Imaging

The Future

Powered by Enigma

How Pictures are Taken

Jack Sparrow

Picture Output

Hmm.. What's lens ?

What is Lens?

Focuses light into a single point

DSLR Lens

Glass lens with many moving parts

Liquid Lens

Made of liquid, no moving parts

Wait... there is Image Sensor

1

Why Do We Need Them?

Convert photons to digital signals

2

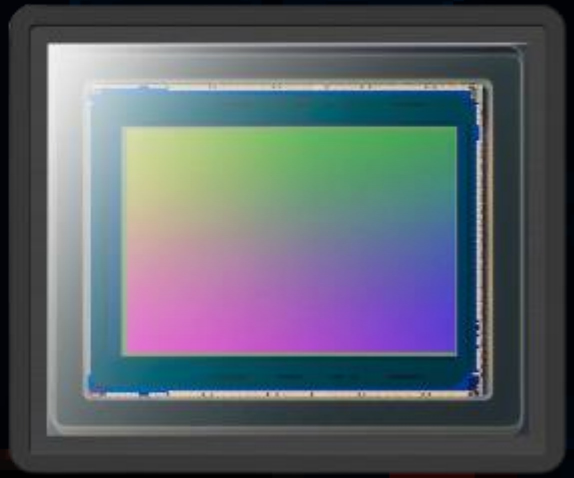
CCD Sensor

Analog sensors, high power

3

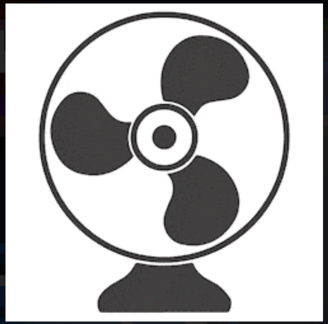
CMOS Sensor

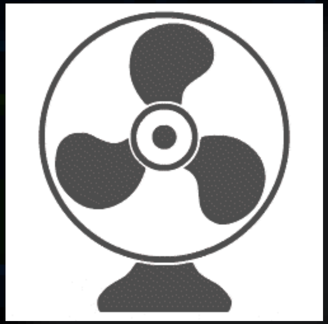
Digital sensors, low power



Sony IMX Image Sensor

Hmm... Shutters ?





Shutter

Controls the amount of light

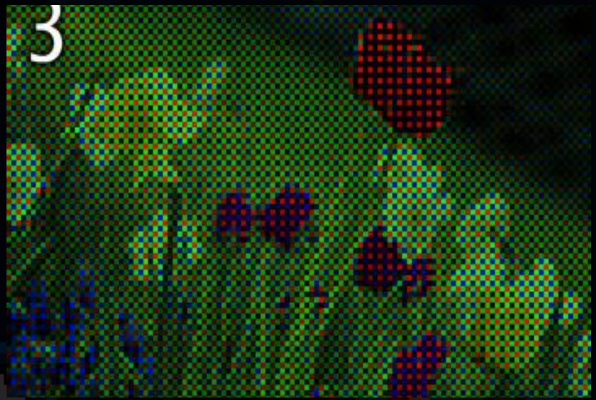
Global Shutter

Better for moving subjects

Rolling Shutter

Better for static subjects

Bayer Filter



Original Image

Nature

Filtering

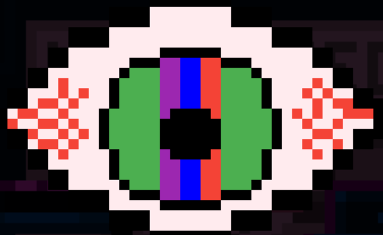
Filters out a single colour per unit

Demosaicing

Averages neighbouring colours

Bayer Filter

RGB Channels



Human Eye

Computer Displays

Image Scanners

Pixels in each image can have a brightness intensity between 0 and 255.

