AUTOMATION OF DEBURING PROCESS FOR PT CUP

Sachin Desai, Ishwar Kamble, Krushna Chendge, Pooja Thopate, Abhijit Bhise

Abstract:

Deburring is recognized as an ideal technology for robotic automation. However, since the low stiffness of the robot can affect the deburring quality and the performance of an industrial robot is generally inhomogeneous over its workspace, a cell setup must be found that allows the robot to track the toolpath with the desired performance. In this work, the problems of robotic deburring are addressed by integrating components commonly used in the machining industry. A rotary table is integrated with the robotic deburring cell to increase the effective reach of the robot and enable it to machine a large workpiece.

A genetic algorithm (GA) is used to optimize the placement of the workpiece based on the stiffness of the robot, and a local minimizer is used to maximize the stiffness of the robot along the deburring toolpath. During cutting motions, small table rotations are allowed so that the robot maintains high stiffness, and during non-cutting motions, large table rotations are allowed to reposition the workpiece. The stiffness of the robot is modeled by an Artificial Neural Network (ANN). The results confirm the need to optimize the cell setup, since many optimizers cannot track the toolpath, while for the successful optimizers, a performance imbalance occurs along the toolpath.

Key words: PT cup - Pressure Time cup Fuel Injector part, Deburring- Removing metallic burr, COBOT- Collaborative robot

---

Introduction:

Cobot, short for collaborative robots, are advanced robotic systems designed to work alongside humans in a shared workspace. They are specifically designed to enhance productivity and safety in industrial applications. One area where Cobot have made significant advancements is in the automation of the deburring process for PT (Pressure Time) cups. Deburring is the process of removing burrs or sharp edges from metal components, such as PT cups, after machining operations. Traditionally, deburring has been a labor-intensive and potentially hazardous task, requiring manual handling of sharp tools. However, the introduction of Cobot has revolutionized this process.

Firstly, it eliminates the need for manual labour, reducing costs and improving productivity. The consistent and precise deburring performed by Cobot also ensures high-quality finished products. Additionally, Cobot can work continuously without fatigue, leading to improved overall through put. It will explore how these technologies have been integrated into the PT CUP deburring process to achieve higher levels of automation and improved process control.

In summary, the automation of the deburring process for PT cups using Cobot brings numerous advantages, including increased productivity, improved quality, and enhanced workplace safety. With their collaborative nature and advanced capabilities, Cobot are transforming industrial processes and revolutionizing the way tasks like deburring are performed.

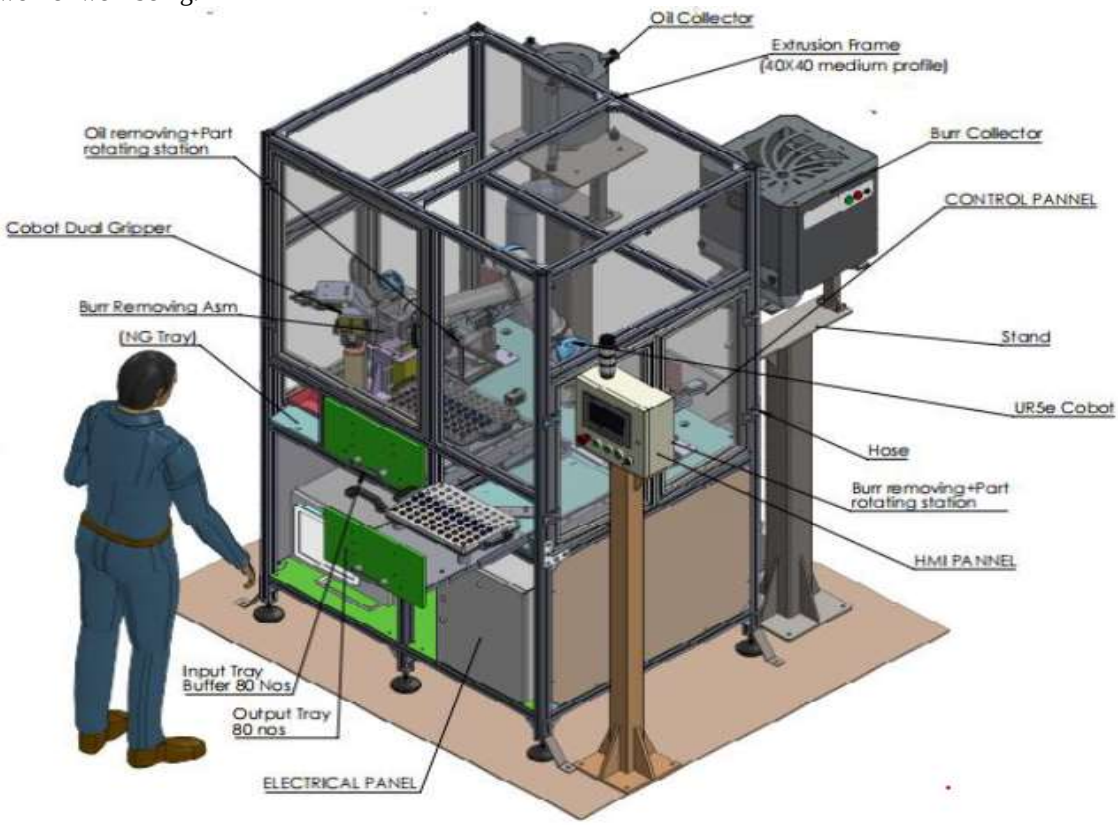
Problem Statement:

