodworking company, 2025)**

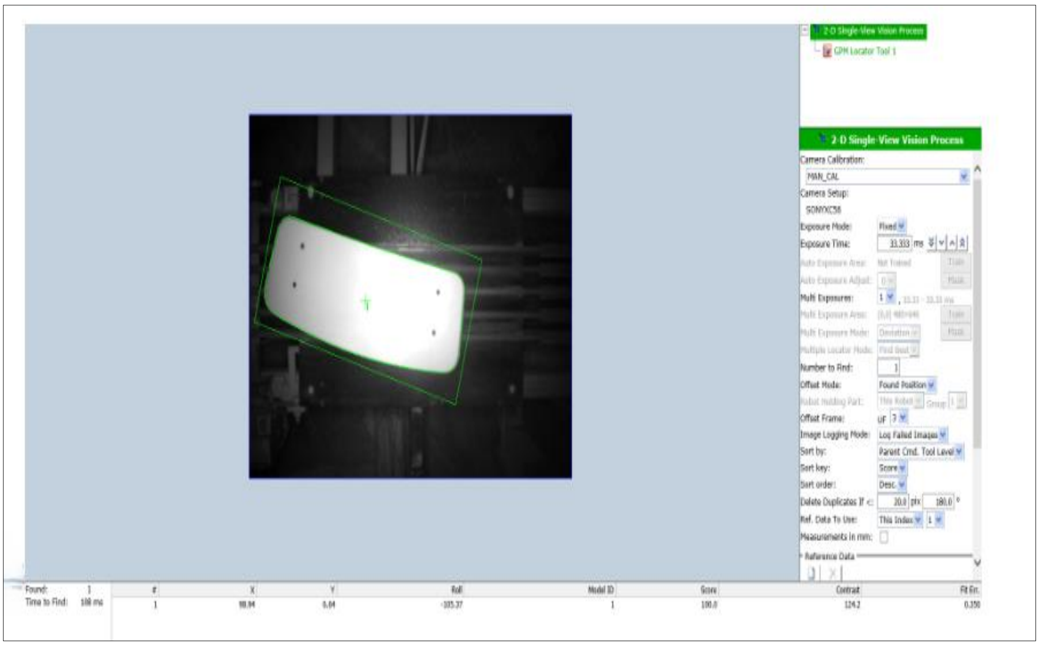

Figure 5 **FANUC robot program**_5 (woodworking company, 2025)

CONCLUSIONS

Development of adaptive optimization algorithms for the grinding process, which analyze in real time the brush wear or the pressure exerted on the part, automatically adjusting the working parameters.

Integration of IoT and Industry 4.0 technologies into automatic grinding systems, for remote monitoring of the entire production line and predictive interventions on equipment.

Analysis of the economic and ecological impact of automation, in order to reduce energy consumption, minimize the waste of abrasive materials and improve the sustainability of the production process.

Testing new environmentally friendly abrasive materials, compatible with industrial robots, to support the transition to a more environmentally friendly industry.

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