RGB Channels

RGB Channel Merged Image

Red Channel Image

Green Channel Image

Blue Channel Image

Human Vision v/s Computer Vision

Human Vision

Our eyes depend on
Light

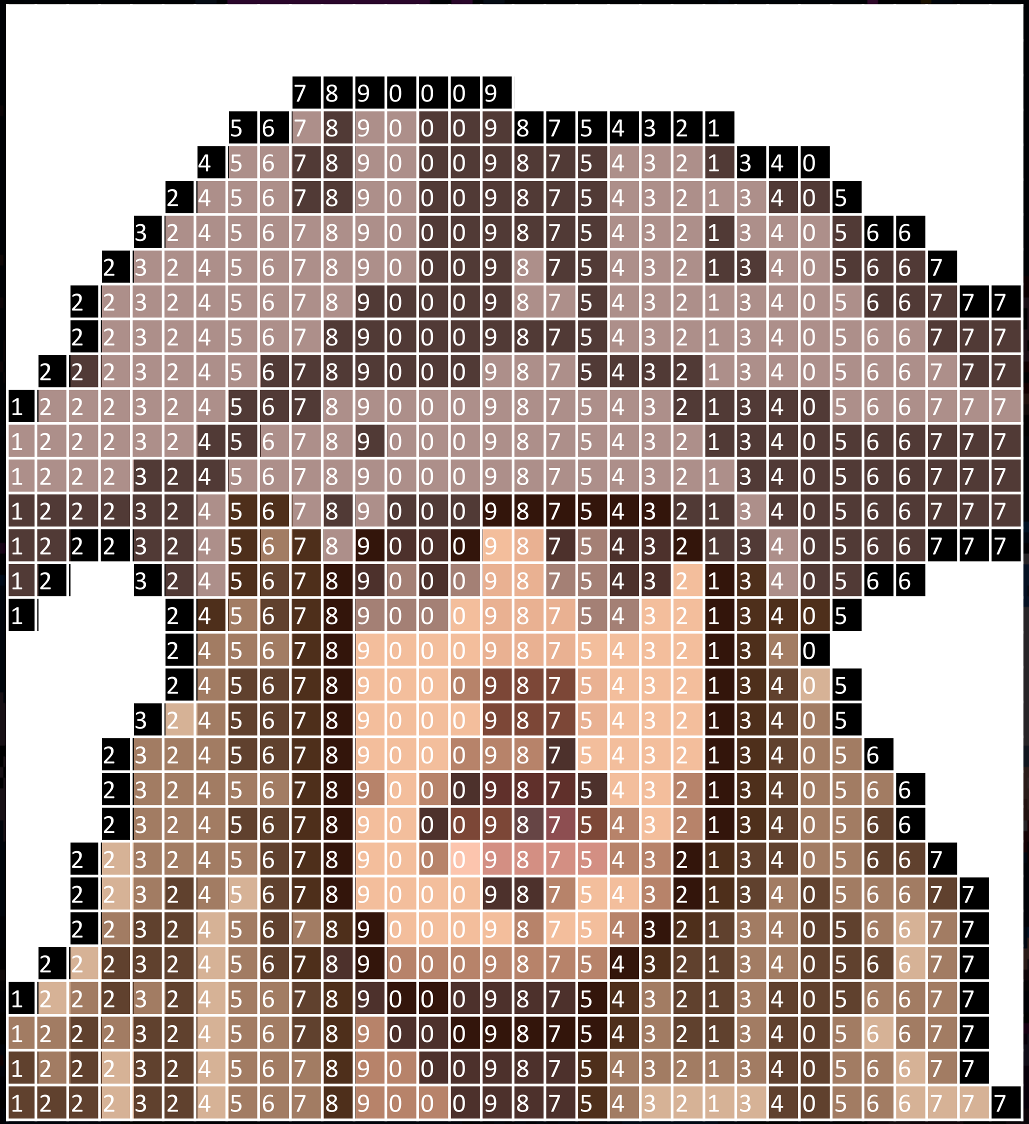
Conversion

Image gets divided into a matrix

