Highly Adaptable, Strong, and Flexible Biotic Robotic Arm: A Modular Gear Chain Mechanism for Single-Handed Task Mastery

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In this study, we aimed to develop a cost-effective, adaptable, and easily repairable prosthetic arm, addressing the limitations of current prosthetic devices in terms of expense, inflexibility, and frequent damage. Our novel prosthetic arm employs a gear chain mechanism that enhances ease of assembly and repair, even for amputees. This innovative design enables the completion of tasks typically requiring two hands, such as water-pouring, through a single-handed mechanism, demonstrating the practical benefits of our approach. The gear chain mechanism was selected for its simplicity, ease of assembly, and repairability. We evaluated various materials and ultimately chose 3D printing material and carbon fiber due to its low cost, minimal backlash, and resistance to freezing. The prosthetic arm's functionality was tested by attempting to grasp a variety of objects, including a hand cream bottle, water bottle, tissue box, and phone holder. Results indicated an 95% success rate, demonstrating the arm's capability to handle objects of varying sizes and textures. This novel prosthetic arm design has the potential to improve the daily lives of amputees, offering a more affordable and versatile alternative to traditional prosthetic devices By addressing the concerns of 91% of the population who are hesitant to invest in expensive prosthetic arms, our project provides a practical solution to enhance the efficiency and quality of life for amputees. The single-handed mechanism for completing two-handed tasks, as demonstrated by the water-pouring act, highlights the innovative and practical potential of this new prosthetic arm design. Key words: single-handed task mastery, adaptable, easily repaired, gear chain mechanism, low price

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