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Outline

- Background
- Problem Statement
- Objectives
- “Design Applications for Girls”-Spy Prototype
- Educational Applications
- Economic Applications
- Summary
- Recommendation
- References

Background

- High Dropout Rates
 - Cultural Priorities
 - Economic Barriers
- STEM Education
 - DAG Program
 - Community Growth



Figure #1: School Children in Arusha [1]

Background

- Employment Barriers
 - Domestic Labor
 - Household Expectations
- Economic Needs
 - Flexible Sources of Income
 - Education and Health



Figure #2: Maasai woman and young girl [2]

Problem Statement

- Design an academic tool that generates interest for technical careers.
- Provide flexible employment opportunities for Maasai women.



Figure# 3: Travel for education [3]

Objectives

- Hands-on Education Tool
 - Affordable for Rural Families
 - Features STEM topics (Natural Sciences)
 - Utilizes Local Resources
- Regional Business Opportunities
 - Tourism Attractions
 - Local and Cultural Art

D.A.G. - Spy Prototype



Figure# 4: Spyglass Prototype + Artistic Demo

D.A.G. - Spy Prototype: Optics

Modeled Lenses:

- Objective: $d = 3.15\text{cm}$, $f_o = 15\text{cm}$
- Eyepiece: $d = 1.27\text{cm}$, $f_e = -2\text{cm}$
- Total Length: 13cm

Prototype Lenses:

- Objective: $d = 7\text{cm}$, $f_o = 16.8\text{cm}$
- Eyepiece: $d = 2.1\text{cm}$, $f_e = -1.5\text{cm}$
- Total Length: 15.2cm

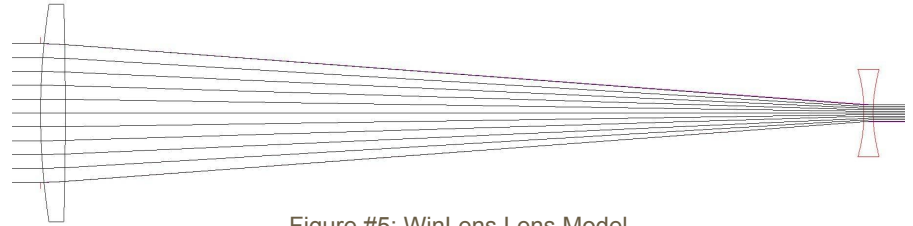


Figure #5: WinLens Lens Model



Figure #6: Final Lens Selection

D.A.G. - Spy Prototype: Lens Mounts

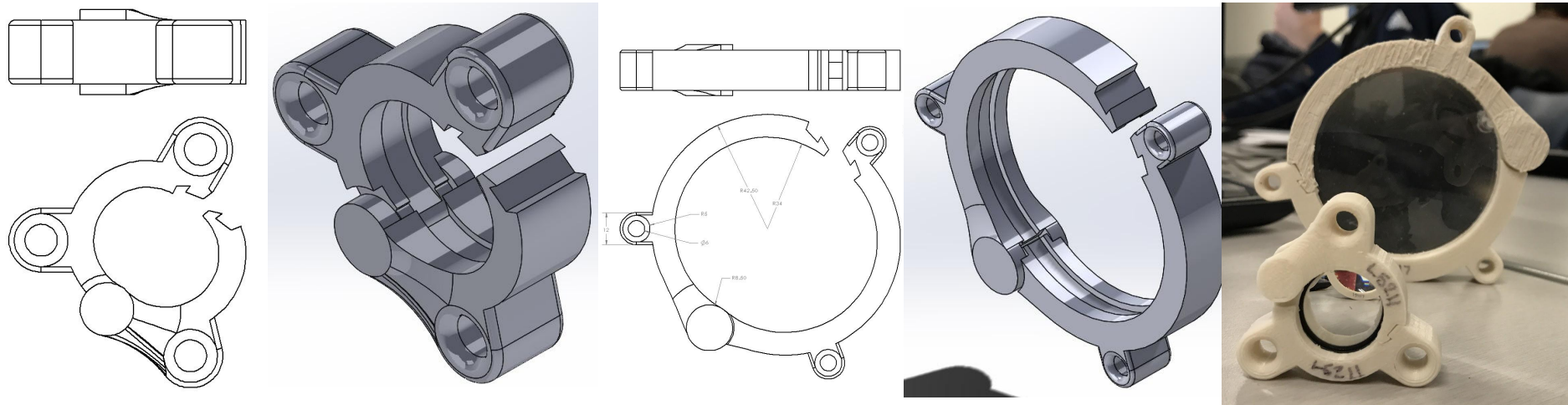


Figure #7: Final Lens Mount Models/Prints

D.A.G. - Spy Prototype: Housings

Alternative Options:

- Foldscope
 - Educational tool
- Origami design
 - Affordable
 - Structural Limitations
 - Origami Experience
- Upcycled Housings
 - Structural considerations
 - Design freedom for locals

