DEPARTMENT OF MECHANICAL ENGINEERING

ENME - E3 – 100% Mechanical Mechanical Water Balloon Rupture Device

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Motivation, Goal, Impact

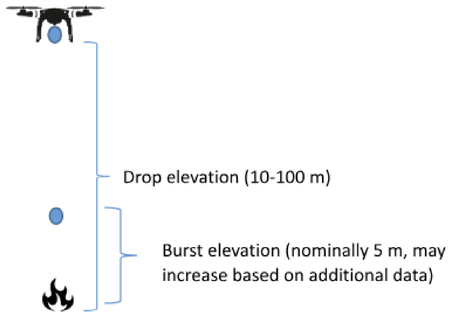
• With the increase of damaging wildfires throughout the western US, the need for fire prevention is at an all time high

• The XPrize competition was designed to motivate the nation's leading universities and companies to design and build solutions in early wildfire detection and suppression

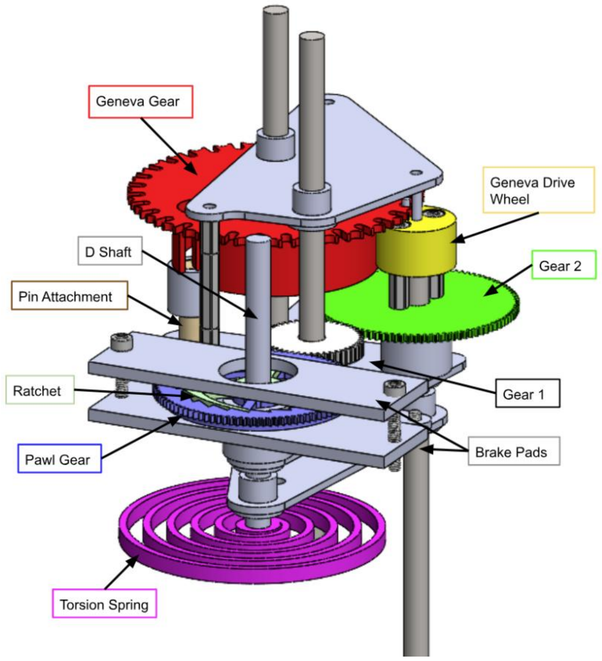
Our Goal is to replace the current electrical solution created by the UMD Crossfire team with a purely mechanical system that can rupture a balloon dropped by a drone after a user specified amount of time

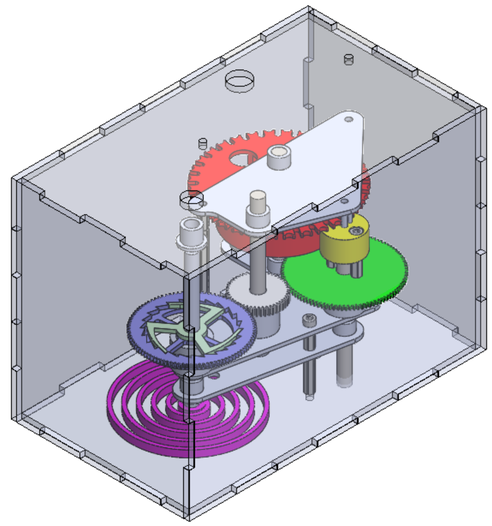
Requirements

- Puncture balloon 1-5s after release within 25ms margin of error
- Design is 100 cm^3 or smaller
- Less than 250 g total weight
- 5-10 kg water balloon will burst
- Biodegradable or environmentally friendly materials



Final Design

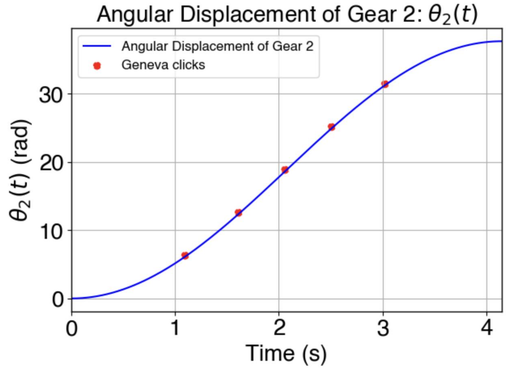




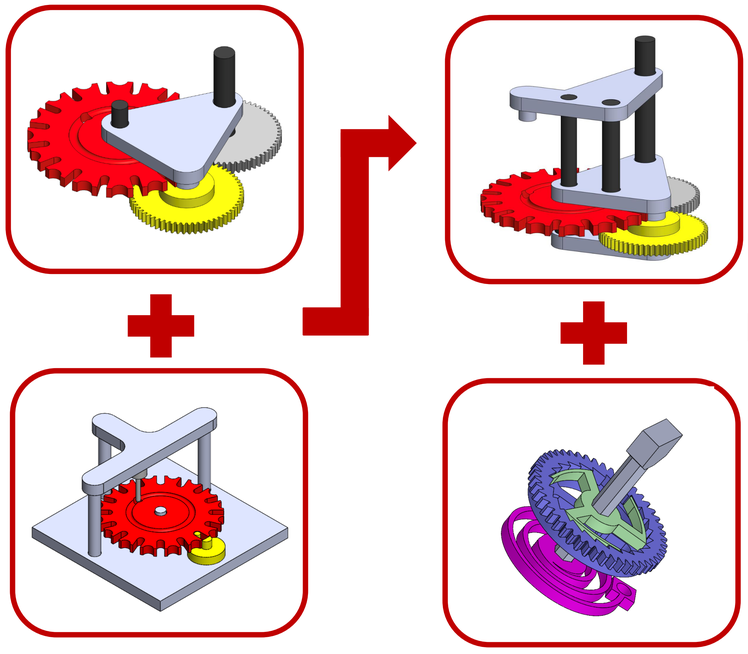
Design Calculations & Decisions

- Designed for laser cutting with tolerances of +/- 0.001” for 1/8” maple boards
- Prototype scaling by factor of 1.5 for ease of testing
- We derived the equation below to represent how much our Geneva gear needed to turn to keep our timing consistent and graphed it for ease of interpretation

$$\theta_2(t) = \frac{R_1}{R_2} \cdot \theta_0 \cdot \left(1 - \cos\left(\sqrt{\frac{k}{I_1 + I_2\left(\frac{R_1^2}{R_2^2}\right)}} \cdot t\right)\right)$$

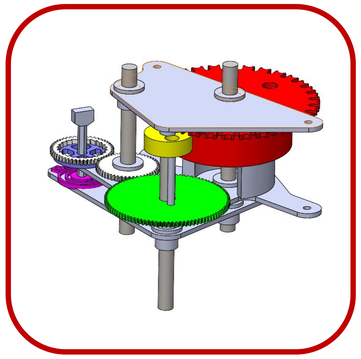


Prototype & Test Results

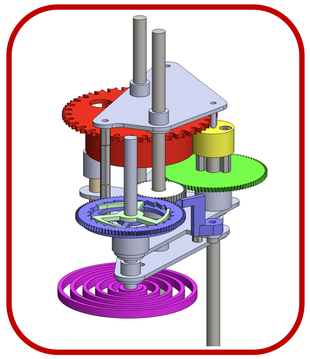


Designed Timing and Popping subsystems separately

Created design for full combined system



Adjusted design based on testing



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Resources & Additional Information