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MACHINE TENDING USING COBOT

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ABSTRACT:

In a manufacturing facility, the process of automating the loading and unloading of industrial machine tools is referred to as "machine tending." Robot automation systems are typically used in this process. Although loading and unloading are the main responsibilities of machine tending systems, the robot frequently handles other crucial tasks that are essential to the automation system, such as part inspection, blow off, wash, deburring, sorting, packaging, and measuring.

Machine manufacturing industries underwent a change with the introduction of CNC machine tools. Because of these machines' exceptional productivity, production increased by two and three times. As CNC machined parts were more consistent than hand machined ones, rejection of machined components significantly decreased. Automation of CNC machines came next.

Key words: Machine Tending, industrial machine tools, part inspection, deburring.

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1. INTRODUCTION

Today's machine tending requires cobots, or collaborating robots. The most common application of cobots in manufacturing automation today is machine tending, a sector that is constantly growing. Collaborative robots, often known as "cobots," are innately capable of working with humans as opposed to traditional industrial robots, which replace workers. Consider the goals of your automation project initially. Do you primarily need cobots to support your agents when working on more difficult parts, free up your machining operators, or increase the productivity of your continuous machining operations? These goals can subsequently be used to guide your selection of cobot models or machining kits. There are various things to take into account, such as:

- Increase your capacity given your workplace's design.
- The component weight and consequent necessary robot burden.
- Specifically, designed precision grasping for the form of your components...
- The programming, ease of implementation, and safety characteristics could also be important to focus on.

The cobot and end effector you select will depend on how significant you consider those attributes to be.

Machine tending is the act of a human worker inserting a component into a machine to complete a task. The worker then removes the finished product and places a fresh component in its place. Due to the repetitive nature of the tasks, not only does this squander a great deal of time that could have been spent more productively, but it also increases the risk of injury.

Cobots work with humans in a range of robotic machine tending applications for quick production changeovers and increased accuracy. Humans are no longer required to perform dangerous, monotonous tasks. They can use their skills to complete jobs that add value and provide quality control instead by incorporating CNC machines.

The CNC machinery used two different programming languages: G-code and M-code. The most well-known of the CNC programming languages, general or geometric code (also known as G-code), controls when, where, and how machine tools move—for example, when to switch on or off, how rapidly to travel to a certain spot, what paths to take, etc.

2. COBOT

Compared to earlier versions in the JAKA Zu line, the JAKA Zu 12 can manage a payload of 12 kg and a working radius of 1327 mm. It can work continuously for 50,000 hours on laborious chores that would need at least two humans to perform.

The JAKA Zu 12 has an exceptional repeatability of 0.03 mm and is dependable and accurate due to its 6-axis design. It may be installed at any angle, including vertical, horizontal, and any angle in between, and is quite light for such a high payload. It is ideal for application in a variety of fields, including food packaging, advanced manufacturing, the fabrication of home appliances, the automotive and auto parts industries, and advanced manufacturing.

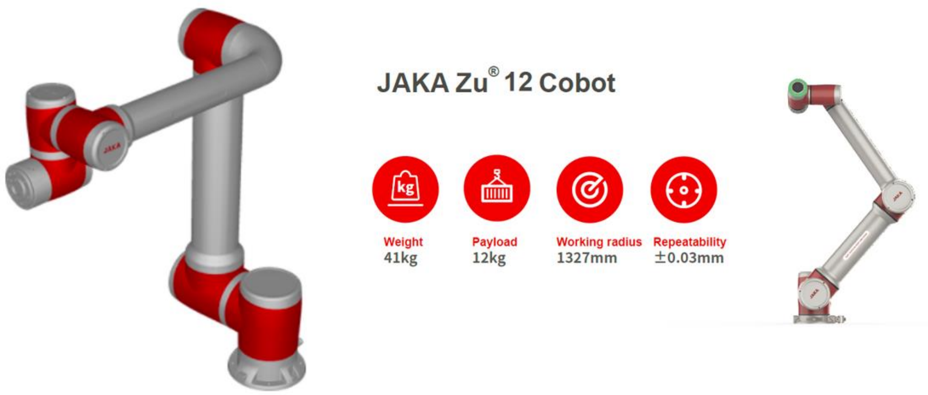

Fig. 1. Cobot

3. CONTROLER

- 16 digital inputs, 16 digital outputs, and 2 analogue inputs or outputs are included in the IP44 Tool I/O specification.
- 24 V for I/O Power.
- Modbus TCP, Modbus RTU, and TCP/IP communication.
- 100–240 V AC, 50–60 Hz power.
- Dimensions: 410 x 307 x 235 (mm) (W x H x D) Package Dimensions 600 mm (L x W x H) x 325 mm 12-kg weight Stainless steel is the substance.

