

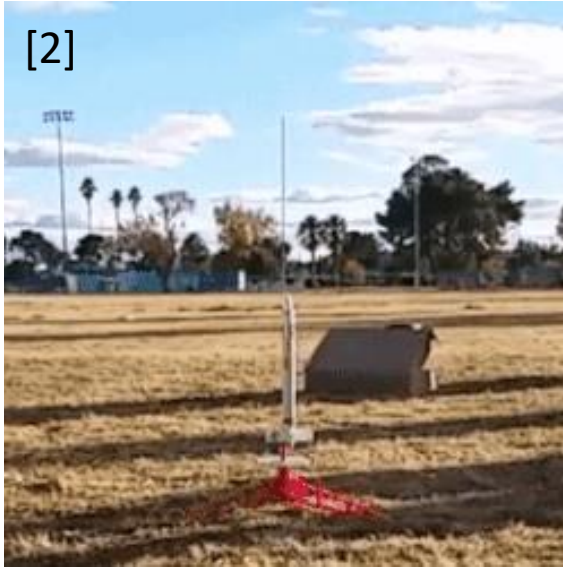
3D Printed Model Rockets For STEM Education

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Advisor: Satyajit Mojumder

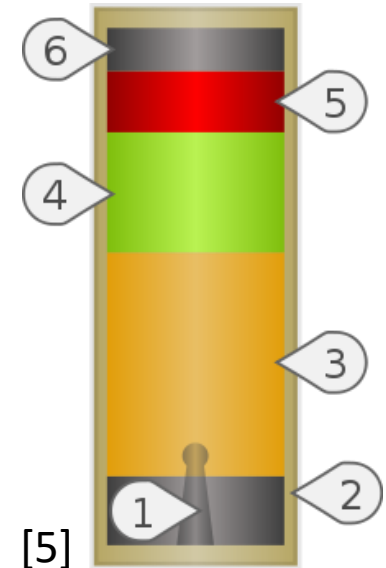


[1]

Model Rockets



- Low altitude rockets used by hobbyists for fun and education
- Made of cardboard fuselage and plastic tailpiece/nose
- Use black powder single-use engines (available at hardware stores or hobby shops)
- Very popular among kids AND adults
- Safe and readily available- no license needed

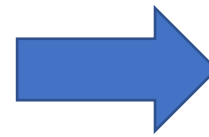


Anatomy of a basic black-powder model rocket motor. A typical motor is about 7 cm (2.8 in) long. 1. Nozzle; 2. Case; 3. Propellant; 4. Delay charge; 5. Ejection charge; 6. End cap

Model Rocket Issues



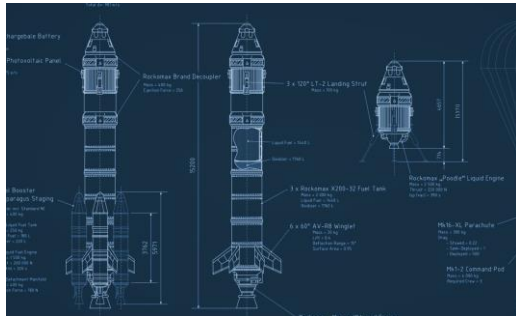
Standard kit



Finished product

- Carboard fuselage not very strong
- NOT customizable- rockets come in kits ready to put together
- Rocket design not included- no engineering, just putting pieces together
- Components not usually recyclable (Subham's Project)

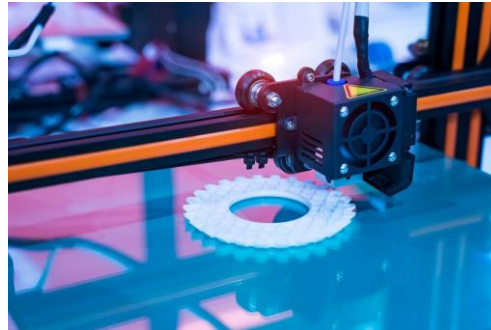
3D Printed Rockets As STEM Education Teaching Tool



[8]

Aerospace Engineering

1. Successfully launch and fly
2. Lightweight
3. Fit most engines and recovery systems



[9]

3D Printing

1. Durable enough to last at least 10 flights
2. Recyclable and eco-friendly
3. Convenient



[10]