Computer Vision

Computers depend on
Pixels

How Computers See



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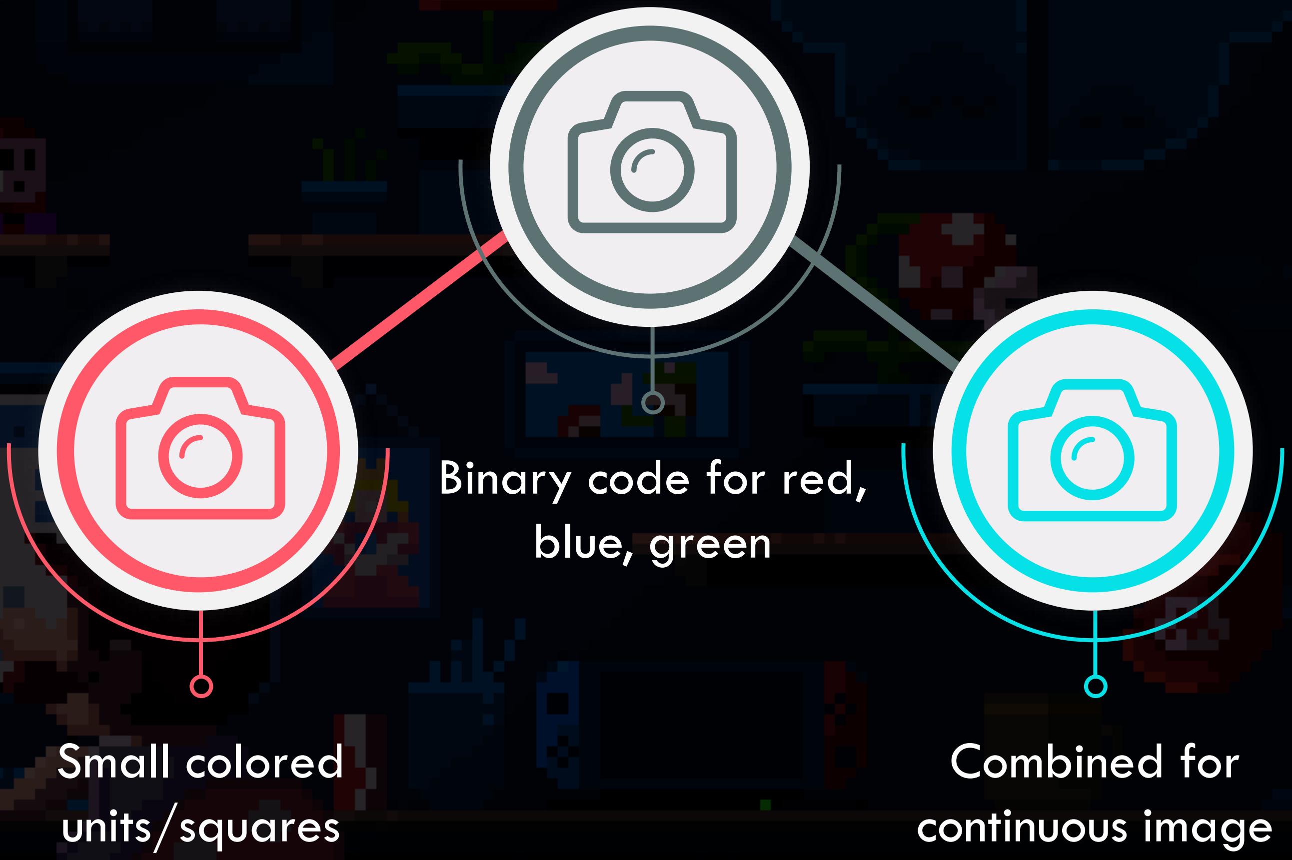
What is a Pixel ?

Pixeled Picture of Jack Sparrow

That's a Pixel !



