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 linkages to mimic mechanical design and 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 laser-cut acrylic components. A Raspberry Pi interface syncs with an O-Drive controller to operate two brushless motors, providing efficient and programmable actuation. 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 3D printed feet improve traction and stability on varied surfaces.

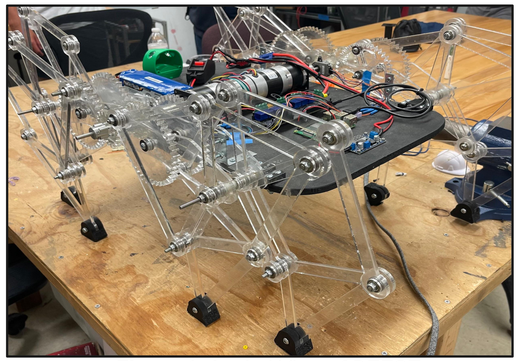

Figure 1. *Angled View of BEEST*

Engineering Analysis

Leg Linkages

BEEST's legs each consist of a Jansen linkage. The unique aspect of the linkage is the ability to convert rotary motion into linear motion. The linkage typically consists of several connected segments arranged in a specific pattern as seen in *Figure 2*. A key enhancement to BEEST's linkage design has been to change the material of all linkages to acrylic. This has increased rigidity and made movement more stable while in operation.

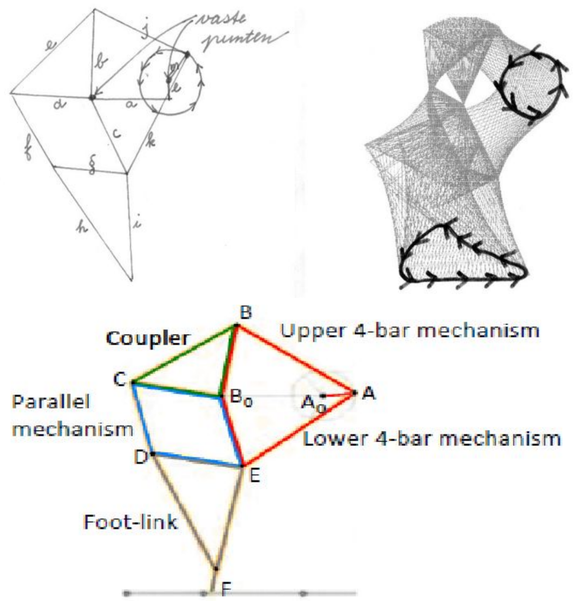

Figure 2*. Theo Jansen's Linkage Strandbeest*

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.

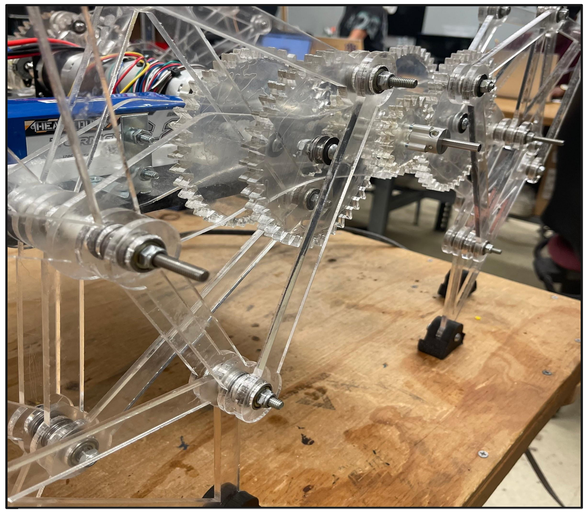

Figure 3*. Motor Shafts and Gears*

Feet

BEEST's flat-bottomed PLA feet are mounted with a single bolt, allowing free rotation and consistent ground contact. Embedded weights help maintain a parallel orientation to the ground at the start of each step. Additionally, a new layer of grip tape enhances traction across various surfaces.

Electronics

A Raspberry Pi 4 runs Python scripts that connect a wireless controller to the O-Drive motor controller, using encoder feedback for precise motor control.

To further improve system readability, a previously damaged power switch was replaced with a reliable inline version for safer, easier power cycling.

A turtle shell–shaped electronics casing is also being developed. A matching 3D-printed head will feature a Billy Bass–style speaker and a servo-driven jaw for synchronized audio and movement, giving the robot a fun, animated presence that reflects our organization's spirit.

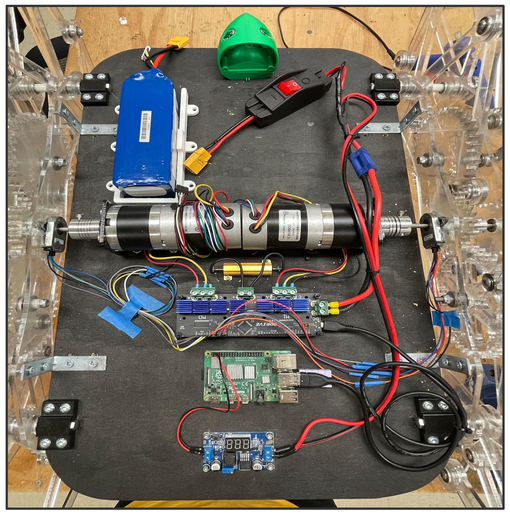

Figure 4. *View of BEEST's Electronics System*
Note: Shell modifications still in progress

Manufacturing

BEEST's main baseplate was cut from 3/8" plywood. Custom linkages, gears, and side plates were laser cut from 1/4" OPTIX Acrylic. Each gear consists of two acrylic layers adhered together to allow for increased contact area and wear resistance.

Outcomes

- Create an easy to control robot, directly connected to its controller without external startup.
- Produce stable forwards, backwards and turning motion 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, utilize 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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