Week 1 task - Takh2100

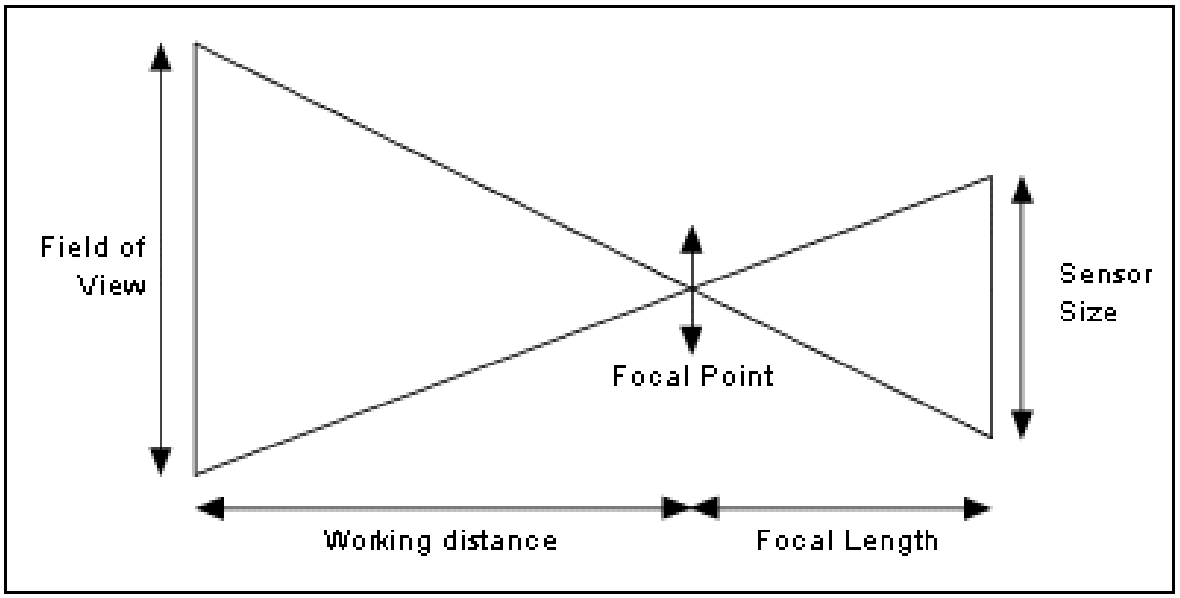
[Link to code]

Introduction

This assignment involved working with camera capture, field of view calculations and the relationship between focal length, sensor size and projection. Through implementing a python script that integrates OpenCV for camera input and Matplotlib for visualization, I gained insight into how these parameters interact in imaging systems.

Field of View Calculation

FIeld of view(FOV) is a crucial concept in imaging that determines how much of a scene is visible given a cameras sensor size/width and focal length (distance between the sensor and the lens) as can be seen in the figure below.