STEM Education

1. Customizable
2. Applicable to data science/engineering experiments
3. Educational

Most Importantly: FUN

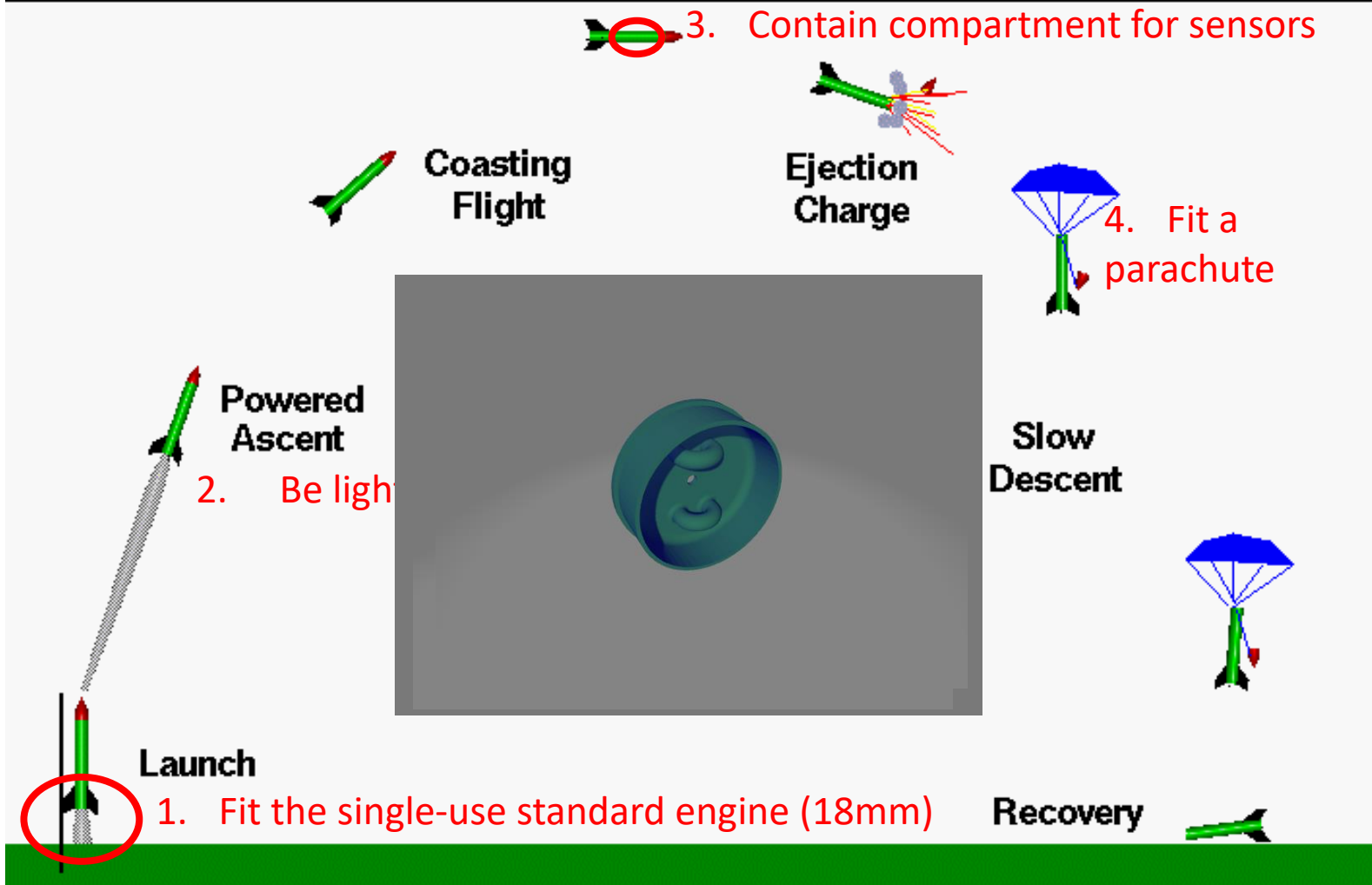
1. Aerospace Engineering



1. Aerospace Engineering: Design Requirements