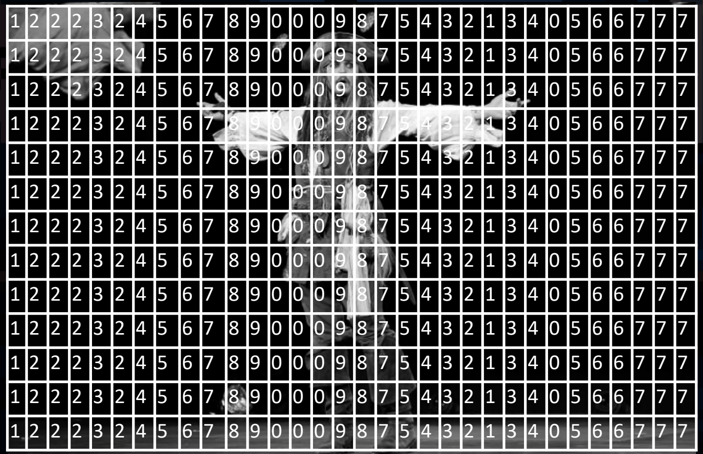
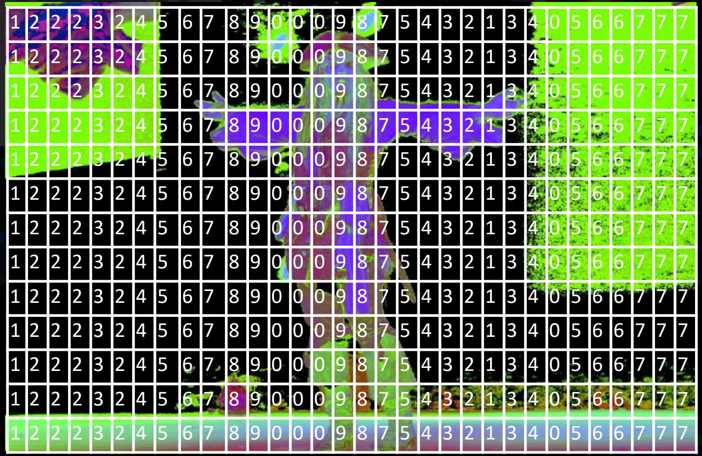
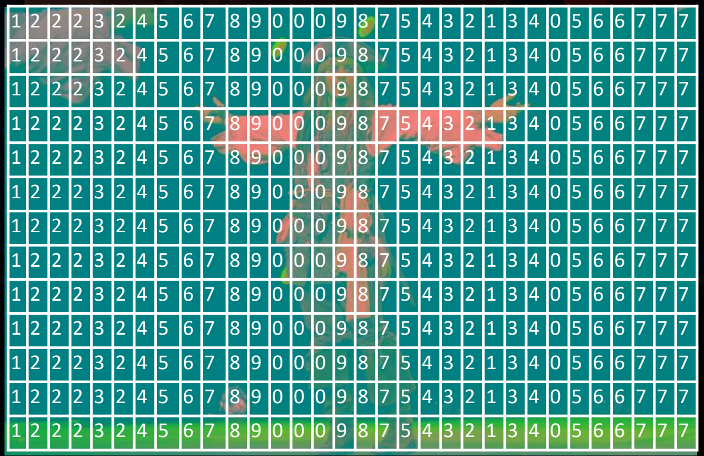
Color Spaces aka Filters



GRAYSCALE

HSV

LAB

HDR, RAW and Image Compression

1

HDR
High range,
greater detail.

HDR Images

2

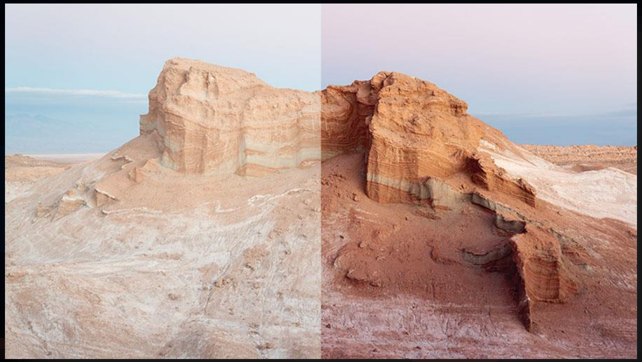
Compression
Generally, in JPEG,
smaller size, effects.