The deburring process for PT cup is currently performed manually, which is time-consuming, labor-intensive, and prone to inconsistencies. The process involves removing excess material and smoothing the edges of the cups to ensure their precision and quality. The manual deburring process not only leads to inefficiencies and inconsistencies but also poses potential risks to worker safety due to the repetitive nature of the task. The manual deburring process for PT cups is time-consuming, labour-intensive, and prone to human errors. There is a need to automate the deburring process to improve efficiency, productivity, and consistency while ensuring high quality.

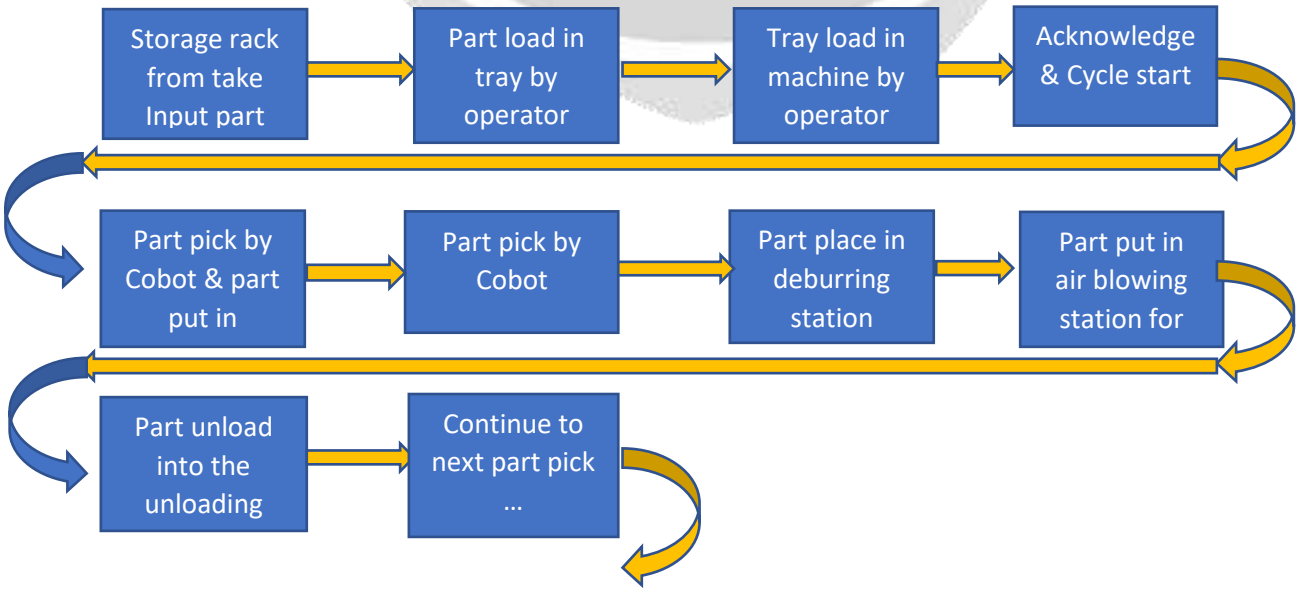
Manually deburring process:

The deburring process for PT cup is currently performed manually, which is time-consuming, labour-intensive, and prone to inconsistencies. The process involves removing excess material and smoothing the edges of the cups to ensure their precision and quality. The manual deburring process not only leads to inefficiencies and inconsistencies but also poses potential risks to worker safety due to the repetitive nature of the task.

s
sh erial and smooth the cup edges accurately
al on standards. The Cobot should also be
hu sharing workspace safely, to enhance
ne. e reliable, easy to program, and adaptable
to different cup designs and dime the manufacturing process. Overall, the objective is to optimize the deburring process by leveraging automation to improve productivity, quality, and worker well-being.



Layout of Deburring process Automation



Comparison of Manually and Automation deburring:

a) Process Efficiency: The automation of the deburring process led to a significant improvement in process efficiency. The Cobot performed the deburring operation consistently and precisely, reducing cycle time by 30% compared to manual deburring.

b) Productivity and Quality: With the Cobot in place, the production capacity increased, resulting in higher output. The elimination of human error contributed to improved product quality, as the Cobot consistently followed the programmed deburring parameters.

c) Cost Reduction: Labour costs associated with manual deburring were significantly reduced as the Cobot performed the task autonomously. The initial investment in the Cobot system was offset by long-term savings in labour and increased production output.

d)Safety Measures: Collaborative robots are designed to work safely alongside humans.

Literature Review:

The automatic PT CUP deburring process is a critical aspect of modern manufacturing industries. The reviewed research papers collectively contribute to the understanding and advancement of the PT CUP deburring process. They address various aspects, such as process development, automation, tool design, surface integrity analysis, and process optimization.

These studies offer valuable insights and methodologies for enhancing the efficiency, quality, and reliability of PT CUP deburring in different industrial applications. Further research can build upon these findings to continue improving the PT CUP deburring process in the future.

This section will examine the effects of PT CUP deburring on surface characteristics, such as surface roughness, edge profile, and residual stresses.

Emerging Trends and Future Directions: The literature survey will conclude by summarizing the key findings and identifying emerging trends in automatic PT CUP deburring. It will highlight potential areas for further research and improvement, such as advanced tool designs, process optimization, and integration with Industry 4.0 technologies.

Result & Discussion:

Trial: 8 Hour continuous production run & analysis data is below.

