Conic Compass: An Advanced Compass

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Introduction

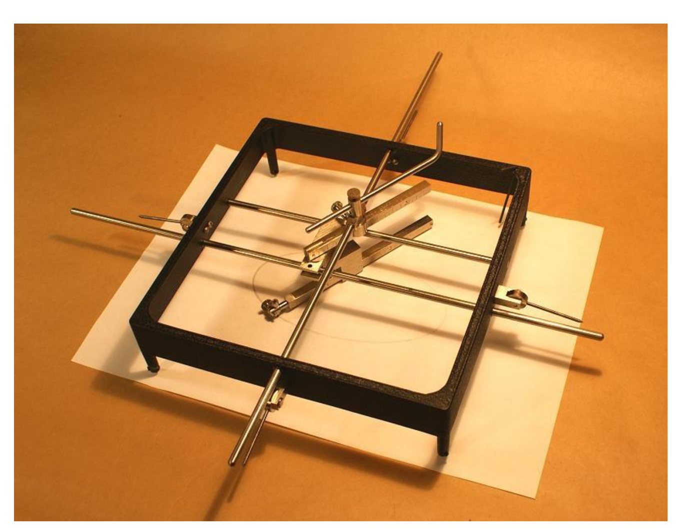
The compass is a significant mathematical tool that was initially created by the ancient Greeks. This poster presents a new advanced compass, called Conic Compass, that allows individuals to create any and all conic section functions which include: circles, ellipses, hyperbolas, and parabolas.

The compass is easy to use, compact, and durable. In the following sections of the poster, we present a brief background on compasses and the mathematics behind the compass, part creations that we designed in SolidWorks, and future work to be explored for the project.

History

The ancient Greek mathematicians created dividers and compasses, two drawing tools, which helped measure distances, transfer lengths, and trace circles. The compass was particularly used in compass-straightedge construction (making lengths, angles, and geometric figures with a compass and a straightedge). Euclid's Elements, ancient mathematical books, features many constructions with these two tools.

Elliptographs (a.k.a. ellipsographs) are drawing tools that can trace ellipses, and include elliptical compasses and elliptical trammel (a.k.a. Trammel of Archimedes). One example of an elliptical compass was created by A. E. Randles Co. in 1968.



Compasses are often used now for technical drawing in engineering and in mathematics for geometry problems. There is a large variety of compasses sold.