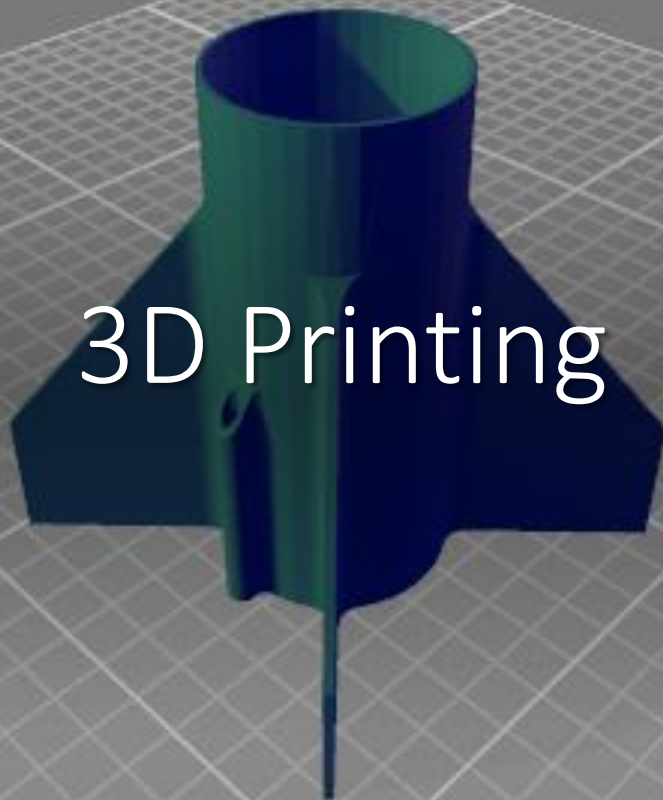


Flight of a Model Rocket



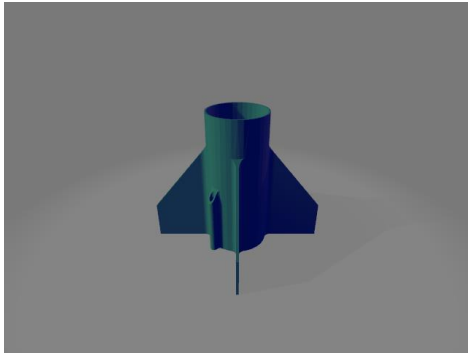
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3D Printing

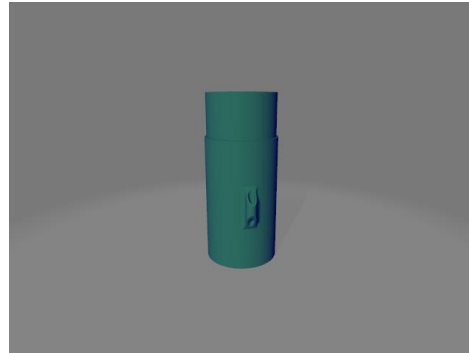
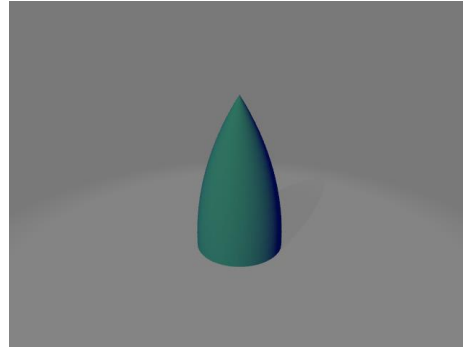


