Rock, Paper, Laser

The Effect of Red Laser on Origami Paper
By: Elijah Horland
MS104 / Class 632
January 2017
http://www.notabomb.org

About This Project

This investigation will test a red laser and how changing the paper color affects the time it takes to melt through the paper. I will be using a red laser to cut through the paper.

Lasers are a part of everyday use now. From CD's and DVD's to grocery checkout, we use dozens of lasers each day without even realizing it. I wanted to play with some powerful ones, and see what they can really do. Is it like science fiction? Will I find them useful?

*The death star laser would never work because a laser keeps going in a straight line the way it fired
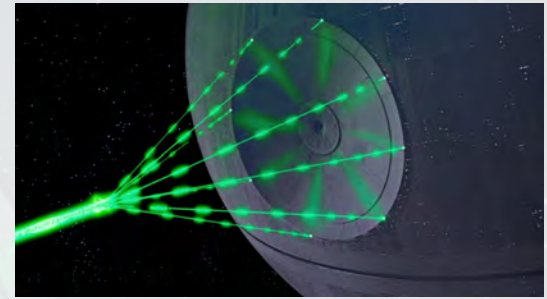
This would never work*
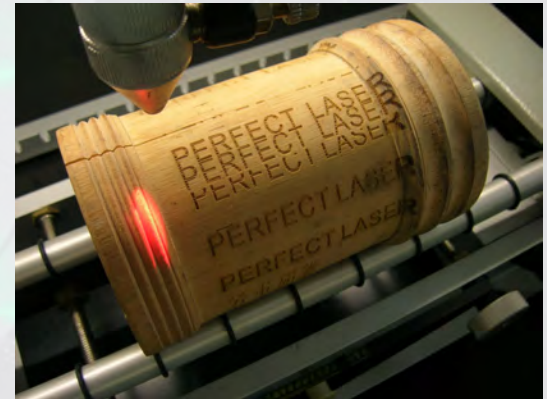
Artists & Industry use lasers more than the military.

About This Project

The independent variable affects the dependent variable when we change the color of the paper to affect the time it takes for the laser to cut the paper.

My Independent Variable affects my dependant variable because of the fact that different colors of paper absorb different amounts of light which means some papers may take a longer or shorter time to cut depending on its color.

We are cutting this type of paper

Our red laser module

Background research

I did some research on the colors of the spectrum and found out black was the most absorbent of light. I also found out that you make a laser by getting a large amount of atoms "excited" and ready to emit photons. Photons are particles of light. Once one of them emits a photon, it will stimulate some of the other atoms to do the same.

Once you have all that going you have a light then you need to trap the photons in between two mirrors and let it bounce around then open an extremly tight hole and let out a strong and focused light.

Arthur Schawlow
(Inventor of the laser)