Math Background

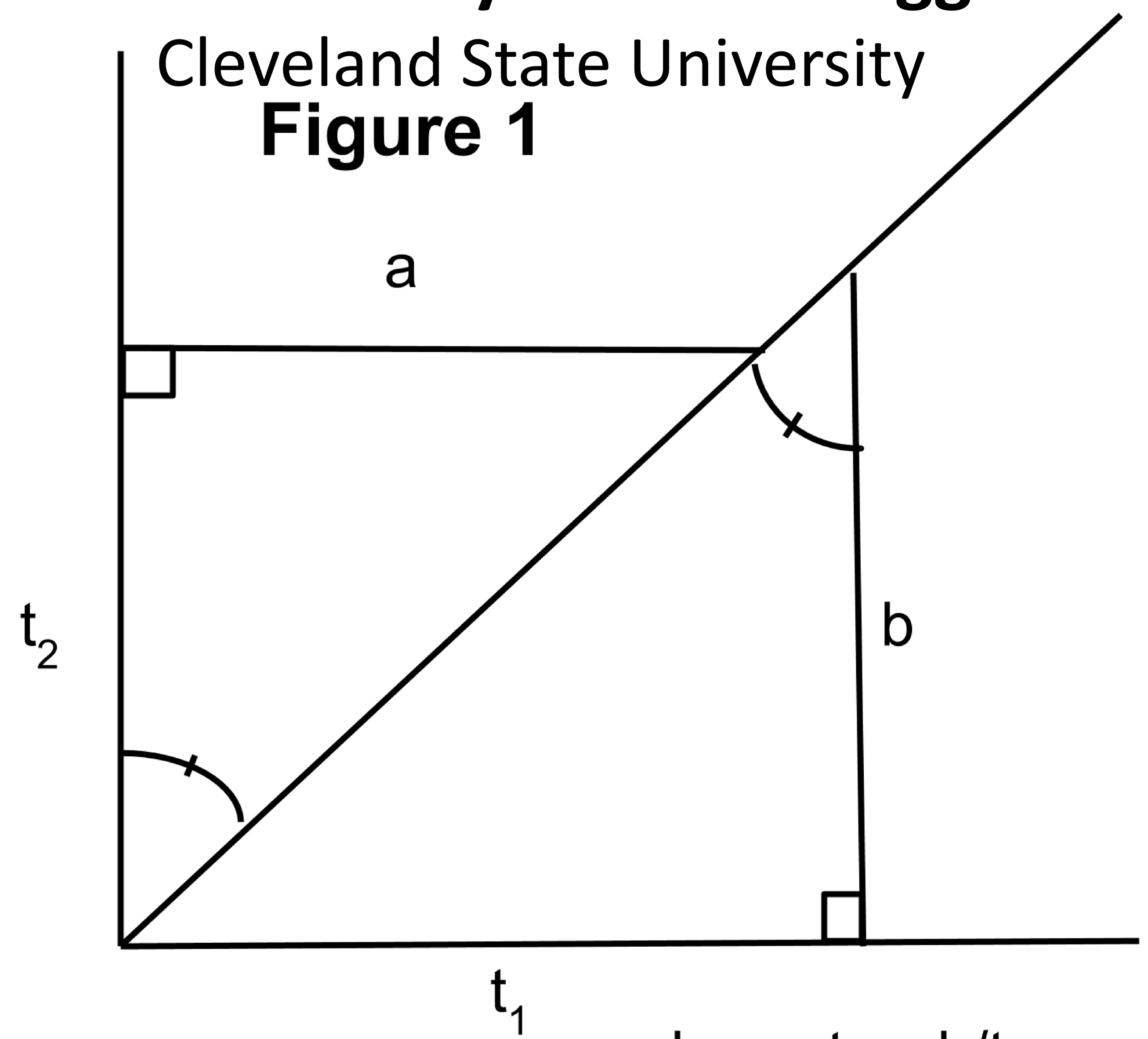
In polar coordinates, the equation: r=c/(1+*cos) defines a conic section function (circles, ellipses, hyperbolas and parabolas). The design of the conic compass implements this relationship between "r" (the radial distance from a pivot) and "θ"(the relative angle).

To mechanically implement this relationship, the compass functions on the principle of parametric or linked equations. In this way, the original polar equation takes the form of an inverse relationship linked to a sinusoidal relationship: r= c/(t), t = 1+ε*cosθ.

Independently, these relationships can be easily mechanically modeled in a wealth of different ways. One way uses the relationship between the sides of similar triangles (fig. 1).