2. 3D Printing

1. Customizable



2. Stronger



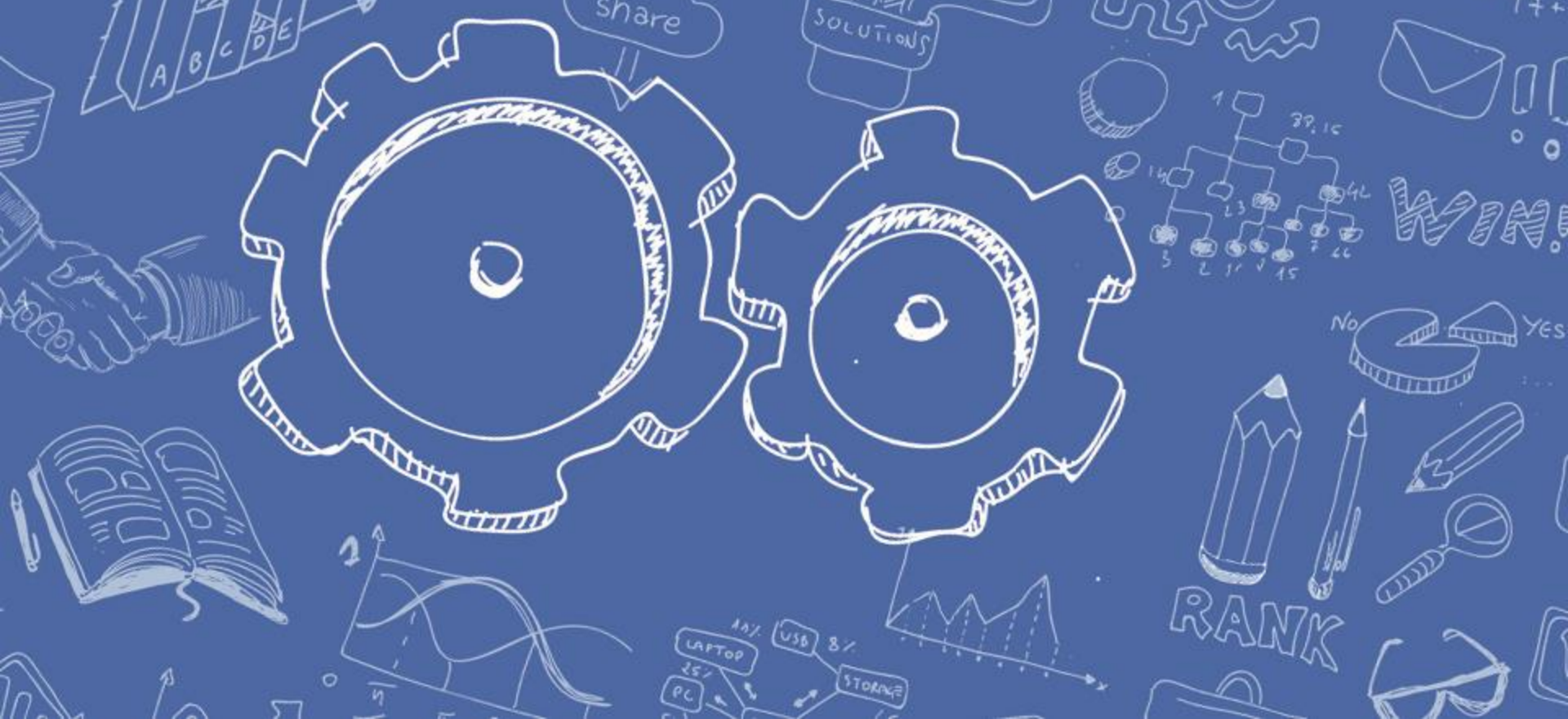
3. Reusable



The Most Critical Question:

What should we name the rocket?



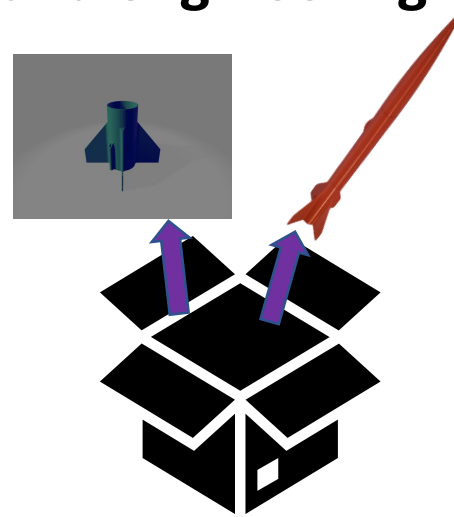


STEM Education

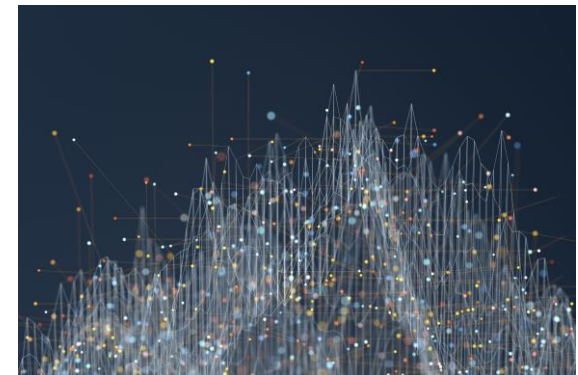
STEM Education: Main Goal

Design an educational tool that students of all backgrounds can use to learn data science and engineering