My project
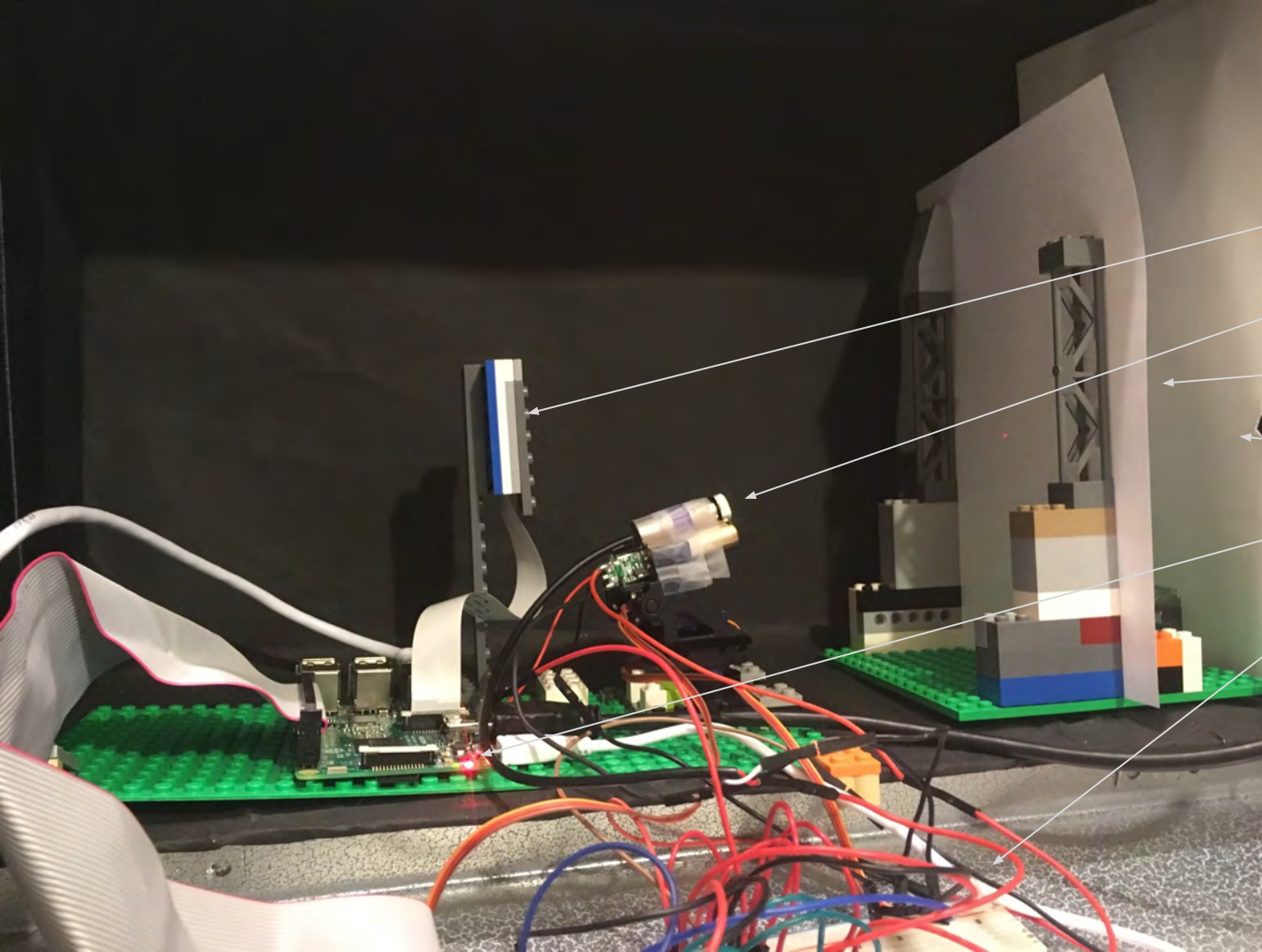
- Camera
- Laser
- Paper
- Background
- Raspberry Pi
- Bread Board

Materials

- Laser red (200mW)
- Laser firing box
- Laser servos x2
- Raspberry pi computer
- 2n2222 transistors x3
- Patch wires
- Breadboard
- Portable Battery
- Paper target holder
- Origami Paper 8 different colors

Laser and Black Wrap

Variables

Color of Paper : Independant Variable

Time to Cut : Dependant Variable

Laser Color : Constant Variable

Laser Angle : Constant Variable

Hypothesis

This is the paper that will soon be cut

If a red laser is pointed at a dark color paper such as black then the laser will cut through the paper faster because darker colors absorb more light

1. Build laser fire safety box
2. Wire battery to raspberry pi and breadboard
3. Wire laser to transistor and battery on breadboard
4. Wire transistor to raspberry pi
5. Wire servo motor to raspberry pi
6. Place laser on servo
7. Write aim and firing code
8. Arrange laser, servo, and paper holder in laser box and focus laser
9. Place one color of origami paper in paper holder
10. Start video camera
11. Start laser fire
12. Wait for laser to finish
13. Stop camera
14. Rotate paper 90d
15. Repeat twice to make average
16. Repeat from step 9 until all colors are done
17. Trim video in computer to find seconds to cut through paper