4 COBOT IN MACHINE TENDING PROCESS

The robot that was used, the control system, the application, the goals, the major findings, and the recommended future work for all of these investigations were all studied. For the following reasons, these were picked. The selection of the robot is crucial since it reveals which systems are successfully used in collaborative applications. Given that it determines the task's performance and safety requirements, the control system is an intriguing object of analysis. Additionally, when a human is involved in the control loop, the control system choice is unique to the way in which human-machine interaction is carried out. By observing which approaches are more widely used and successfully implemented, we can spot trends and future directions. In our classification of control systems, we distinguished between vision systems (which include cameras and laser sensors), position systems (which include encoders, which are typical of classic industrial robots), Audio systems (connected to voice command and utilized for voice/speech recognition), impedance control systems (via haptic interfaces), admittance control (making use of the cobot torque sensors or voltage measurement), and other systems (that were not easily classified, or that were introduced only in one instance).

The programmer serves as a representation of the cobots task, which, in our opinion, aids in a better understanding of the possibilities of collaborative robots. These tasks were broken down into three categories: assembly (where the cobot works alongside the operator to complete an assembly process), human assistance (where the cobot provides the operator with ergonomic support, such as moving fixtures or performing quality control using vision systems), and machine tending (where the cobot completes loading and unloading tasks).

Additionally, we separated the goals into three main areas: productivity, which represents studies focused on task allocation, quality improvement, and cycle time reduction; safety, which includes not only strictly safety-related topics like collision avoidance, but also an increase in human ergonomics and reduction of mental stress; and HRI (Human-Robot Interaction), which is focused on the development of new HRI methodologies, like voice recognition. It should be highlighted that the suggested subdivision is in no way absolute; these works were regarded as safe since, despite maintaining a high level of production, they adhere to HRC safety.

5. PROPOSED SYSTEM ARCHITECTURE

Clarifying the scope and purpose of the cobot-assisted machine tending technique is the main objective of this chapter. Machine tending is the process of putting parts and materials on a certain machine and moving them around. People still do many of these responsibilities today. Operators still have control over the majority of CNC equipment, including milling and turning machines. They establish the fundamental materials, maintain the machines, and take out the machined parts. Because it is becoming more and more difficult to find suitable personnel to accomplish it, this job can be completely automated with a cobot. Since the machine and the robot can communicate with one another, the robot knows when to load and unload. As long as there is a source of raw materials, the cobot can function.

The autonomous loading and unloading system at the MTC use pneumatic technology. A single work item could be operated for 90 seconds using the existing human method. 35 seconds are spent machining the work component. For the cobot-equipped component, the loading and unloading of the work piece takes 20 seconds. In the meanwhile, it manages the three CNC machines. As a result, the company's output will increase. Additionally, it reduces the necessity of paying the salaries of new employees. As a result, the machine's overall cost is lower and the system is more dependable. It is simple to install the system at the customer's site. The system is made dependable and safe since it can be stopped at any intermediate condition.

A. *Installation unit*

The project to begin, initial mechanical and electrical setup is made. All parts must be fixed, an input and output table must be present, and an end effector must be present. The electrical setup consists of things like panel wiring, field wiring, and wiring for CNC machines.

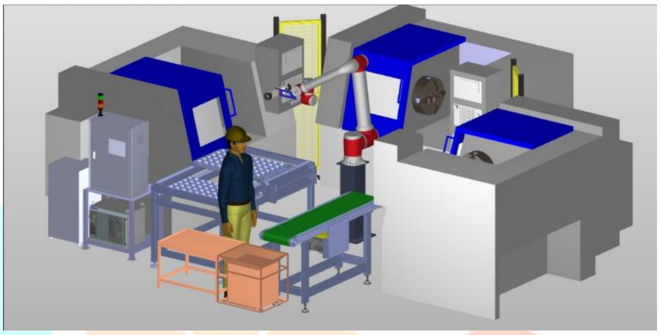

Fig. 2. Installation Setup Design

B. *Program work*

Our main programmer makes advantage of processed data from the cobot and the plc. Aside from data from the CNC, the PLC will also receive all system inputs. Programming must prioritize safety; even with cobots, there are cobot constraints and emergency stops. The cobot is built to work in concert with the CNC machines according to preset rules after the three CNC machines are combined with a plc, which serves as the main programming component. The system should be as user-friendly as possible, according to the programmers. To accomplish this in this, an HMI device is used. Ethernet I/P is the language that devices use to communicate with one another.

C. *Output-*

Our final product shows a cobot operating all three CNC machines quickly and accurately over and over again. Only loading and checking the part are the only responsibilities of a human.

