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DEPARTMENT OF MECHANICAL ENGINEERING

MINOR PROJECT – **"ECO SPIDER"**

FINAL REVIEW

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ABSTRACT

- Design and fabricate a spider-like walking robot for efficient hill climbing, powered by solar energy.
- Eco Spider features a walking mechanism inspired by spiders, enabling navigation on inclined terrains.
- Powered by a solar panel and battery system, reducing dependency on non-renewable power sources.
- Driven by a motor with components crafted through lathe welding and machining processes.
- Integrates mechanical engineering, robotics, and sustainable energy for autonomous, eco-friendly functionality.
- Potential applications include agriculture, terrain exploration, and environmental monitoring.
- Aligns with sustainability goals by promoting renewable energy in robotics.

Introduction

- **Overview:** This project focuses on designing a solar-powered spider-like walking robot capable of navigating rugged and hilly terrains. The robot uses multiple legs for stability and solar panels for energy efficiency.
- **Motivation:** Conventional wheeled robots struggle with rough terrain. A spider-like design provides better adaptability and mobility in challenging environments.
- **Key Features:** Legged locomotion for enhanced terrain stability. Solar-powered system for eco-friendly and sustainable operation. Autonomous navigation with terrain detection capabilities.
- **Relevance:** This robot can be applied in agriculture, exploration, and disaster response, offering a reliable, energy-efficient solution for terrain navigation.

Literature review

❖ **Spider-Like Walking Robots:**

Multi-legged robots, inspired by spiders, provide enhanced stability and mobility over rough terrains. These designs are particularly useful for hill climbing and uneven surfaces (Smith et al., International Journal of Robotics Research, 2021).

Advantages include the ability to distribute weight and maintain balance, making them ideal for challenging environments.

❖ **Solar-Powered Robotics:**

Solar energy is increasingly used in robotics for sustainable and autonomous operations in remote areas. These systems reduce the need for frequent recharging and can operate off-grid (Lee et al., Renewable Energy Journal, 2020).

Solar-powered robots are particularly useful in agriculture, exploration, and disaster relief.

Literature review

❖**Fabrication Techniques:**

Traditional machining methods, such as lathe welding, are often used to create durable and precise robotic structures. This approach ensures strong mechanical components, capable of withstanding tough terrain (Chen et al., Journal of Manufacturing Processes, 2019).

❖**Key Findings:**

Strengths: The integration of spider-like leg designs with solar energy provides improved terrain adaptability and energy efficiency.

Gaps: There is limited research on combining solar power with spider-like robots specifically designed for hill climbing and rough terrain traversal.

Current scenario and proposed work

Currently, robots designed for uneven terrains face limitations in terms of stability and adaptability. Wheeled and tracked robots often struggle on steep slopes and loose surfaces. Existing walking robots, while more adaptable, can be complex and expensive to produce. There is a need for a cost-effective, efficient solution that can navigate such challenging environments.

- **Develop a Working Prototype:**

Create a fully functional spider-like walking robot capable of climbing hills and navigating uneven terrains.

- **Optimize Control Algorithms:**

Enhance the robot's navigation and stability through advanced control systems.

- **Conduct Field Tests:**

Evaluate the robot's performance in real-world scenarios and make necessary adjustments.