- Used in schools
- Ordered online
- Fun to work with

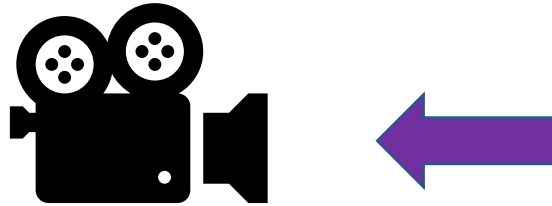


Short term goal:
Integrate rocketry with
MDS



STEM Education: Integrate Rocketry and MDS

Calculate the acceleration/velocity of the rocket at different stages of flight using cameras



[14]

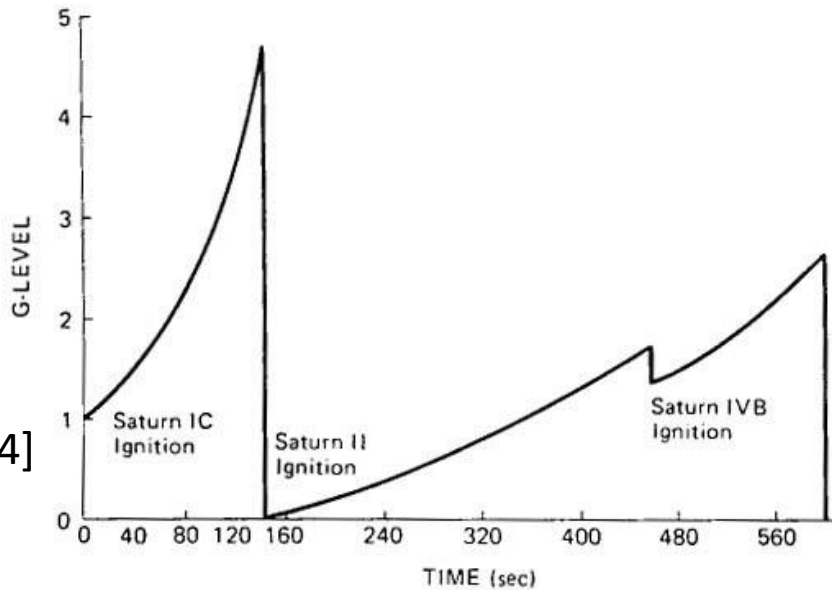


Figure 2. Typical Apollo launch profile – Saturn V launch vehicle.

[1]

This is a 3D problem!

We can set up three cameras to accurately plot the 3D motion

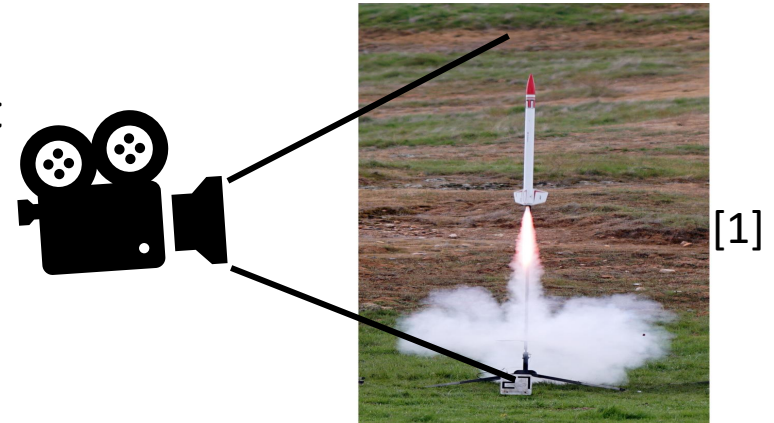


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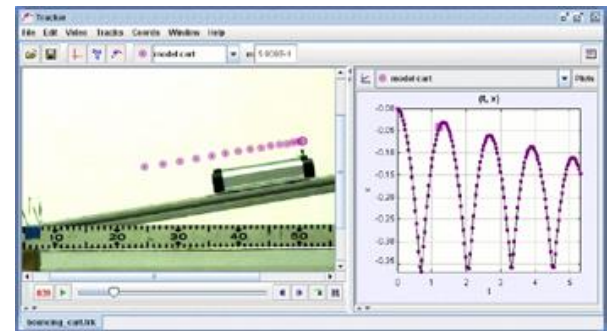