Me Building the Laser Fire Box

Raw Data

	Trial 1	Trial 2	Trial 3	Average
Black Paper	1.5	0.9	0.7	1.03
Red Paper	0	0	0	0
Orange Paper	0	0	0	0
Yellow Paper	0	0	0	0
Green Paper	0.1	0.6	0.1	0.26
Blue Paper	1.2	2	3.2	2.13
Purple Paper	2.7	0.1	0.3	1.03
White Paper	0	0	0	0

The Time it Takes Different Color Origami Paper to Be Cut By a Red Cutting Laser
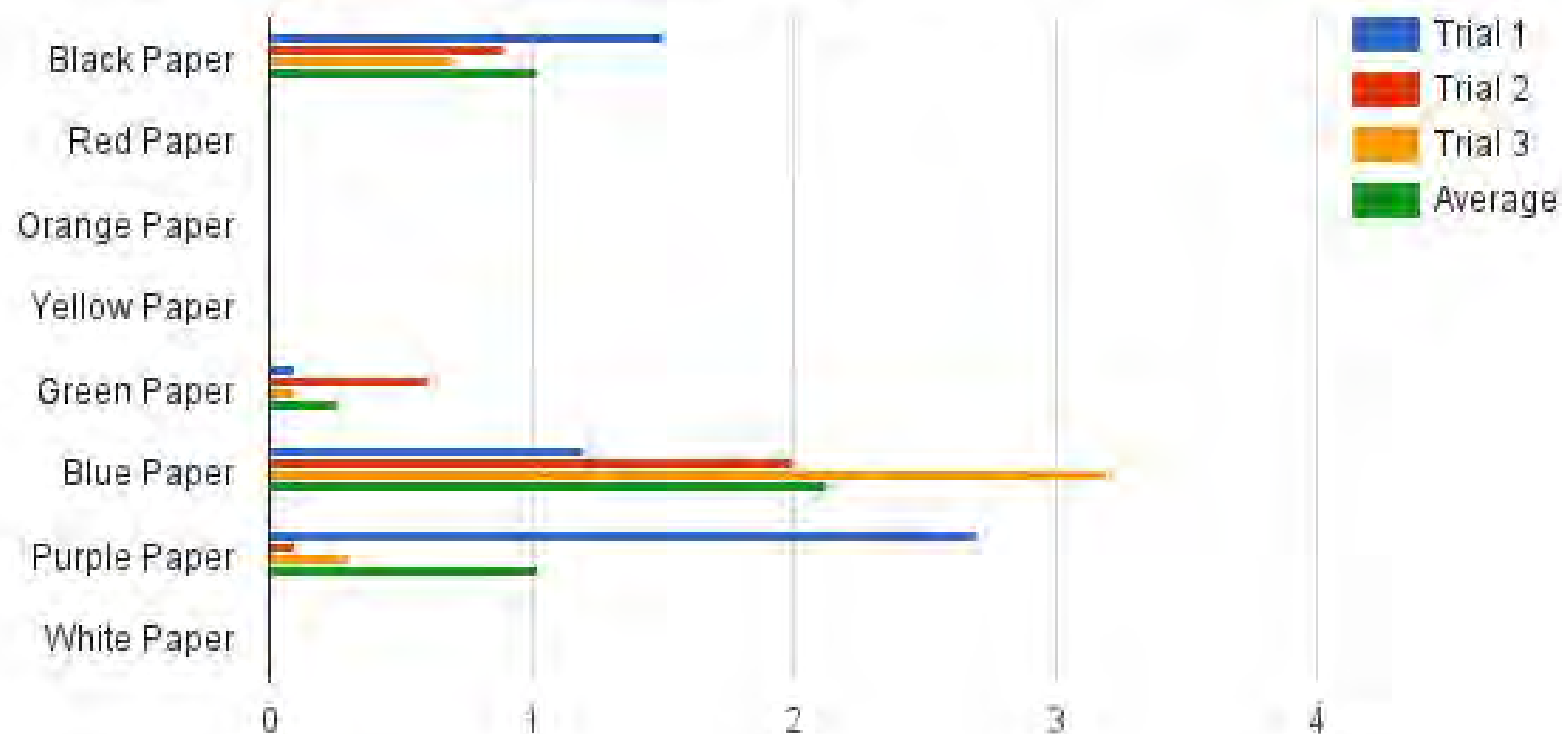
What the data shows