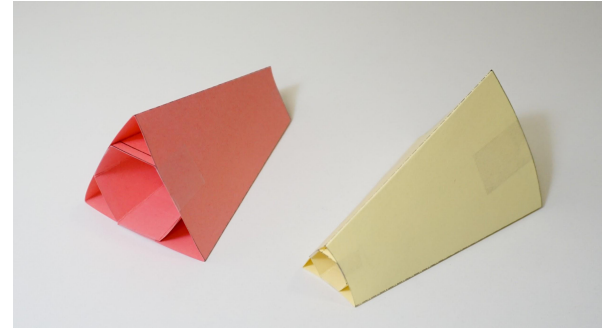


Figure #8: Tri-Hex Origami Prototype



Figure #9: Foldscope [4]

D.A.G. - Spy Prototype: Housings

- Gourd Housings:
 - Decorative
 - Variable Size
 - Durable



Figure #10: Construction Process

Educational Applications

STEM Programs based around physics and engineering elements of project

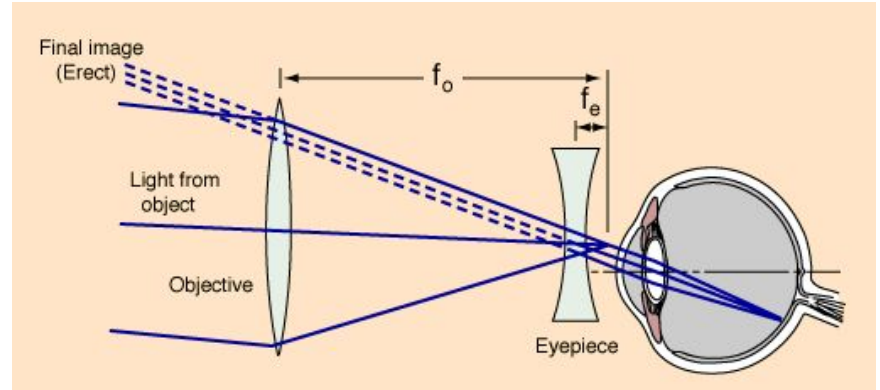
- Physics
- Engineering
 - Design Process
 - Rapid Prototyping
 - CAD and Testing
- Outreach programs

Educational Applications: Physics - Optics

- Galilean Telescope:
 - Versatile
 - Simple construction
 - Simple design calculations

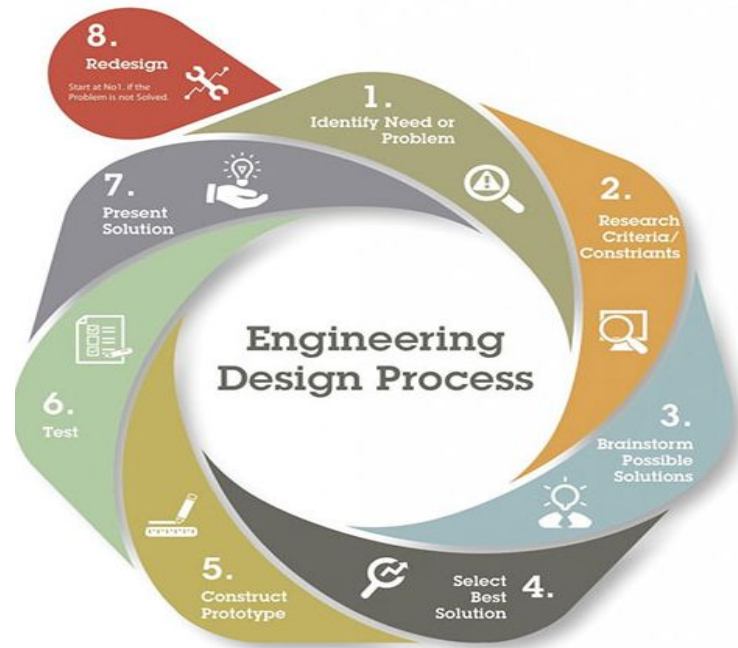
$$M = -\frac{f_o}{f_e} \quad L = f_o + f_e$$

$$\frac{1}{f} = (n - 1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$



Figure#11: Galilean telescope [5]

Educational Applications: Engineering - Design Process



Figure#12: Design Process [6]

Educational Applications: Engineering - rapid prototyping:

The challenge:



Figure 13: materials provided



Figure 14: Brainstorming

Educational Applications: Engineering - rapid prototyping: The process:



Figure#15: designing



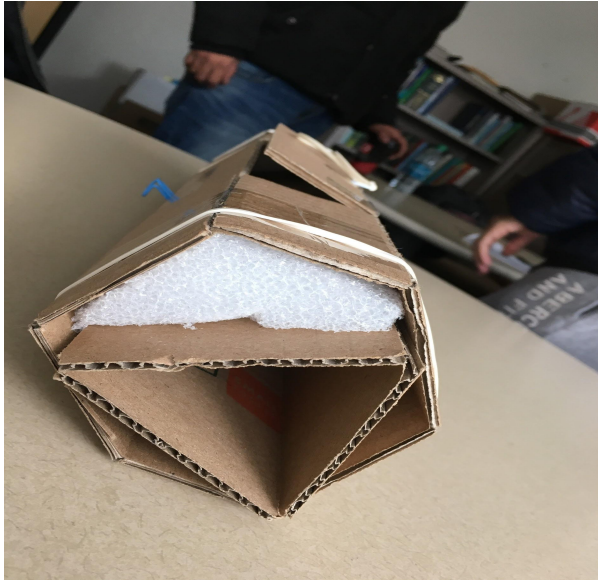
figure#16: communicating



Figure #17: prototyping

Educational Applications: Engineering - rapid prototyping

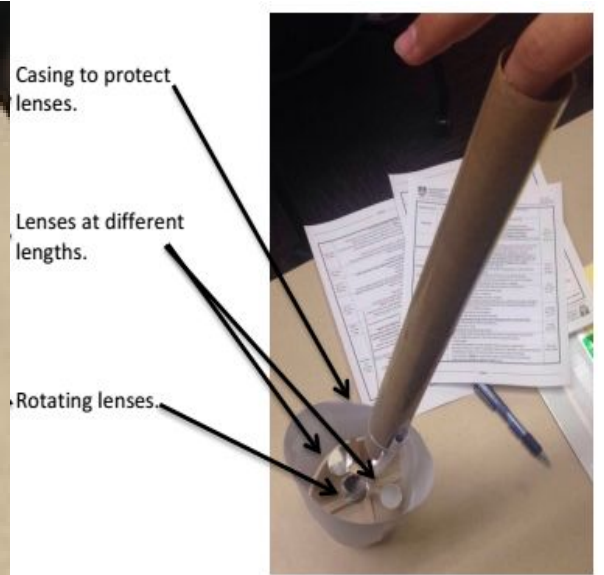
The result:



Figure#18: storage spyglass



Figure#19: eyewear spyglass



Figure#20: multi lenses spyglass

Educational Applications: Engineering - CAD and Testing

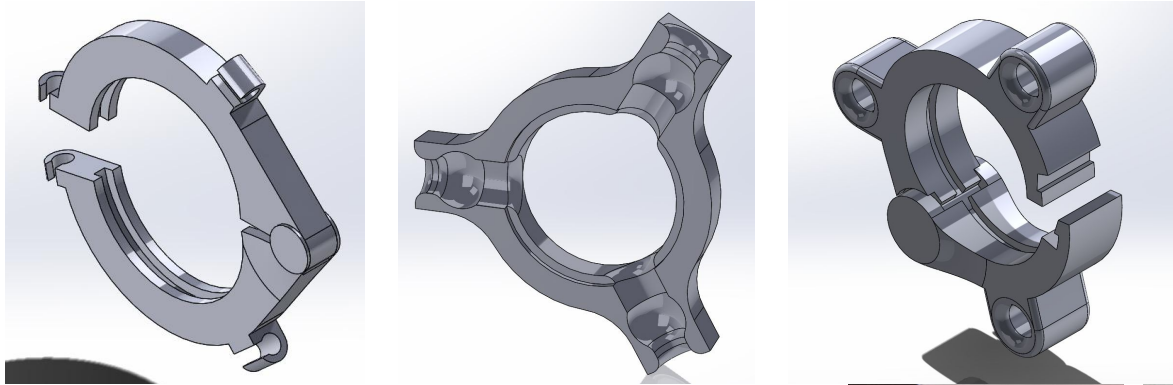


Figure #21: Lens Mount Iterations



Figure #22: Printed Prototypes

Educational Applications: Outreach programs

- The Arboretum of Flagstaff
 - Coreen Walsh - Public Programs Manager



Figure #23: Arboretum greenhouse

Educational Applications: Outreach programs

- Wildlife education - Environmental research
- Local school education
- Traveling Education (Tourism)



Figure #24: Butterfly identification guide [7]

Economic Application: Business skills

- Business Education for Community
 - Market Considerations
 - Demand and Buying Power
 - Supply Chain Management
 - Raw Materials and Transportation
 - Managerial Accounting
 - Human Resources and Finance

Summary

- Educational and economic issues
- Solution Considerations
- DAG -Spy
 - Optics
 - Lens Mounts
 - Housing
- Educational and economic applications
 - Physics
 - Engineering
 - Outreach
 - Business skills

Recommendations

- Future Project Directions
 - Lens design program using Raspberry Pi
 - Comprehensive business model
 - Partnership with Arboretum
 - Climate change study
 - Wildlife educational tools

ACKNOWLEDGMENTS

- Dr. Dianne McDonnell
- Ashwija Korenda
- Evalyne Long'arwa
- Dr. Christopher Mann
- Todd Rossman
- Jon Helleson
- Sharna Beahm
- Kristin Whitten
- Garin Slim
- Coreen Walsh

Questions



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