

RobotSketch: An Interactive Showcase of Superfast Design of Legged Robots

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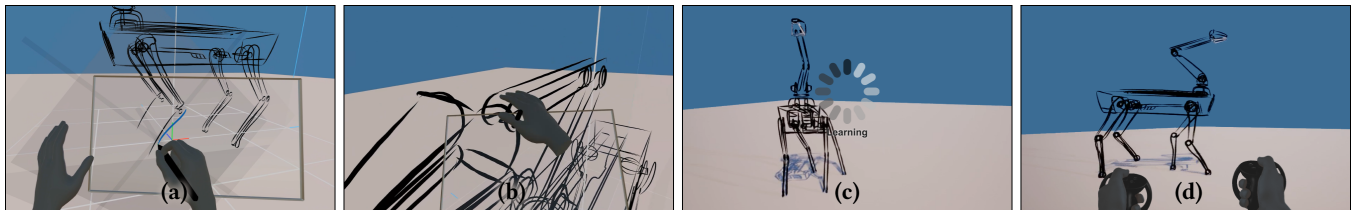


Figure 1: We showcase a novel interactive system where a robot designer can (a) directly sketch a robot in 3D using a transparent panel synchronized with a physical graphics tablet, and (b) experience the result at real scale within an immersive VR workspace. (c) The concept robot acquires walking skills through reinforcement learning in a physics simulation, (d) allowing the designer to control it in real time using VR controllers.

ABSTRACT

Robots consisting of many articulated parts performing complex movements are challenging to design. We showcase an interactive system for exploring shapes and structures of robots through 3D sketching, generating plausible movements of robots through AI, and reviewing and refining them in VR. Such immersive prototyping in the early stages can help reduce the time and cost associated with trial and error in later stages, contributing to shortening and streamlining of the robot development process.

ACM Reference Format:

Joon Hyub Lee, Hyunsik Oh, Junwoo Yoon, Seung-Jun Lee, Taegy Jin, Jemin Hwangbo, and Seok-Hyung Bae. 2024. RobotSketch: An Interactive Showcase of Superfast Design of Legged Robots. In *Special Interest Group on Computer Graphics and Interactive Techniques Conference Emerging Technologies (SIGGRAPH Emerging Technologies '24)*, July 27–August 01, 2024, Denver, CO, USA. ACM, New York, NY, USA, 2 pages. <https://doi.org/10.1145/3641517.3664382>

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SIGGRAPH Emerging Technologies '24, July 27–August 01, 2024, Denver, CO, USA
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ACM ISBN 979-8-4007-0524-3/24/07
<https://doi.org/10.1145/3641517.3664382>

1 INTRODUCTION

With rapid advancements in cutting-edge robotics, we are entering a new era of robots that exhibit organic forms and functions, such as Spot from Boston Dynamics and Digit from Agility Robotics. Equipped with powerful onboard AI, these robots are expected to offer valuable services to people, and may adopt shapes and structures specialized for environments and circumstances in which they operate. These trends point to an imminent Cambrian explosion in the robotics ecosystem.

However, the current robot development process requires months or even years of design and engineering before it is possible to validate a robot's ability to perform desired movements, at which point failure necessitates returning to the drawing board. This lengthy development cycle is a severe bottleneck that needs to be addressed for the robotics industry to meet the rapidly diversifying and evolving demands for commercial robots.

Our novel interactive system combines 3D sketching, VR, and AI to facilitate a new design workflow for the early stages of robot development (Figure 1). Robot designers can quickly express robots' 3D shapes and structures and experience them at real scale by creating 3D sketches in an immersive VR workspace. The resulting concept robots can acquire legged locomotion skills that comply with the laws of physics through reinforcement learning and walk fluently in response to designers' instructions. Reviewing these results in real time can help designers iterate on the robot design in shorter cycles.