Fig. 3. Output Unit

6. CAD MODELLING OF SYSTEM

Fig. 4. Actual Installation Setup

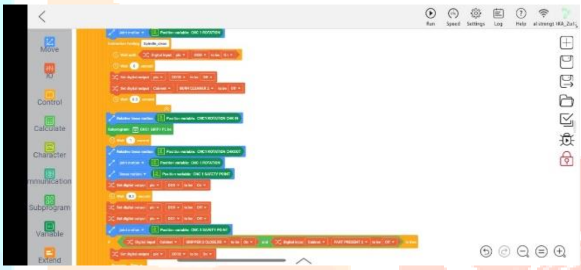

Fig. 5. Sample Cobot Program

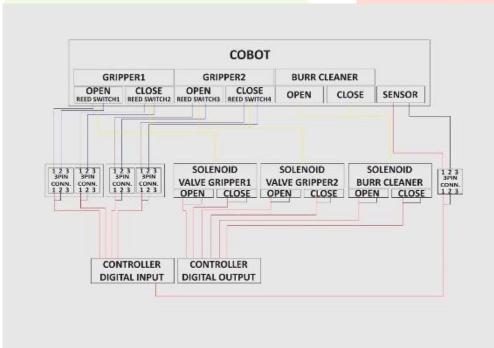

Fig. 6. Basic Program Sketch

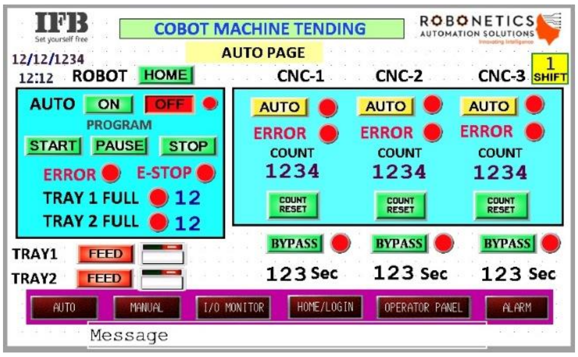

Fig. 7. Sample HMI Design

7. CONCLUSION AND FUTURE WORK

There is currently a different employee working on each CNC machine. In order to circumvent this, we provide a cobot for three CNC machines.

The system is accessible in accordance with client satisfaction. We finished the work ahead of schedule, as planned. The deadline allows for the completion of the work's objective. We were able to finish the specified scope of work with humans in 0.35 percent of the anticipated cycle time.

The autonomous loading and unloading system at the MTC use pneumatic technology. One piece of work could be operated for 90 seconds using the existing human method. 35 seconds are spent machining the work component. For the cobot-equipped component, the loading and unloading of the work piece takes 20 seconds. In the interim, it manages the three CNC tools. As a result, the company's output will increase. Additionally, it minimizes the need to pay higher wages to more employees.

REFERENCES

[1] K.R. Prakash and Sandeep S., "Automation of loading and unloading to CNC Turning Center," International Journal on Mechanical Engineering and Robotics (IJMER), Vol. 1, 2013, P8-P12.

[2] "Productivity Improvements on a CNC Lathe by Automatic loading and unloading of Throttle Valve Component," Rohan Kulkarni, S. Shivakumar, and Roopa K. Rao. Volume 2, Issue 12 of the International Journal of Scientific & Engineering Research, December 2011.

[3] Shivbhadrasinh Jhala, Apurva Indrodila, and R.L. Jhala, "Design and Development of Automation. IJSTE - international Journal of Science Technology & Engineering, Volume 1, Issue 11, May 2015, "Of loading and unloading to DX-100 CNC turning Center".

[4] Central Manufacturing Technology Institute's Machine Tool Design Handbook.

[5] S. Crowe, 2018. Asia is where Universal Robots is growing quickly. 2018-03-12, The Robot Report. accessed on January 27, 2020, visit: https://www.therobotreport.com/universal-robotsstrong-growth-asia/

[6] M. S. Knudsen and J. Kaivo-Oja, 2019. The cobots have finally emerged from their cages. Blogi tutkimuskeskuksen tulevaisuuden. On January 27, 2020, visit: https://ffrc.wordpress.com/2019/11/05/cobots/

[7] ESPAS, a system for analyzing European strategy and policy, 2019. Global Trends through 2030, ESPAS Report 2019. Accessed on January 27, 2020 at: https://espas.secure.europarl.europa.eu/orbis/sites/ default/files/generated/document/en/ESPAS_Report2 019.pdf

[8] B. Halder, 2019. How the "Cobot" Revolution in China might revolutionize automation. Ozy. On January 27, 2020, visit: https://www.ozy.com/fastforward/how-chinas-cobot-revolution-couldtransform-automation/93044/

[9] In 2019, Huang, J., Pham, D. T., Wang, Y., Qu, M., Ji, C., Su, S., Xu, W., Liu, Q., and Zhou, Z. A case study of how humans and robots can work together to disassemble press-fitted parts. Journal of Engineering Manufacture: Proceedings of the Institution of Mechanical Engineers, Part B.

[10] Marvel, J. (2014). An entryway to information on manufacturing automation is collaborative robots. "National Institute of Standards and Technology." On January 27, 2020, visit: https://tsapps.nist.gov/publication/get_pdf.cfm?pub _id=916485

[11] Marvel, J. A., and Norcross, R., 2017. In collaborative robot work cells, speed and separation monitoring is implemented. Robotics and Computer-Integrated Manufacturing, 144–155.

[12] Fast-Berglund, A., Palmkvist, F., Nyqvist, P., Ekered, S., and A Kerman, M. 2016. Cobots are being assessed for final assembly. 44, 175–180 of the Procedia CIRP.