Strandbeest (BEEST)

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TEXAS A&M UNIVERSITY Engineering

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ROBOTICS TEAM & LEADERSHIP EXPERIENCE

Problem Definition

This project is inspired by Theo Jansen's Strandbeests. Jansen is a Dutch artist who has merged art and engineering in a dynamic illustration of movement. The Strandbeest uses mechanical design in linkages to mimic biological locomotion. BEEST continues to serve as a demonstration robot for TURTLE.

Methodology

The BEEST system was designed within an existing CAD model optimized for 3D-printed components. A Raspberry Pi interface syncs with an O-Drive linked to a remote controller to operate two brushless motors, providing efficient and precise actuation and speed. These motors drive Jansen-style linkages, to convert rotational input into a biomimetic walking motion. A custom gear train ensures torque consistency across the legs, while silicone molded feet improve traction and stability on varied surfaces.

Figure 1. *Angled View of BEEST*

Engineering Analysis

Leg Linkages

BEEST's legs use a modified Jansen linkage with filleted vertices to improve strength and reduce stress concentrations. This linkage replicates efficient biological-style movement, as shown by the leg path in **Figure 2**. The design uses several connected segments arranged in a specific pattern, and 3D-printed PLA components further enhance durability, reduce brittleness, and improve cost-effectiveness and manufacturability.

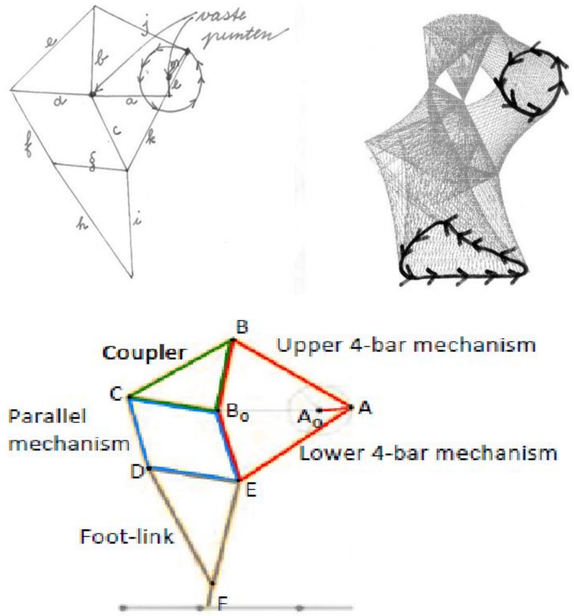

Figure 2*. Theo Jansen's Linkage Strandbeest*

Mechanical Power and Motion Transmission

BEEST's mechanical motion begins with the rotary input provided by the motors. The motor shafts are coupled to D-shafts, which drive two gears each, one for each set of legs. The small gears drive two larger gears to ensure that the front and back legs remain in sync while operating.

Figure 3*. Motor Shafts and Gears*

Feet

- The previous foot design was too rigid, causing BEEST to misstep.
- The feet are now spherical to remove the need for rotation about an axis.
- Silicone molding is used to provide improved traction without relying on grip tape.
- Molds from the QUAD project were adapted and attached to updated versions of the earlier 3D-printed feet.

Electronics

- A Raspberry Pi 4 runs Python scripts that link a wireless controller to the O-Drive motor controller.
- A future 3D-printed head will include a Billy Bass–style speaker and a servo-driven jaw.
- The head will provide synchronized audio and movement to create an engaging, animated presence for children's outreach events.

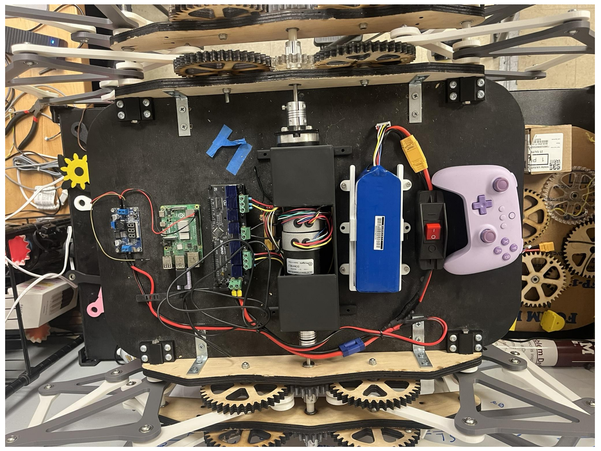

Figure 4. *View of BEEST's Electronics System*
Note: Shell modifications still in progress

Manufacturing

BEEST's main base plate was cut from 3/8" plywood. Custom linkages were 3D-printed in PLA at 1/4'' thickness. Each gear was cut out of 1/2" plywood, which was chosen to allow for increased contact area and wear resistance. A 3D-printed motor cover was added for protection, as seen in ***Figure 4***.

Goals

- Create a robot which is easy to control and headless.
- Produce stable forwards and backwards across a variety of flat surfaces.
- Introduce a unique take on the generic quadruped design that weaves Theo Jansen's wind walking sculptures with electric motors and controls.
- Gain experience using CAD, perform motion analysis, use specialized manufacturing techniques such as laser cutting and 3D printing, as well as practice Python coding and electronics management.
- Use **BEEST** in the future to promote our organization at recruitment events and act as a showcase robot for outreach events with local educational STEM groups.

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References:

[1] an, A. & Heinloo, M.. (2014). Analysis and synthesis of the walking linkage of Theo Jansen with a flywheel. 12. 657-662.
Accessed 12 Apr. 2025.

[2] Theo Jansen's Linkage Mechanism on Kinetic Architecture, papers.cumincad.org/data/works/att/caadria2018_140.pdf. Accessed 12 Apr. 2025.

[3] Tsuji, T., Ohtsuki, K., & Oshima, K. (2022). Bio-inspired walking mechanism using Jansen linkage with variable stroke control. Procedia Computer Science, 207, 2446–2451.
Accessed 12 Apr. 2025.