

Colour Blindness Report
COMP120 Tinkering Graphics

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0.1 Introduction

Colour Blindness or Colour Deficiency, affects 1 in 12 men and 1 in 200 women across the world.¹ This means that there are 3 million people in the UK that are colourblind. Colour Blindness is usually a genetic fault on chromosomes, the overpowering bias towards males in the figures is due to the most common form of Colour Blindness, red-green, being transferred through the X Chromosome.² On the opposing side, an injury can induce Colour Blindness, these include: Eye Diseases (Glaucoma and Macular Degeneration), Brain and Nervous System Diseases (Alzheimers or multiple Sclerosis) or alternatively there are some types of medicines with side effects as Colour Blindness, such as Planquenil, a rheumatiod arthritis medicine.³

There are many different types of Colour Blindness, I shall strive to create an algorithm to simulate every type of Colour Blindness. The types depend on how many of the cone types are defficient. You have Anomalous Trichromacy in which one type of cone is defficient, Dichromacy is where two of the cones are completely defficient and Monochromacy where the patient sees no colour, with usually greyscale vision.⁴ It can also be noted that some people describe that Colour Blindness as the confusion of different colours, this is seen in some of my code.⁵

In this report I shall set out my work to produce an a couple of algorithms to simulate all the different types of Colour Blindness, they have all be produced in PyCharm 2019.2.3 using PyGame 1.9.4 in Python 3.7. The image that I shall be using is one that I have taken, it requires no citing.

¹ Colour Blindness. URL: <http://www.colourblindawareness.org/colour-blindness/>.

²L. T. Sharpe and Karl R. Gegenfurtner. *Color vision: from genes to perception*. 1st ed. Vol. 1. Cambridge University Press, 2001.

³ What Causes Colour Blindness? URL: <https://nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/color-blindness/causes-color-blindness>.

⁴ Types of Colour Blindness. URL: <http://www.colourblindawareness.org/colour-blindness/types-of-colour-blindness/>.

⁵ Colour Vision Deficiency. URL: <https://www.nhs.uk/conditions/colour-vision-deficiency/>.

0.2 Anomalous Trichromacy

0.2.1 Protanomaly

Protanomaly is reduced sensitivity to red light.⁶

Code

```
import pygame
pygame.init()

main_window = pygame.display.set_mode((500, 500))

my_surface = pygame.image.load('Lizard.jpg').convert()

def TriColourBlindness(surface, filename):
    pixel = pygame.Color(0, 0, 0)
    for x in range(surface.get_width()):
        for y in range(surface.get_height()):
            pixel = surface.get_at((x, y))
            pixelValue = (pixel.r + pixel.g)/2
            surface.set_at((x, y), (pixelValue, pixel.g, pixel.b))
    pygame.image.save(surface, filename)

TriColourBlindness(my_surface, "protanomaly.png")

running = True
while running:
    for event in pygame.event.get():
        if event.type == pygame.QUIT:
            running = False
    main_window.fill((255, 255, 255))
    main_window.blit(my_surface, (0, 0))
    pygame.display.update()

pygame.quit()
```

⁶ *Types of Colour Blindness*, op. cit.

Results

Figure 1: Original Picture



Figure 2: Protanomaly version

0.2.2 Dueteromaly

Dueteromaly is reduced sensitivity to green light.⁷

Code

```
import pygame
pygame.init()

main_window = pygame.display.set_mode((500, 500))

my_surface = pygame.image.load('Lizard.jpg').convert()

def TriColourBlindness(surface, filename):
    pixel = pygame.Color(0, 0, 0)
    for x in range(surface.get_width()):
        for y in range(surface.get_height()):
            pixel = surface.get_at((x, y))
            pixelValue = (pixel.g + pixel.b)/2
            surface.set_at((x, y), (pixel.r, pixelValue, pixel.b))
    pygame.image.save(surface, filename)

TriColourBlindness(my_surface, "deuteromaly.png")

running = True
while running:
    for event in pygame.event.get():
        if event.type == pygame.QUIT:
            running = False
    main_window.fill((255, 255, 255))
    main_window.blit(my_surface, (0, 0))
    pygame.display.update()

pygame.quit()
```

⁷Ibid.

Results

Figure 3: Original Picture

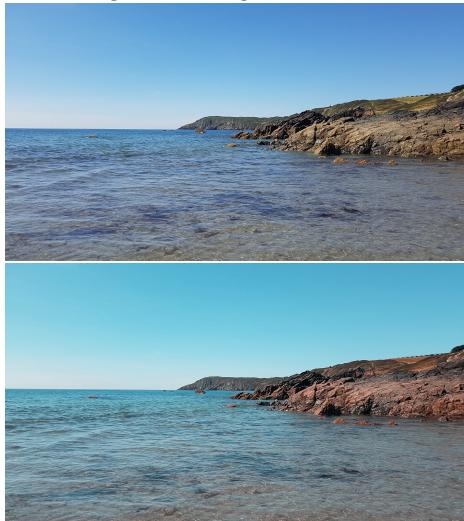


Figure 4: Dueteranomaly version

0.2.3 Tritanomaly

Tritanomaly is reduced sensitivity to blue light.⁸

Code

```
import pygame
pygame.init()

main_window = pygame.display.set_mode((500, 500))

my_surface = pygame.image.load('Lizard.jpg').convert()

def TriColourBlindness(surface, filename):
    pixel = pygame.Color(0, 0, 0)
    for x in range(surface.get_width()):
        for y in range(surface.get_height()):
            pixel = surface.get_at((x, y))
            pixelValue = (pixel.b + pixel.r)/2
            surface.set_at((x, y), (pixel.r, pixel.g, pixelValue))
    pygame.image.save(surface, filename)

TriColourBlindness(my_surface, "tritanomaly.png")

running = True
while running:
    for event in pygame.event.get():
        if event.type == pygame.QUIT:
            running = False
    main_window.fill((255, 255, 255))
    main_window.blit(my_surface, (0, 0))
    pygame.display.update()

pygame.quit()
```

⁸Ibid.