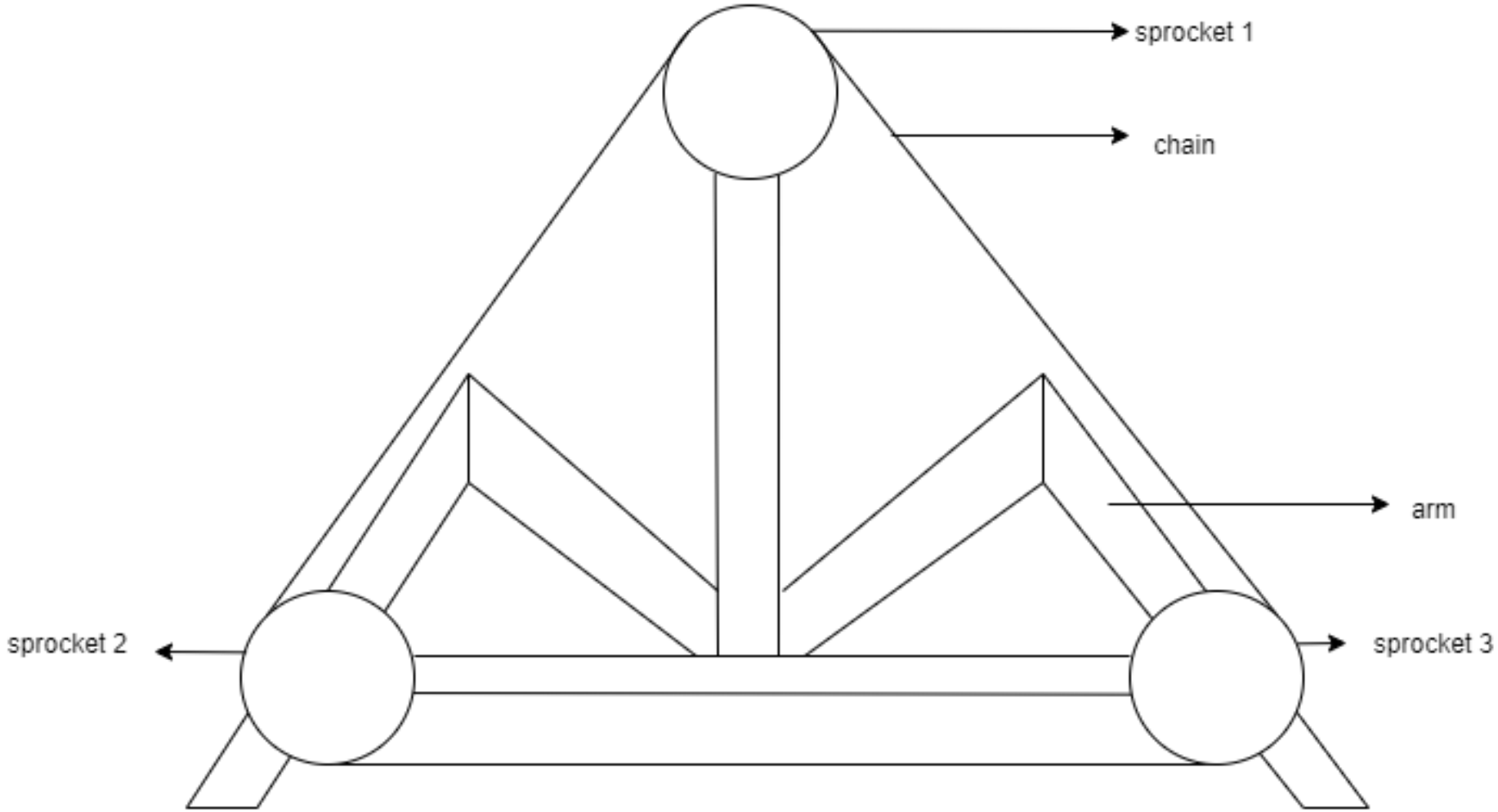
Methodology of the project

- **Design Process:** The robot's design is developed through manual sketches and technical drawings, outlining the spider-like walking mechanism and overall structure.
- **Fabrication Process:** The model is constructed using lathe, welding, and traditional machining methods to create durable mechanical components.

Materials: Lightweight and durable metals are selected for the robot's frame to ensure stability and flexibility on uneven terrain.

