2023

The Potential of the Implementation of Offline Robotic Programming into Automation-Related Pedagogy

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Abstract

In this study, the offline programming tool RoboDK is used to program industrial robots for the automation sector. The study explores the feasibility of using this non-disruptive robot programming software for classroom use; assesses how well RoboDK can be used to program various robots used in the industry; creates and tests various applications; and pinpoints technical obstacles that prevent a smooth link between offline programming and actual robots. Initial results indicate that RoboDK is an effective tool for deploying its offline programming code to a Universal Robot, UR3e. There are many potential for advanced applications. The goal of the project is to utilize RoboDK, the offline robot programming software to respond to the rising need for knowledgeable robot programmers in the automation sector.

Introduction

The industrial sector has seen a considerable transformation thanks to automation technologies, which have utilized robotic systems in places of manual operations. Robots are essential for boosting productivity because they can quickly and accurately do repetitive jobs, freeing up human workers to concentrate on more difficult tasks. Manufacturing processes are made precise, consistent, and effective through automation.

This study intends to inform students about automation's potential and the opportunities it presents across many industrial sectors. State of the art offline programming software, such as RoboDK offer user-friendly interfaces and programming capabilities for smooth integration of robots into industrial operations, enabling businesses to fully reap the rewards of automation.

Methods

To determine the degree by which off-line robotic programming can become apart of pedagogy for fields related to automation in order to adapt to the transition of the increased usage of industrial robots we conducted our research with the intent of investigating if it could be understood and used by students whilst observing how well they could use the software. This was paired with a survey that used a qualitative assessment in order to gauge how their technical skills and knowledge influenced the study as well as how their experience with off-line robotic programming went. Being that RoboDK has shown itself to be an efficient as a universal platform for developing and simulating programs for industrial robots, two undergraduate students studying Mechanical Engineering Technology were tasked with developing at least two programs via the educational version of RoboDK. The machine that was to be simulated and used was the UR3e collaborative robot equipped with a RobotIQ Gripper and Hand-E Wrist Camera. The participants were required to complete the following Universal Robot certifications prior to beginning development: e-Series Core Track, e-Series Pro Track, e-Series Application Track.

They were also provided with RoboDK's documentation for using the software as well as their training videos. The participant's experience over the course of four weeks was be assessed with a qualitative analysis to determine the effectiveness of the software. Setting up a real UR3 robot and integrating its model into the RoboDK program were the first steps towards allowing digital representation and simulation. Additionally imported and specified within the program were square box CAD models. The appropriate movements for the robot were then designed using pick and place trajectories in RoboDK. Simulations were run to verify the robot's movements and enhance overall performance. The software was then tested and analyzed to make sure it was in line with the simulations and to resolve any mistakes or potential improvement areas.

Results

The findings of the study revealed several difficulties with offline RoboDK robot programming. First, faulty grasp planning during execution and erroneous model representation inside the program resulted in collisions, which in turn caused mistakes in the robot's behaviors. Second, the precision and range restrictions on the robot's sensors made it challenging to identify objects and calculate accurate distances, which had an impact on performance

Additionally, there were inaccuracies in the motions and grip of the robot due to calibration inconsistencies between the actual robot and its virtual representation in the software. The precision and dependability of the robot's operations were also influenced by environmental circumstances, such as changes in temperature, illumination, and the presence of impediments. To improve the efficiency and dependability of offline robot programming using RoboDK, these difficulties highlight the need of addressing model correctness, sensor limits, calibration inconsistencies, and environmental constraints.

Industries Utilizing Robots

1. Automotive:

Robots are widely used in assembly lines in the automobile industry to carry out operations including welding, painting, and component assembly. They contribute to increased production efficiency and product quality by facilitating accuracy, speed, and consistency.

2. Electronics:

Electronic gadget manufacture is greatly aided by robots. They work on projects like circuit board assembly, where their exceptional precision and dexterity are essential for precisely putting components. Robots are also used in quality control procedures to test and examine electronic goods, assuring compliance with rigid requirements.

3. Warehousing:

Robots are used in the warehouse industry to streamline picking, packaging, and inventory management tasks. Autonomous mobile robots effectively locate and transfer products as they move around the warehouse. Through automation, operational effectiveness is increased, mistakes are decreased, and order fulfillment is expedited.

4. Pharmaceutical:

In the pharmaceutical sector, robots are becoming a must, especially for operations that call for accuracy and cleanliness. They are used to ensure precise dosage and lower the risk of contamination when performing duties like medicine packing and dispensing. Additionally, robots are used in laboratory procedures to help with sample handling and processing.

5. Food and Beverage:

Robots automate a variety of jobs across the manufacturing and packaging processes in the food and beverage sector, where automation plays a vital role. They handle jobs including packing, sorting, palletizing, and quality inspection, which increases productivity, lowers the need for manual labor, and guarantees a constant level of product quality.

6. HealthCare:

Robots are being used in surgical operations, physical therapy, and patient care in healthcare settings. During minimally invasive procedures, surgical robots provide accurate assistance to physicians, improving surgical results. Patients can do therapeutic activities and restore motor function with the help of rehabilitation robots. Additionally, robots are used in healthcare institutions for logistics, patient monitoring, and drug distribution, which enhances patient safety and healthcare delivery.

Discussion/Conclusion

This study highlights the potential advantages of using RoboDK for offline programming in automation procedures. The study proves that RoboDK's capabilities, especially offline programming, are helpful in increasing productivity and efficiency. One standout feature is the seamless integration attained by offline programming, which minimizes downtime and enables effective use of robot capabilities. In order to effectively capitalize on the benefits of automation across a variety of industries, it underlines the necessity of ongoing study and development in the fields of collaborative robotics and offline programming. With more time, it'd be possible not only better prepare participants so they can use RoboDK to develop more complex programs but expand upon the participants as well to conduct better observations.

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