For the colors that do not cut, going across the color bar from violet at the lowest and red at the highest one can conclude that no color above green can be cut by a 200 mW red laser. The fastest color to cut was green which is half way across the spectrum from red also known as its complementary color. This means that green paper absorbs the red light most effectively, and colors above green in the color spectrum reflect red light more effectively.
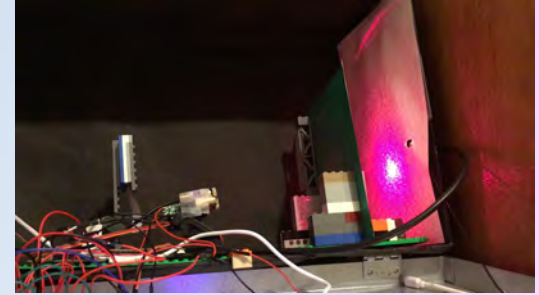
green paper test

Color Spectrum Wheel and Color Spectrum Bar

Visible Spectrum

Did not cut

Best cut

Slowest Cut

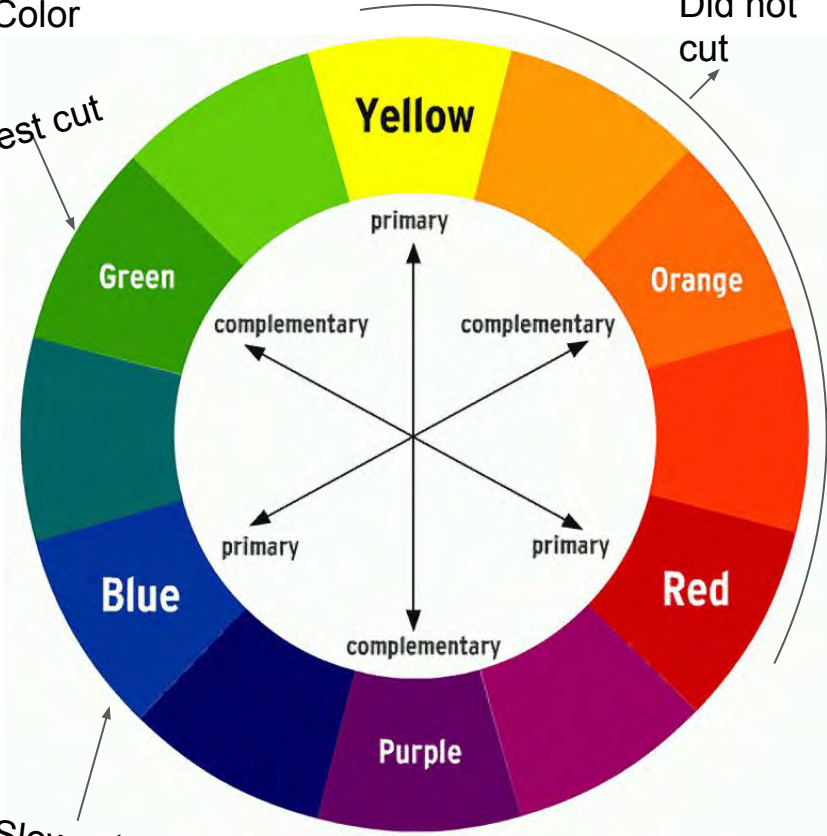Red   Orange   Yellow   Green   Blue   Indigo   Violet

Colors that did not cut

Colors that did cut

0.26

2.13

1.03

How the lasers were fired

I fired the lasers using "python" code written on a raspberry pi computer.

