Final Report: Theo Jansen Walking Mechanism Project

DesignLab – Mechanism Kit Project
Group D (Friday)
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Team Members:

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Project Title

Theo Jansen Walking Mechanism: A Bio-Inspired Mechanical Walking System Using Linkages

Introduction

In the field of mechanical design, the study of linkages and motion conversion is vital. The Theo Jansen walking mechanism represents a unique innovation where rotary motion is converted into a smooth walking motion using a cleverly designed system of linkages. Originally developed by Dutch artist and kinetic sculptor Theo Jansen, this mechanism mimics legged locomotion using purely mechanical means—without motors, sensors, or wheels.

Our project aimed to recreate a scaled version of this walking mechanism as part of the Mechanism Kit initiative. The final goal was to design, fabricate, and assemble a working prototype that could be used for demonstration and educational purposes to explain motion principles in a simplified yet effective way.

Objective

To design and fabricate a functional model of the Theo Jansen walking mechanism that showcases the conversion of rotary motion to walking motion through mechanical linkages. The mechanism aims to:
- Demonstrate the application of four-bar and six-bar linkages.

- Show coordinated motion for stable walking.
- Enhance understanding of mechanical motion and real-world applications of kinematics.

Scope of the Project

This project focuses on:
- Kinematic analysis of the Jansen linkage.
- CAD modeling and optimization of linkage design.
- Fabrication of components using laser cutting.
- Assembly and testing of the prototype.
- Educational demonstration of linkage-based motion systems.

Design and Development Process

1. Research and Planning
We began with an in-depth study of Theo Jansen's original mechanism and its underlying mathematical model.

2. Kinematic Analysis
Using simulation software, we analyzed the linkage behavior to confirm that the leg traced the correct path resembling natural gait.

3. CAD Modelling
Each component of the leg mechanism was modeled using SolidWorks.

4. Fabrication
The final designs were laser-cut using acrylic sheets.

5. Assembly
Once all parts were ready, we proceeded with the assembly.

Mechanism Description

Theo Jansen Linkage:
This linkage is a combination of:
- Four-bar and six-bar linkages
- Crank-rocker mechanism

Features Demonstrated:
- Path tracing similar to biological leg movement
- Multiple degrees of freedom in link motion
- Conversion of circular motion to linear motion
- Coordinated multi-leg motion for balance and stability

Individual Contributions

- Kripalini: Conducted mechanism analysis, helped determine correct linkage dimensions.
- Jasnoor: Led the force analysis of the system, calculated torque requirements.
- Geethika: Designed CAD models and prepared DXF files.
- Rahil: Handled physical assembly and testing.

Progress Milestones

Week 1: Research and concept selection
Week 2: Mechanism analysis and dimensional synthesis
Week 3: CAD modeling and motion simulation
Week 4: Laser cutting and part preparation
Week 5: Assembly and initial testing
Week 6: Final testing and documentation

Challenges Faced

- Maintaining exact linkage ratios.
- Misalignment during assembly.
- Acrylic link breakage and load distribution issues.

Outcomes

- Successfully fabricated and tested a working Theo Jansen mechanism.
- Validated kinematic models and practical application.
- Gained design and fabrication skills.

Applications

- Educational model for demonstrating motion and linkages.
- Bio-inspired robotics.
- Workshops and exhibitions.

Conclusion

This project was a valuable exploration of how abstract motion theories and linkage systems can be transformed into functional prototypes. The Theo Jansen walking mechanism taught us the importance of design precision, teamwork, and iterative development. The final mechanism runs smoothly and provides a fascinating demonstration of converting rotary motion to biological-like walking using only mechanical parts.