Original Image

Compressed Image

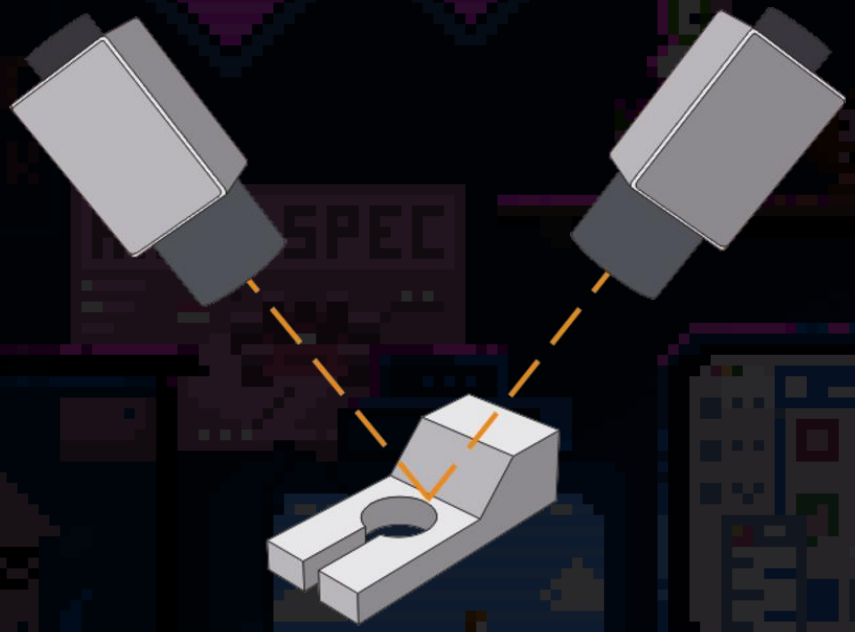
3

RAW
Uncompressed, no effects,
flexible to edit.