Results

Figure 5: Original Picture



Figure 6: Tritanomaly version

0.2.4 Dueteropia

Dueteropia is no sensitivity to green light.⁹

Code

```
import pygame
pygame.init()

main_window = pygame.display.set_mode((500, 500))

my_surface = pygame.image.load('Lizard.jpg').convert()

def Deuteropia(surface, filename):
    pixel = pygame.Color(0, 0, 0)
    for x in range(surface.get_width()):
        for y in range(surface.get_height()):
            pixel = surface.get_at((x, y))
            pixelValue = (pixel.r + pixel.b)/2
            surface.set_at((x, y), (pixel.r, pixelValue, pixel.b))
    pygame.image.save(surface, filename)

Deuteropia(my_surface, "Deuteropia.jpg")

running = True
while running:
    for event in pygame.event.get():
        if event.type == pygame.QUIT:
            running = False
    main_window.fill((255, 255, 255))
    main_window.blit(my_surface, (0, 0))
    pygame.display.update()

pygame.quit()
```

⁹Ibid.

Results

Figure 7: Original Picture



Figure 8: Dueteropia version

0.2.5 Protanopia

Protanopia is no sensitivity to red light.¹⁰

Code

```
import pygame
pygame.init()

main_window = pygame.display.set_mode((500, 500))

my_surface = pygame.image.load('Lizard.jpg').convert()

def Protanopia(surface, filename):
    pixel = pygame.Color(0, 0, 0)
    for x in range(surface.get_width()):
        for y in range(surface.get_height()):
            pixel = surface.get_at((x, y))
            pixelValue = (pixel.g + pixel.b)/2
            surface.set_at((x, y), (pixelValue, pixel.g, pixel.b))
    pygame.image.save(surface, filename)

Protanopia(my_surface, "Protanopia.jpg")

running = True
while running:
    for event in pygame.event.get():
        if event.type == pygame.QUIT:
            running = False
    main_window.fill((255, 255, 255))
    main_window.blit(my_surface, (0, 0))
    pygame.display.update()

pygame.quit()
```

¹⁰Ibid.

Results

Figure 9: Original Picture



Figure 10: Protanopia version

0.2.6 Tritanopia

Tritanopia is no sensitivity to blue light.¹¹

Code

```
import pygame
pygame.init()

main_window = pygame.display.set_mode((500, 500))

my_surface = pygame.image.load('Lizard.jpg').convert()

def Tritanopia(surface, filename):
    pixel = pygame.Color(0, 0, 0)
    for x in range(surface.get_width()):
        for y in range(surface.get_height()):
            pixel = surface.get_at((x, y))
            pixelValue = (pixel.r + pixel.g)/2
            surface.set_at((x, y), (pixel.r, pixel.g, pixelValue))
    pygame.image.save(surface, filename)

Tritanopia(my_surface, "Tritanopia.jpg")

running = True
while running:
    for event in pygame.event.get():
        if event.type == pygame.QUIT:
            running = False
    main_window.fill((255, 255, 255))
    main_window.blit(my_surface, (0, 0))
    pygame.display.update()

pygame.quit()
```

¹¹Ibid.

Results

Figure 11: Original Picture



Figure 12: Tritanopia version

0.2.7 Monochromat

Monochromat is no sensitivity to any coloured light.¹²

Code

```
import pygame
pygame.init()

main_window = pygame.display.set_mode((500, 500))

my_surface = pygame.image.load('Lizard.jpg').convert()

def Monochromat(surface, filename):
    pixel = pygame.Color(0, 0, 0)
    for x in range(surface.get_width()):
        for y in range(surface.get_height()):
            pixel = surface.get_at((x, y))
            pixelValue = (pixel.r + pixel.g + pixel.b)/3
            surface.set_at((x, y), (pixelValue, pixelValue, pixelValue))
    pygame.image.save(surface, filename)

Monochromat(my_surface, "Monochromat.jpg")

running = True
while running:
    for event in pygame.event.get():
        if event.type == pygame.QUIT:
            running = False
    main_window.fill((255, 255, 255))
    main_window.blit(my_surface, (0, 0))
    pygame.display.update()

pygame.quit()
```

¹²Ibid.

Results

Figure 13: Original Picture



Figure 14: Monochromat version

Bibliography

- Colour Blindness.* URL: <http://www.colourblindawareness.org/colour-blindness/>.
- Colour Vision Deficiency.* URL: <https://www.nhs.uk/conditions/colour-vision-deficiency/>.
- Sharpe, L. T. and Karl R. Gegenfurtner. *Color vision: from genes to perception.* 1st ed. Vol. 1. Cambridge University Press, 2001.
- Types of Colour Blindness.* URL: <http://www.colourblindawareness.org/colour-blindness/types-of-colour-blindness/>.
- What Causes Colour Blindness?* URL: <https://nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/color-blindness/causes-color-blindness>.