The program took 5 hours of programing to write and was 120 lines of code long.

Python is a programing language written in 1989 by Guido van Rossum. Python is written in an english like code and is easy to read for beginners. Python is used by web programmers, scientists, and the maker community.

The raspberry pi was created in early 2012 and has become one of the most popular maker and educator computer ever sold. I used the raspberry pi model 3 computer. Raspberry pi has set a computer record with 10,000,000 raspberry pi model 2 computers sold.

*The full length code is available as a handout and pasted beneath this sheet on the science board

Raspberry pi model 3

Guido van Rossum

On the Way to This Project...

Along the way this project took a few twists because of too many independent variables.

The original project was going to include a pan and tilt motor and testing effects on different colors of lasers on different colors of paper at different angles, that is 4 independent variables, 3 too many.

On top of that this project barely had any constant variables. On top of that we were using construction paper which had dull colors and was different thickness even on just one sheet.

We HAD to simplify in order to create usable data.

Original parts
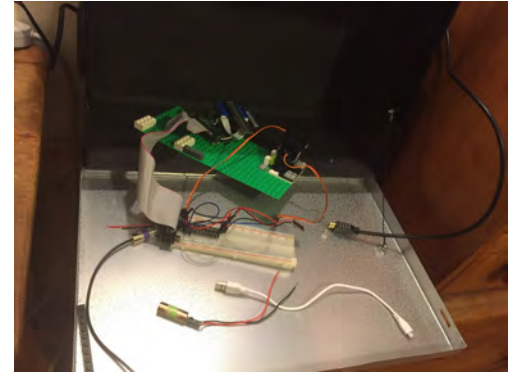
Original plan

Conclusion

- **My hypothesis was that red lasers should cut dark color paper faster and dark colors absorb more light.**

- **Red lasers cut green paper best, followed by black, then purple then blue.**

- **My hypothesis was not correct, cutting speed is affected by the position in the color spectrum.**

- **I learned that any color below green on the color spectrum line can not be cut by a red laser**

- **I also noticed that green cut fastest because it is exactly opposite of red on the color wheel**

Red laser beam

Conclusion

Blue laser beam

- **An error and an uncontrollable variable was the thickness of the paper, even with origami paper which has the most controlled paper thickness out of all the other paper there may have been some spots thicker and thinner than other spots.**

- **If i could do this project again the first thing i would change about it is the wattage of the laser, i only have a 200 milliwatt laser that is less than 1 wat if i had a 2 watt laser i could make very fast cuts and maybe even try the density of different materials**

Conclusion

- **This experiment inspires many other experiments but the one i want to do most is "SPACE LASER" my question for that experiment is what color does a laser have to be so you can see it on the earth's surface from space.**

- **This is actually very helpful in real life in case you need to cut things with lasers professionally, you would know what colors you can cut and what colors you can cut with a red laser.**

Green laser beam

Resources/Work Cited

http://spaceplace.nasa.gov/laser/an

http://www.planet-science.com/categories/over-11s/technology/2012/01/what-is-a-laser.aspx

http://www.hobby-hour.com/electronics/resistorcalculator.php

"The Science of Star Wars" by Jamie Cavelos, 1999 St. Martin's Press

The Raspberry Pi Foundation : http://www.raspberrypi.org

Python Home : http://www.python.org

ServoBlaster Servo Motor Control : https://github.com/richardghirst/PiBits/tree/master/ServoBlaster

Thanks for Watching!!!

QUIZ!!!!

1. What Color Paper Cut the Fastest?
   a. Green
   b. White
   c. Red
   d. Blue

2. What Color Laser Did I Use to Cut?
   a. Blue
   b. Red
   c. Green
   d. Yellow