Depth Estimation from Image

To determine the depth from the camera to each pole in an image with known pole diameters and the horizontal field of view (HFOV) of the camera, you can use trigonometric functions.

Calculating the Angle

First, calculate the angular size of each pole in the image using the formula:

$$\text{Angle (in degrees)} = \left(\frac{\text{Apparent width of the pole in pixels}}{\text{Image width in pixels}}\right) \times \text{HFOV}$$

For the 15cm pole:

$$\text{Angle for the 15cm pole} = \left(\frac{165 \text{ pixels}}{4000 \text{ pixels}}\right) \times 72 = 2.97^\circ$$

For the 10cm pole:

$$\text{Angle for the 10cm pole} = \left(\frac{58 \text{ pixels}}{4000 \text{ pixels}}\right) \times 72 = 1.044^\circ$$

Calculating the Distance to Each Pole

Once you have the angle of each pole, you can use it to calculate the distance from the camera to each pole using trigonometric functions, assuming the camera is at the center of the image and the poles are at the same height from the ground:

$$\text{Distance to the 15cm pole (in centimeters)} = \frac{\frac{\text{Actual pole diameter}}{2}}{\tan\left(\frac{\text{Angle for the 15cm pole}}{2}\right)}$$

$$\text{Distance to the 15cm pole (in centimeters)} = \frac{\frac{15 \text{ cm}}{2}}{\tan\left(\frac{2.97^\circ}{2}\right)} \approx 289.3 \text{ cm}$$

$$\text{Distance to the 10cm pole (in centimeters)} = \frac{\frac{10 \text{ cm}}{2}}{\tan\left(\frac{1.044^\circ}{2}\right)} \approx 548.79 \text{ cm}$$

Note that these calculations assume that the poles are vertically aligned, and there is no tilt or distortion in the camera. In real-world scenarios, you may need to account for lens distortion and other factors that can affect depth estimation accuracy. Additionally, accurate measurements of the pole diameters and the assumption that the poles are at the same height from the ground are essential for these calculations. If these conditions are not met, more complex methods such as stereo vision or depth-sensing technologies may be required for accurate depth estimation.