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Robotic Arm-Automated Spray Painting with One-Shot Object Detection and Region-Based Path Optimization

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Abstract : Painting plays a crucial role in the aerospace manufacturing industry, serving both protective and cosmetic purposes for components. However, the traditional manual painting method is time-consuming and labor-intensive, posing challenges for the sector in achieving higher efficiency. Additionally, the current automated robot path planning has been a bottleneck for spray painting processes, as typical manual teaching methods are time-consuming, error-prone, and skill-dependent. Therefore, it is essential to develop automated tool path planning methods to replace manual ones, reducing costs and improving product quality. Focusing on flat panel painting in aerospace manufacturing, this study aims to address issues related to unreliable part identification techniques caused by the high-mixture, low-volume nature of the industry. The proposed solution involves using a spray gun and a UR10 robotic arm with a vision system that utilizes one-shot object detection (OS2D) to identify parts accurately. Additionally, the research optimizes path planning by concentrating on the region of interest—specifically, the identified part, rather than uniformly covering the entire painting tray.

Keywords : aerospace manufacturing, one-shot object detection, automated spray painting, vision-based path optimization, deep learning, automation, robotic arm
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