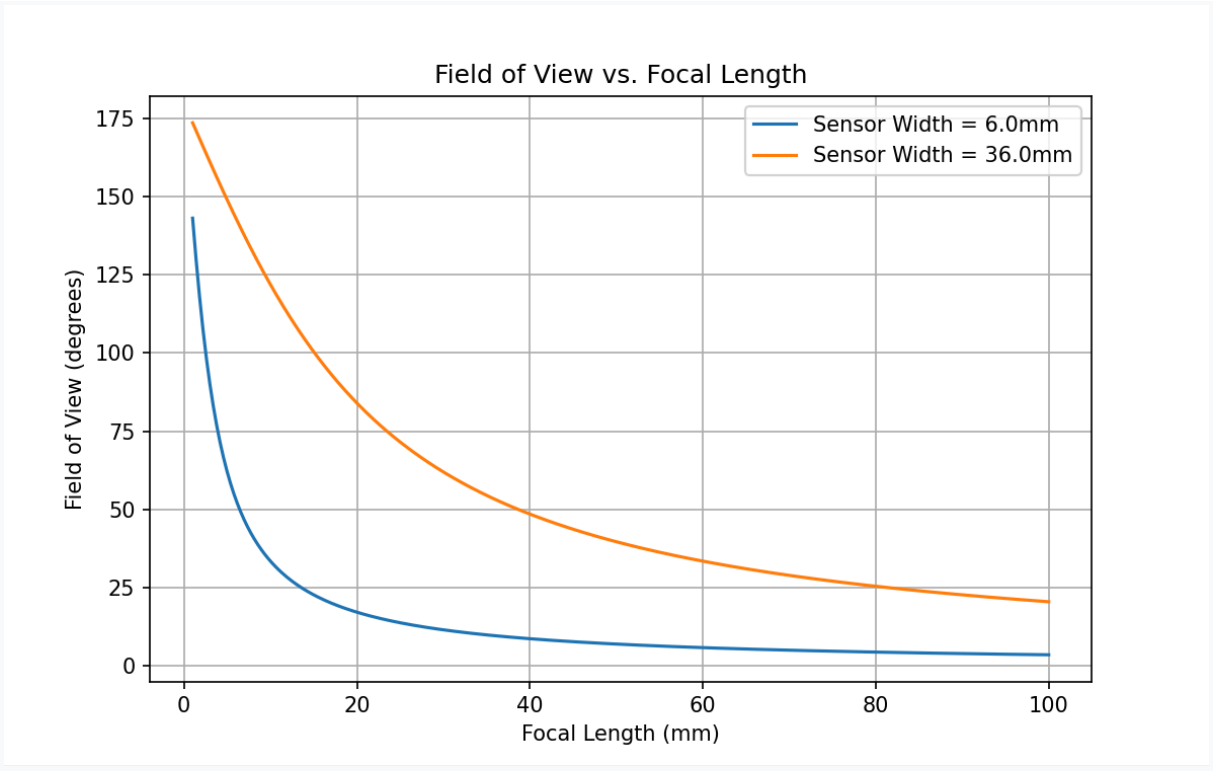


The formula for calculating the Field Of View is:
$\theta = 2 \times arctan\,(\omega / 2f)$ *where*:

θ = field of view in degrees
ω = sensor width
f = focal length

The implementation used this formula to calculate and visualize the FOV for different sensor sizes such as smartphone and DSLR across a range of different focal lengths. The resulting plot demonstrates that increasing the focal length decrease the FOV, which is expected since

zooming in reduces the visible scene.



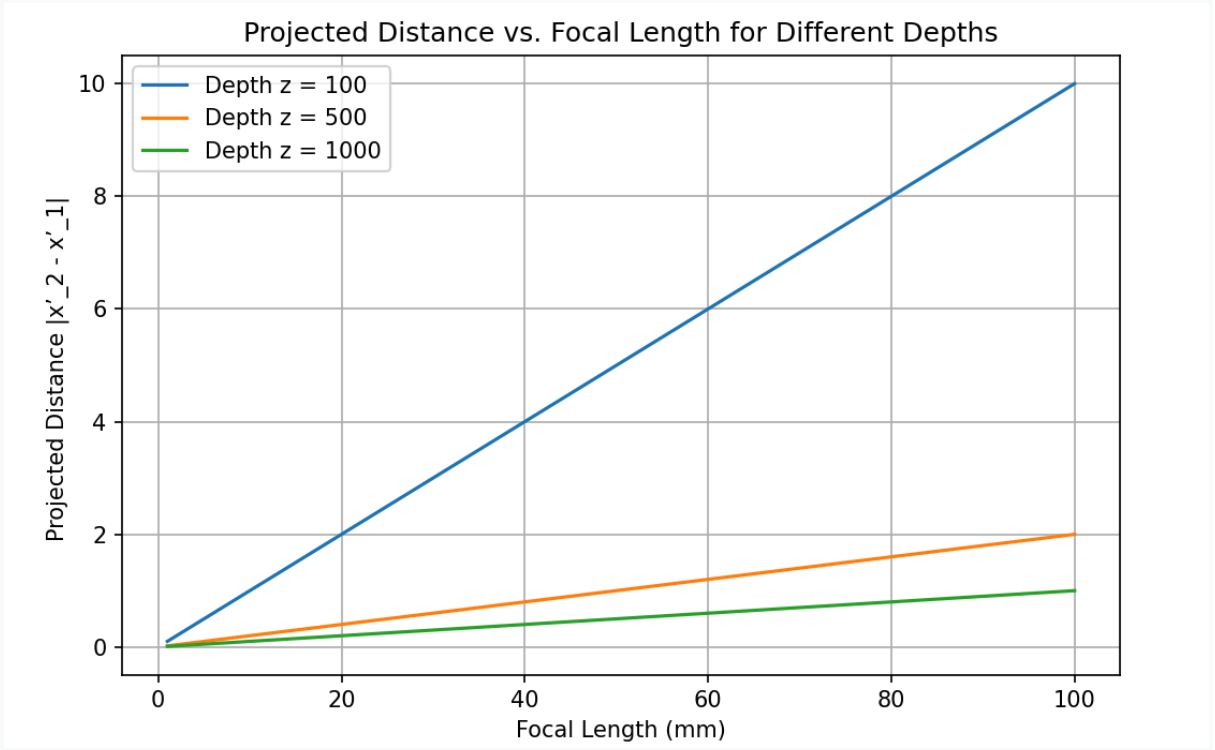
By plotting the FOV for two cameras with different sensor size 6 mm to represent smartphone camera and 36 mm to represent DSLR. This plot showcases the effect of sensor size and focal length in determining a cameras perspective.

Projection of world points

To understand how world points project onto the camera sensor, I analyzed the distance between two projected points $|x'2 - x'1| = f * dx/z$ where:

f = focal length.
dx = real-world distance between two points
z = depth of points

The results showed that increasing focal length increases the projected distance, making objects appear more separated while increasing depth compresses the projected distance making them appear closer to each other. This behaviour aligns with how zooming and depth perception work in camera systems.



Conclusion

Through this assignment, I gained a deeper understanding of camera optics, FOV calculations and image projection. The combination of the theoretical formulas and practical python implementation provided valuable insights into how cameras capture and process images. The plots visually demonstrated key principles of focal length, sensor width and depth in image formation. Granting me deeper knowledge of computer vision and optical systems.