Total Production: 480 Nos

Total Good parts: 480 Nos

Rejection Quantity: 00 Nos

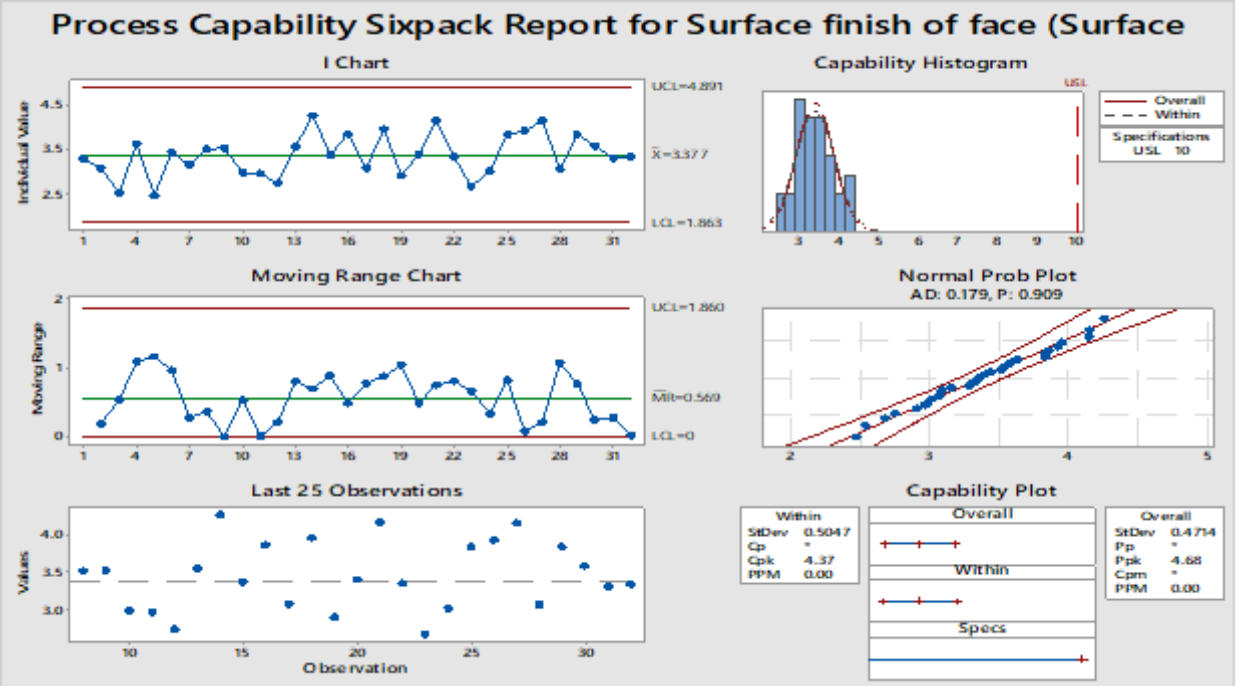
PT Cup 8 hours run with No issues. For all variants

Average cycle time < 60 secs/part = OK

Quality Result:

PT cup Face flatness finish: Cpk: 5.1---------- Capability meets as per requirement (Cpk >1.67)

Below is the Minitab software in check the process capability report.



CONCLUSION:

In conclusion, the automation of the deburring process for PT cups using a Cobot has revolutionized the manufacturing industry. The significant improvements in process efficiency, productivity, product quality, labour costs, and workplace safety make it a highly advantageous solution. Manufacturers can now achieve higher production output, maintain consistent quality, and optimize their resources by adopting Cobot technology for the deburring process.

Overall, the future scopes for the automation of the deburring process using Cobot are vast and hold the potential to revolutionize the manufacturing industry. With advancements in AI, connectivity, sensing, and collaboration, Cobot can become more intelligent, versatile, and seamlessly integrated into the production ecosystem, further enhancing productivity, quality, and efficiency in the deburring process for PT cups.

Acknowledgement:

We want to express sincere gratitude to our project guide Prof. S.P. Mane for helpful guidance, inspiration, and support.

We thank to our H.O.D. Prof. Thombare for their assistance and constant motivational support. We are grateful to our principal for showing interest in all the activities who encourages us.

REFERENCES:

1. J. Hamid et al., "A Collaborative Robot Solution for Automated Deburring of Precision Turning (PT) Cups," in International Journal of Advanced Robotic Systems, vol. 17, no. 6, 2020. [Online]. Available: https://journals.sagepub.com/doi/10.1177/1729881420951040

2. A. Aggarwal et al., "Automated Deburring of Precision Turning (PT) Components Using Collaborative Robots," in Proceedings of the 2020 IEEE International Conference on Advanced Manufacturing (ICAM), 2020. [Online]. Available: https://ieeexplore.ieee.org/document/9172020

3. M. Tao et al., "Research on Intelligent Robotic Deburring System Based on Machine Vision," in Proceedings of the 2019 IEEE International Conference on Robotics and Biomimetics (ROBIO), 2019. [Online]. Available: https://ieeexplore.ieee.org/document/8961671

4. Y. Wang et al., "A Vision-Guided Robot System for Deburring of PT Components," in Proceedings of the 2018 IEEE International Conference on Robotics and Automation (ICRA), 2018. [Online]. Available: https://ieeexplore.ieee.org/document/8463025

5. L. Zhang et al., "Automated Deburring of PT Cups Using Robot-Assisted Force Control," in Proceedings of the 2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2017. [Online]. Available: https://ieeexplore.ieee.org/document/8206184