A bipedal robot that can walk using just one actuator

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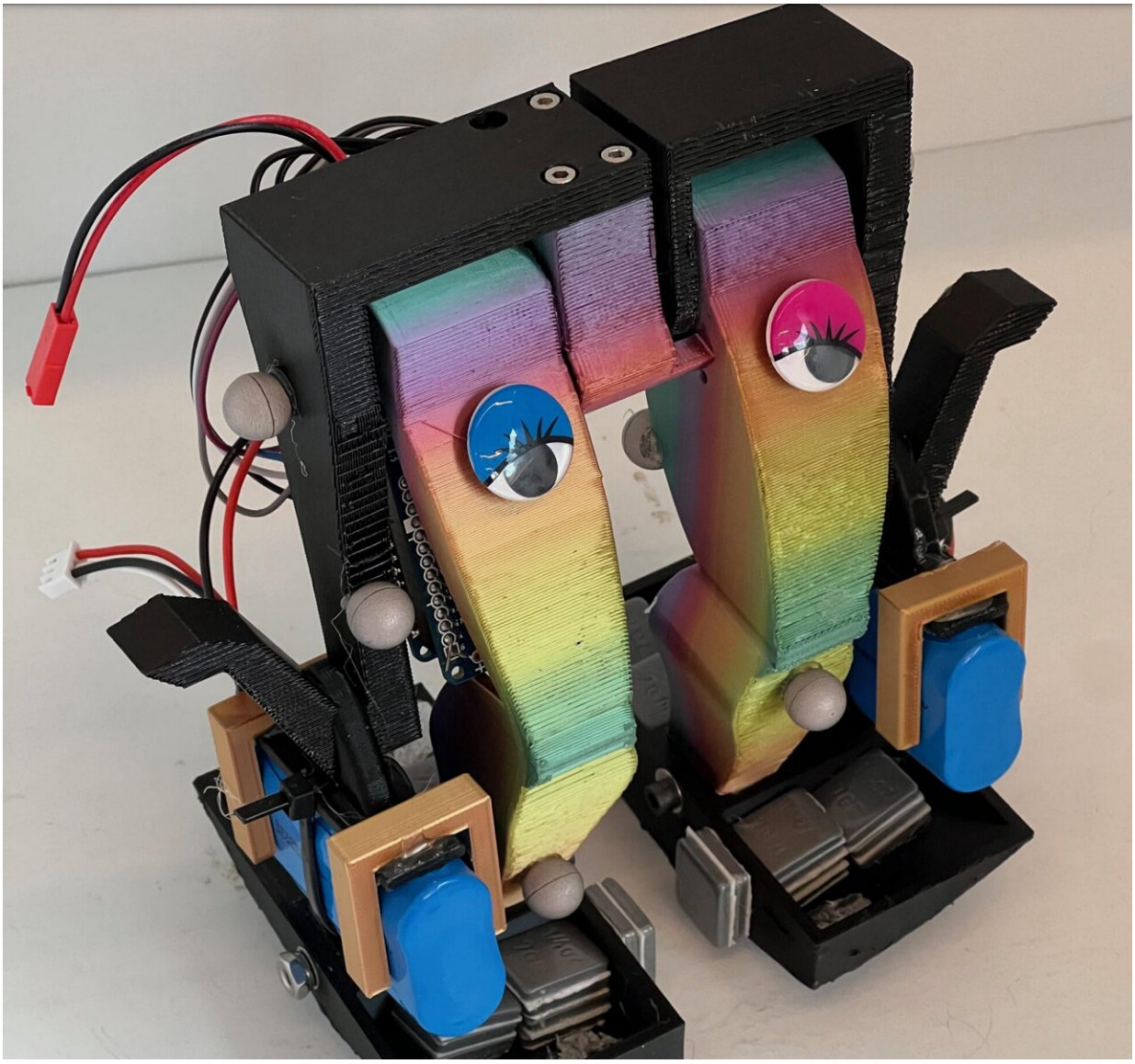

The “simplest” hip-actuated bipedal robot consisting of only two rigid bodies and

containing only one actuator, exhibiting open-loop stable walking, self-starting, and left and right steering. Credit: *arXiv* (2023). DOI: 10.48550/arxiv.2308.08401

A small team of mechanical engineers at Carnegie Mellon University, working with a colleague from the University of Illinois Urbana-Champaign, has designed and built what they describe as the simplest walking robot ever. They have written a paper describing the ideas they used to build the robot and the factors that have led to its simplicity and have posted it on the *arXiv* preprint server.

Over the past several decades, robotics engineers have been working toward creating robots that can walk on two legs and do so as smoothly as animals or humans. Thus far, such efforts have proved fruitful, but the ultimate goal has yet to be achieved. Robots still walk like robots.

As work has progressed on designing walking robots, a lot of engineering has evolved involving motors, hydraulics, processing chips and various other pieces and parts. The results have tended to be exceptionally complicated, sophisticated and expensive. Because of that, many have wondered if there might not be a less complicated way to do things. In this new effort, the research team has taken an entirely new approach to the problem and in so doing, have found a way to greatly simplify the features needed to allow a robot to walk on two legs.

The work by the team was inspired by the work done by Canadian engineer Tad McGeer—back in the late 1980s, he built a simple robot that had no motors, actuators or computers to control its movements. Instead, it involved a design that allowed a robot to lope down a slightly inclined plane with an easy gait. This was made possible, the researchers note, by making clever use of balance and gravity in the design.

In taking a new look at such an approach, the researchers on this new effort designed a similar robot that could walk on a level surface, courtesy of just one actuator. Their idea was to build a robot made of nothing but legs connected together, which could walk. The result was a robot they named Mugatu.

It has two legs, connected together at the top. Each leg has a foot on the bottom end but no knee. All its parts were designed to take advantage of gravity—the feet for example, were shaped in such a way that allows the robot to roll back and forth but also to turn slightly to one side or the other.

The legs were also put together in a way that ensured that the robot's center of gravity was always below the center of curvature for each foot. That meant that if the robot went off balance, it would always roll back to an upright position. They also added another feature—when standing with feet together, the robot would always lean slightly backward, allowing a leg to lift without ever running into the ground.

The final result is a robot with all of its parts balanced together in a way that ensures it can walk without falling while using just one actuator as a power source. The design also turned out to be highly efficient, energy-wise. The team concludes by suggesting that their design is just the first step in the creation of a new type of bipedal robot—one that relies more on leg design than on ways to move them.

More information: James Kyle et al, The Simplest Walking Robot: A bipedal robot with one actuator and two rigid bodies, *arXiv* (2023). DOI: 10.48550/arxiv.2308.08401

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