$$r = \frac{c}{1 + \varepsilon cos\theta}$$

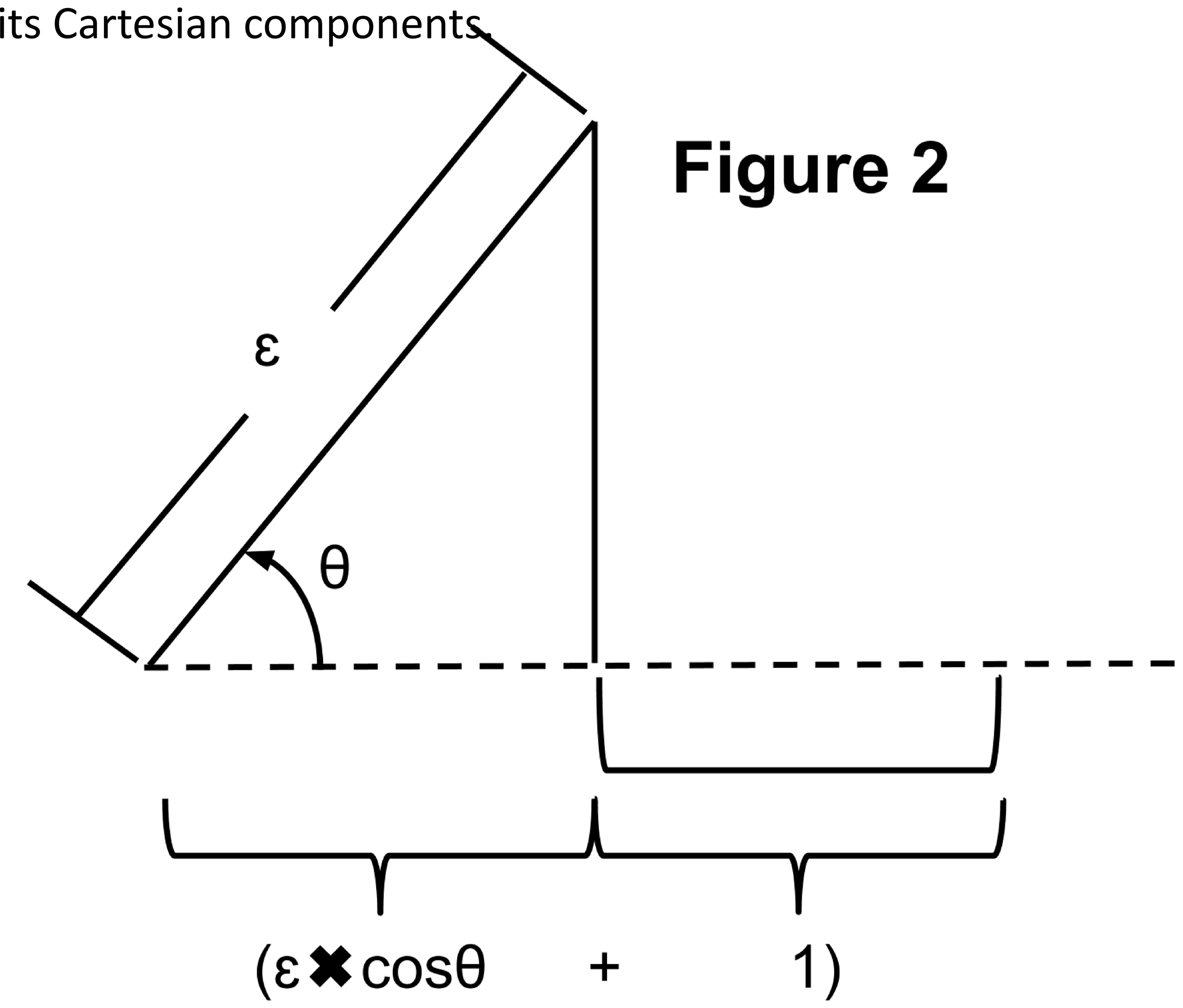
Figure 1



where: t_1=ab/t_2

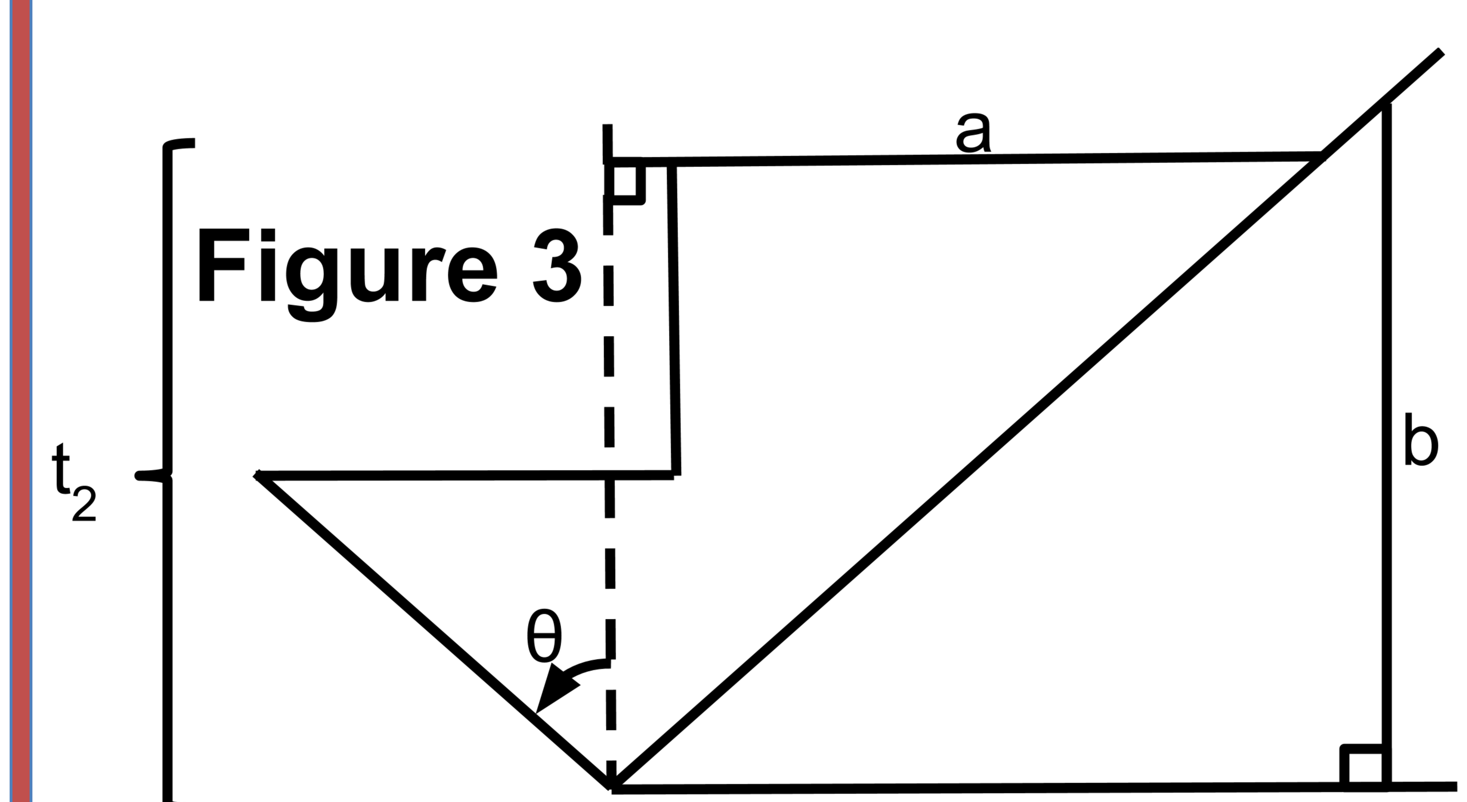
To obtain the sinusoidal relationship (fig. 2), we can exploit the correlation between a phasor arm and one of its Cartesian components.

Figure 2



Finally, combining these relationships (fig. 3) produces the equation r=c/(1+*cos).