STEM Education: MDS Plan

1. 3 cameras will be set up and film the rocket lifting off

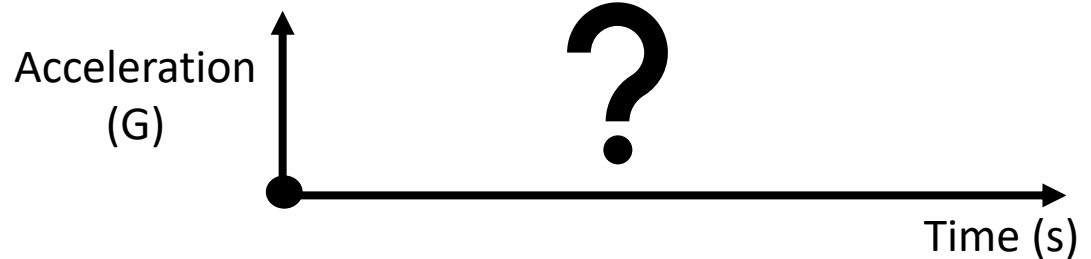


2. An object detection tracking software will be used to track the motion

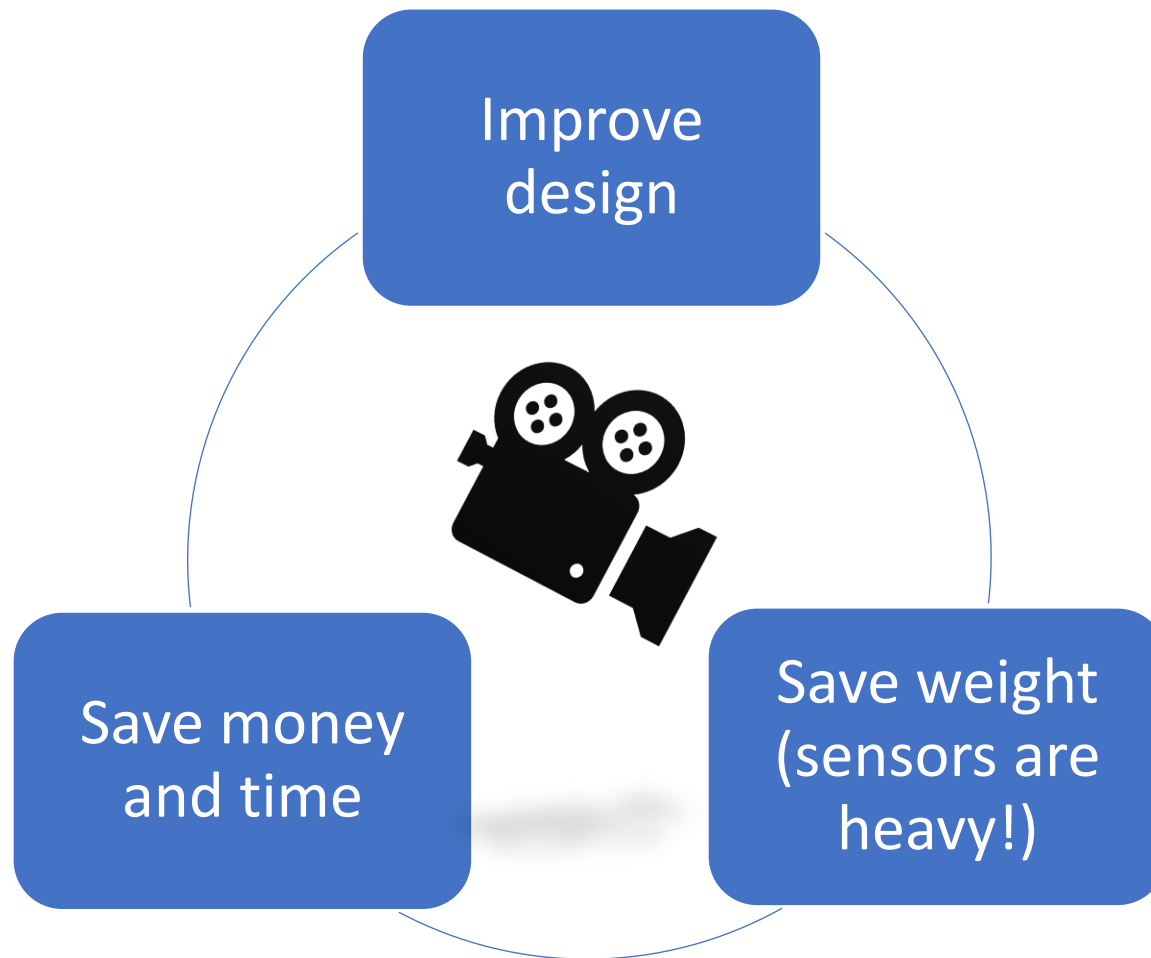


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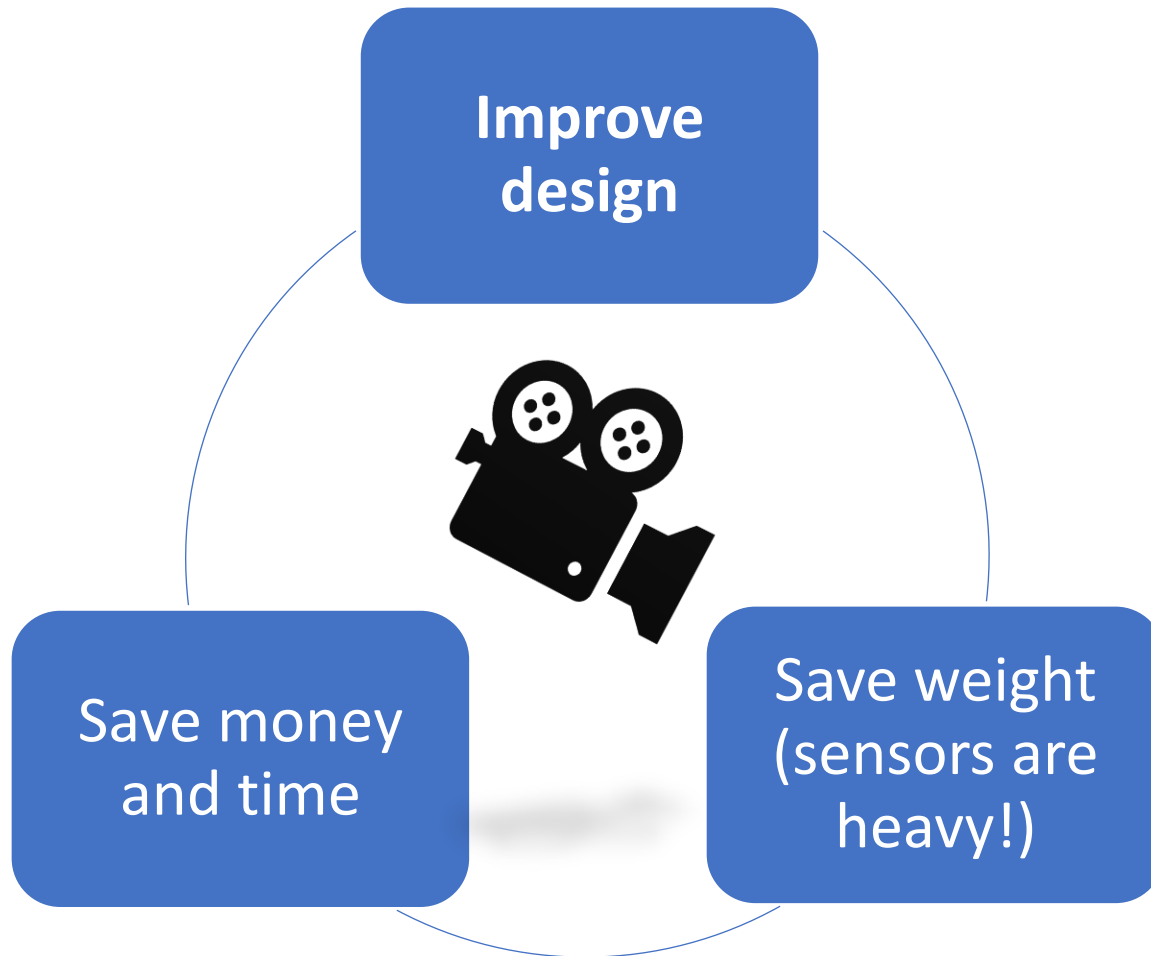
4. An accurate reading of the acceleration and velocity will be produced