RAW Images

Stereo Vision



Stereo Vision Camera Setup

Advantage : Gives us Depth

Results

Stereo **Geometry**

$$d = x_L - x_R$$

$$x_L = f\frac{x_L}{x_L}$$

$$x_R = f\frac{x_R}{x_R}$$

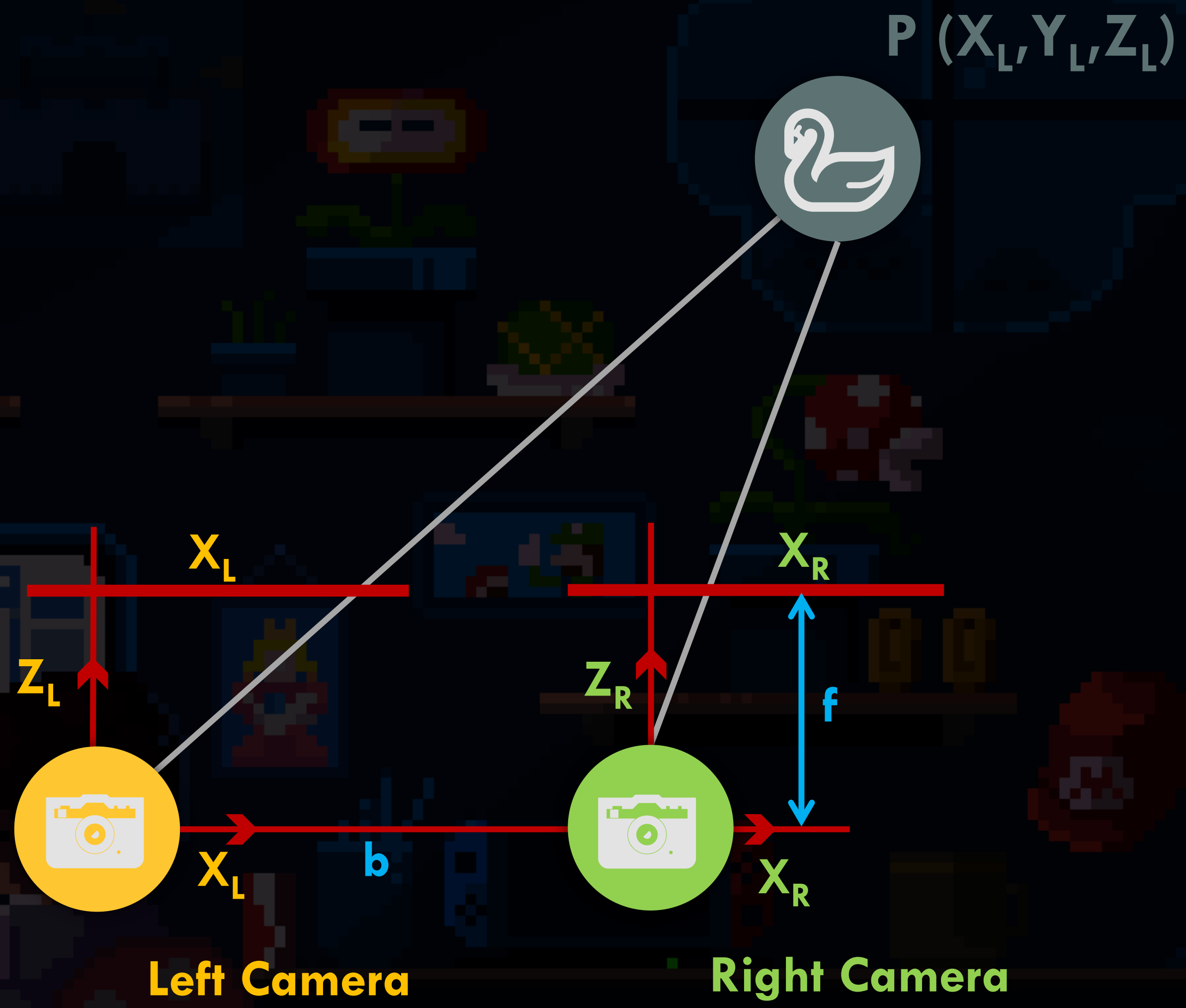
f is focal length
b is baseline length

$$\therefore Z_R = Z_L = Z \text{ and } X_L = X_R + b$$

$$\because d = x_L - x_R = f\frac{X_R+b}{Z} - X_R = f\frac{X_R+b-X_R}{Z} = f\frac{b}{z}$$

$$\boldsymbol{d = f\frac{b}{z}}$$

$$\boldsymbol{z = f\frac{b}{d}}$$



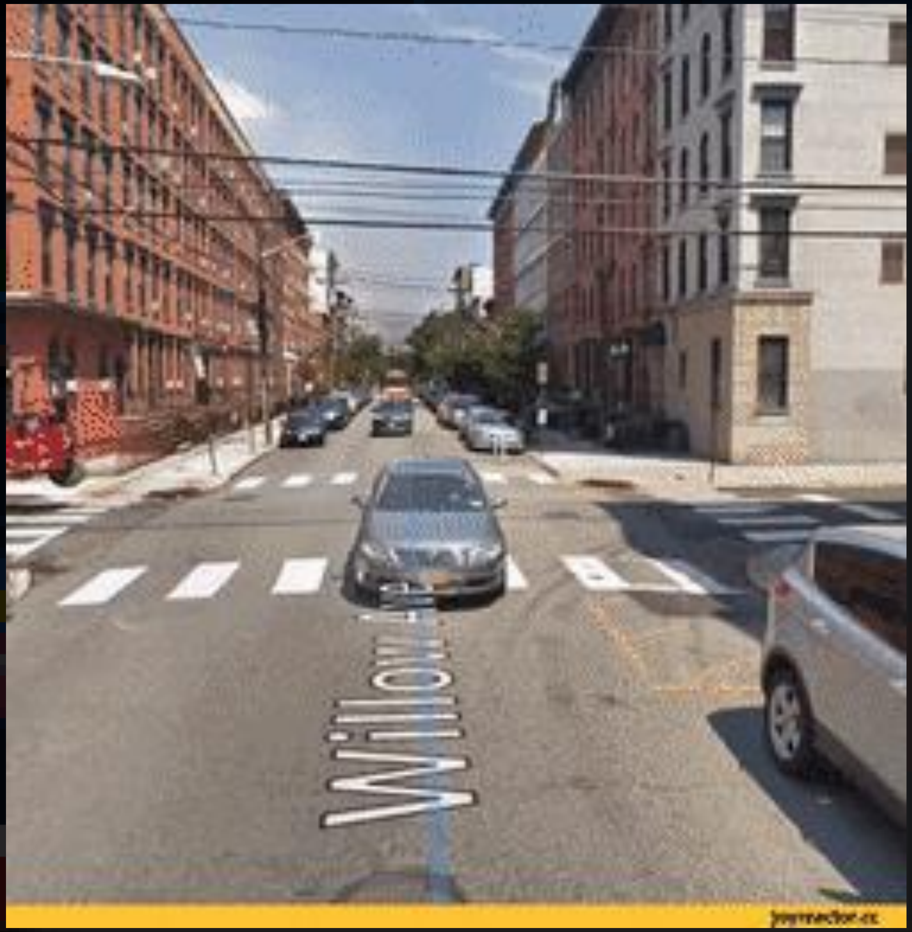
As disparity increases, Z value is smaller.
As disparity decreases, point goes further away.