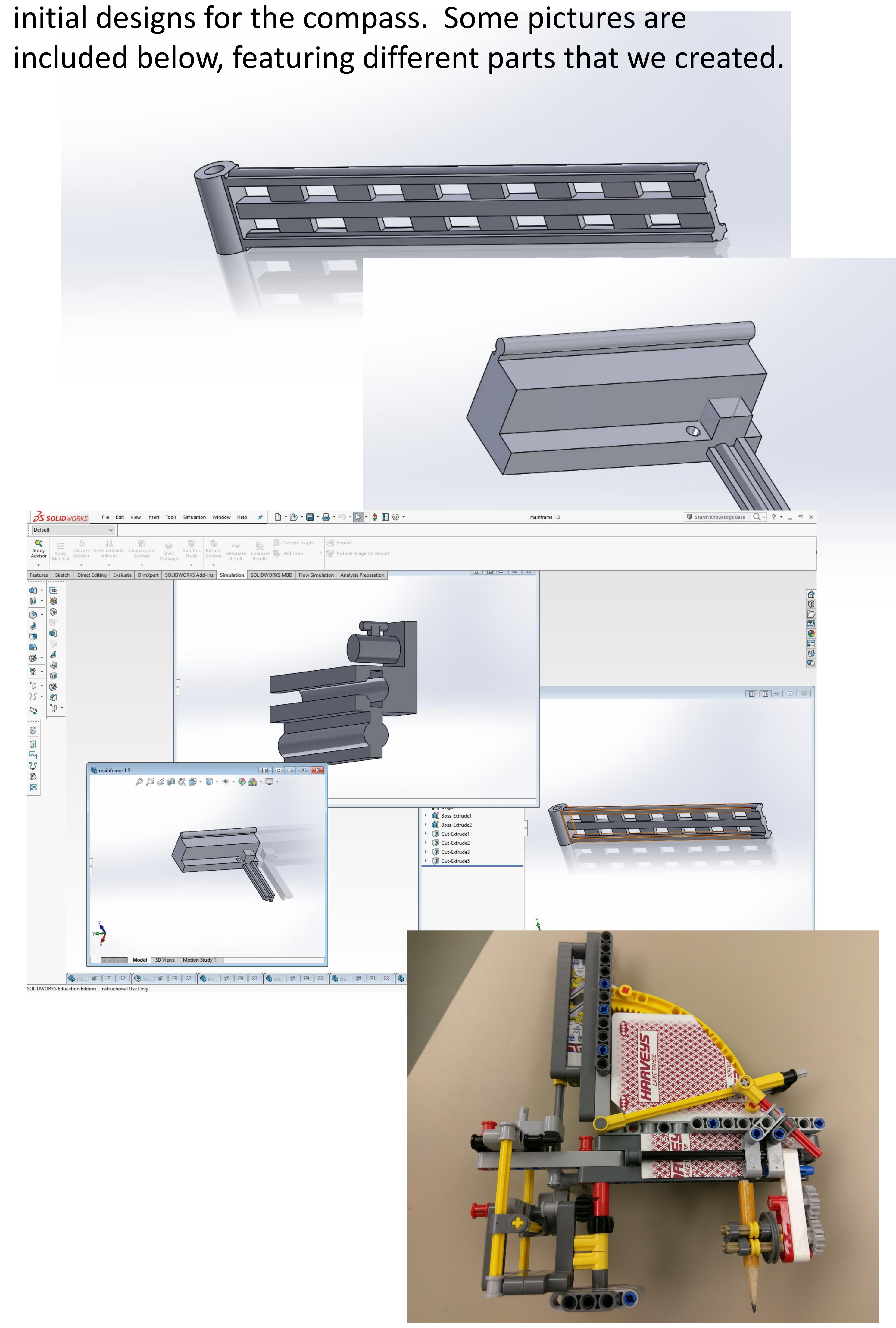
Figure 3



where: t_2=1+ε✖cosθ and: t_1=ab/(1+ε✖cosθ) ~r=c/(1+ε✖cosθ)

SolidWorks Compass Design

As previously mentioned, we used SolidWorks to create initial designs for the compass. Some pictures are included below, featuring different parts that we created.



Conclusion & Future Work

In conclusion, we are creating an advanced compass to draw any conic section function – including circles, ellipses, hyperbolas, and parabolas.

Future work for this project includes finalizing the design and producing the product. We plan to create a website for the compass to market it to more individuals.

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