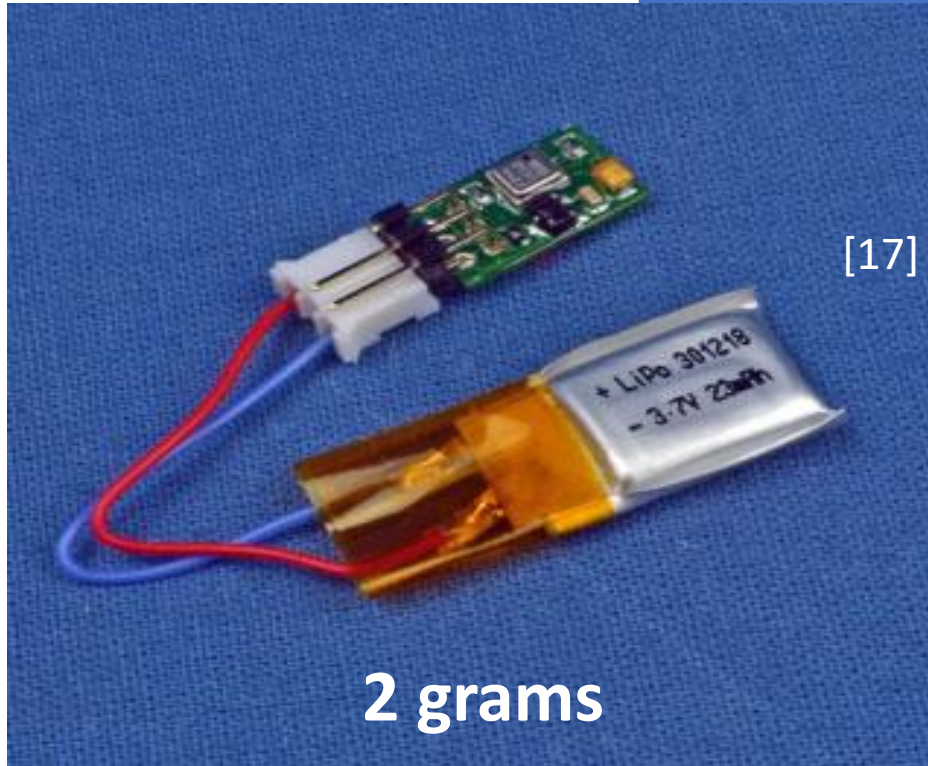
STEM Education: Camera Applications



STEM Education: Camera Applications



STEM Education: Camera Applications



Save weight
(sensors are heavy!)

STEM Education: Camera Applications



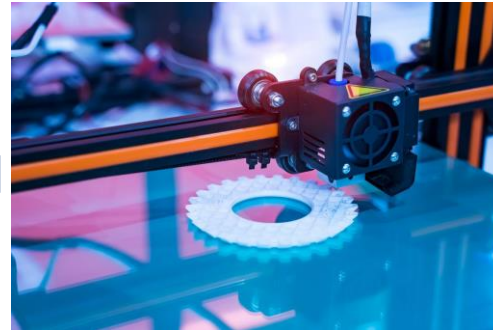
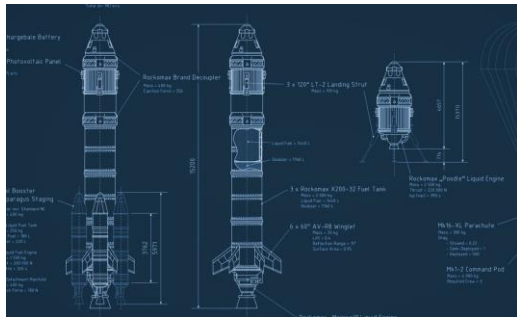
Save money
and time

Save weight
(sensors are
heavy!)

STEM Education: Other applications?

1. Optimize heat resistance
2. Predict flight path
3. Optimize weight
4. Self-landing rocket
5. Electric powered rocket
6. Strength simulations
7. Your thoughts...

A STEM Education Teaching Tool



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Special thanks to

Professor Wing Kam Liu

Satyajit Mojumder

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Stefan Knapik

Xiaoyu Xie

Subham Mitra

And anyone else not listed who contributed!

Questions/discussion

- What should we name the rocket?
- What other applications do you see for this project?

References

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