Panoramic stitching

Result

360° Images

360 Camera Setup on Google Street View Car

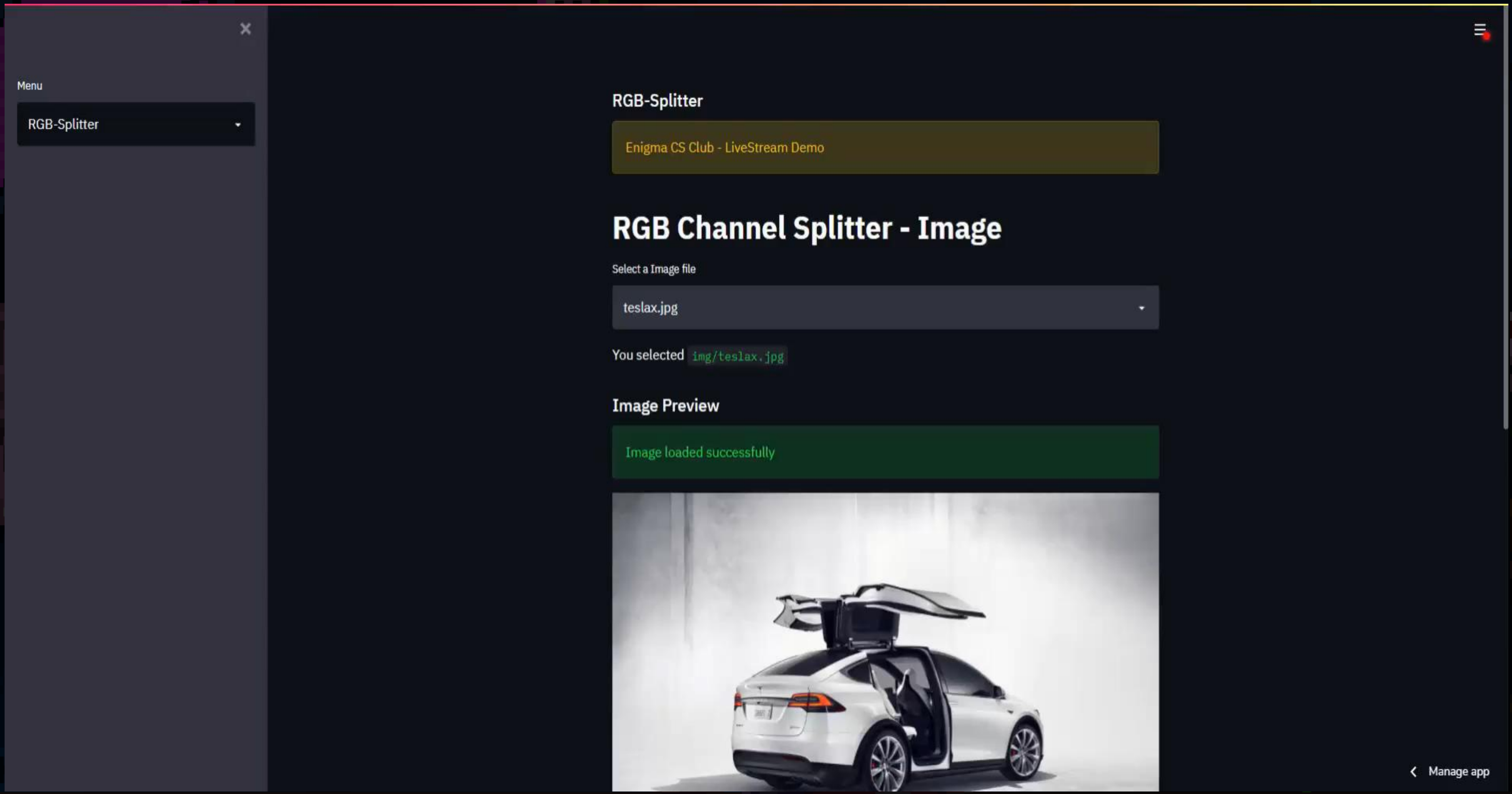


Result

Let’s Recap

1. Image Sensors
2. RGB Channels
3. Pixel and Color Spaces
4. Computer Vision vs Human Vision
5. Modern Photography

WebApp



Streamlit

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