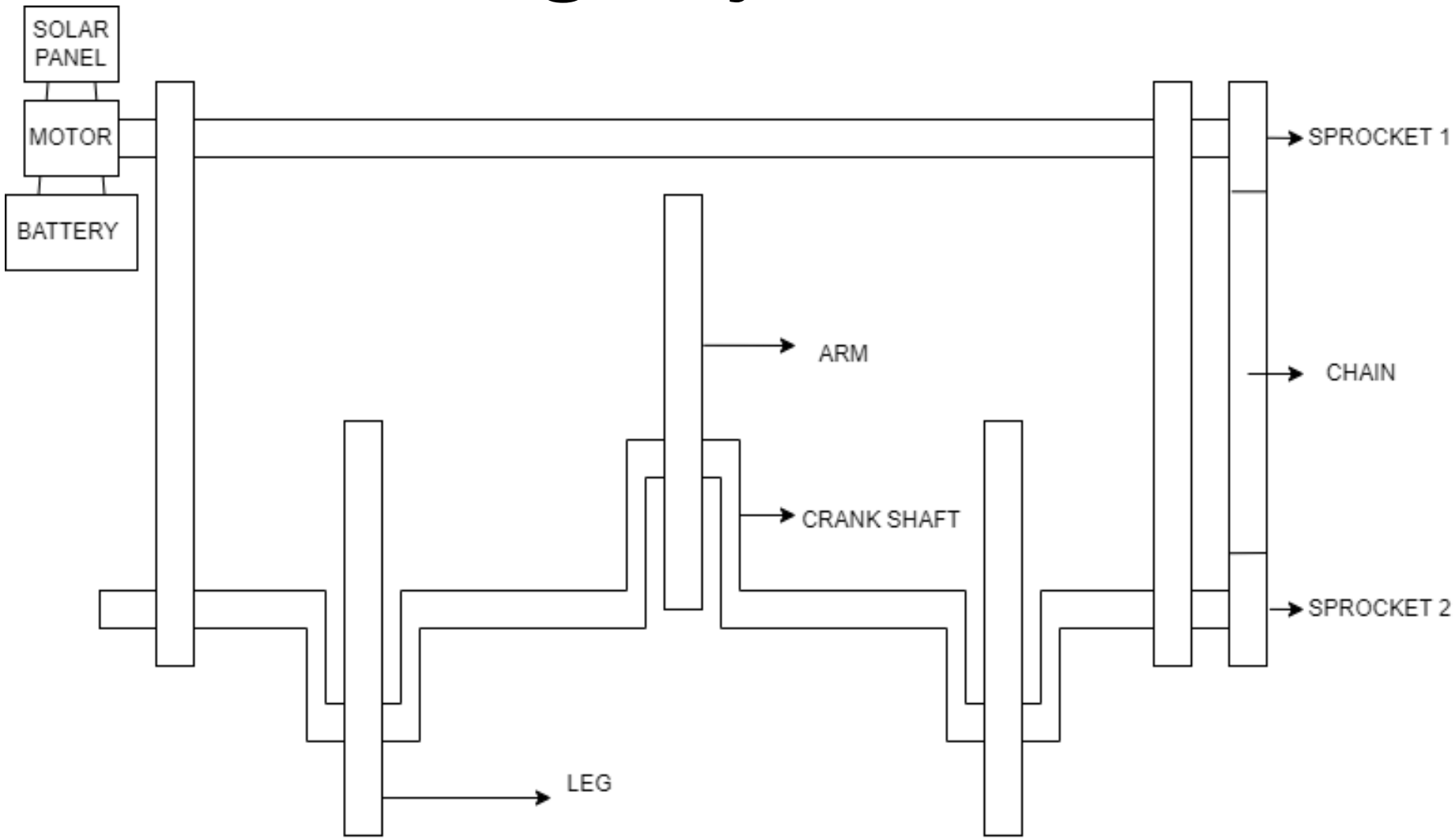
- **Power System:** Integrated a solar panel system to power the robot, paired with a battery for energy storage and efficient operation during non-sunlight hours.
- **Walking Mechanism:** Spider-like legs are fabricated and assembled through welding and machining. These legs are designed for enhanced stability on rough terrains, ensuring balanced movement.
- **Testing & Refinement:** The prototype will be tested on various terrains, and the results will guide iterative improvements to optimize performance and stability.

Design layout



Side view

Design layout



Front view

Result and discussion

- The Eco Spider design integrates a spider-inspired walking mechanism, optimized for stability on slopes and rough terrains.
- Designed to operate on solar power with battery backup, reducing reliance on conventional energy.
- Finalized design demonstrates structural robustness, fabricated through precise lathe welding and machining processes.
- Potential for use in agriculture, environmental monitoring, and exploration of challenging landscapes.
- Project focused solely on design; a physical demonstration and testing of the prototype were not conducted.
- Further development could enhance functionality, including on-field testing and refinement for real-world applications.

Cost Estimation

COMPONENT	ESTIMATEDCOST (LOW – END)	ESTIMATED COST (HIGH – END)
SOLAR PANEL	1000	5000
MOTOR	900	3000
BATTERY	1000	3500
BODY MATERIAL	500	2000
MISCELLANEOUS COMPONENTS	500	1500
TOTAL ESTIMATED COST	3900	15000

Application

❖ **Agriculture:**

Field Monitoring: Navigate through rough and hilly farmlands to monitor crop health and soil conditions.

Autonomous Tasks: Assist with planting, spraying, and carrying materials across uneven terrains.

❖ **Military and Surveillance:**

Reconnaissance: Perform surveillance and reconnaissance missions in challenging terrains.

Logistics Support: Transport supplies or gather intelligence in remote or hostile environments.

❖ **Sustainability Initiatives:**

Renewable Energy: Demonstrate the use of solar power in robotic systems, promoting sustainable and energy-efficient technologies.

Conclusion

- The Eco Spider project has been successfully designed, achieving the objective of an efficient, terrain-adaptive robot powered by renewable energy.
- Design finalization includes a spider-like walking mechanism suitable for hill climbing and rough terrain.
- Solar power integration in the design aligns with sustainable energy practices.
- Though only design aspects are finalized without a physical demonstration, Eco Spider shows potential for future applications in agriculture, environmental monitoring, and exploration.
- This project lays the groundwork for developing eco-friendly, autonomous robots in challenging environments.

Reference

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Thank
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