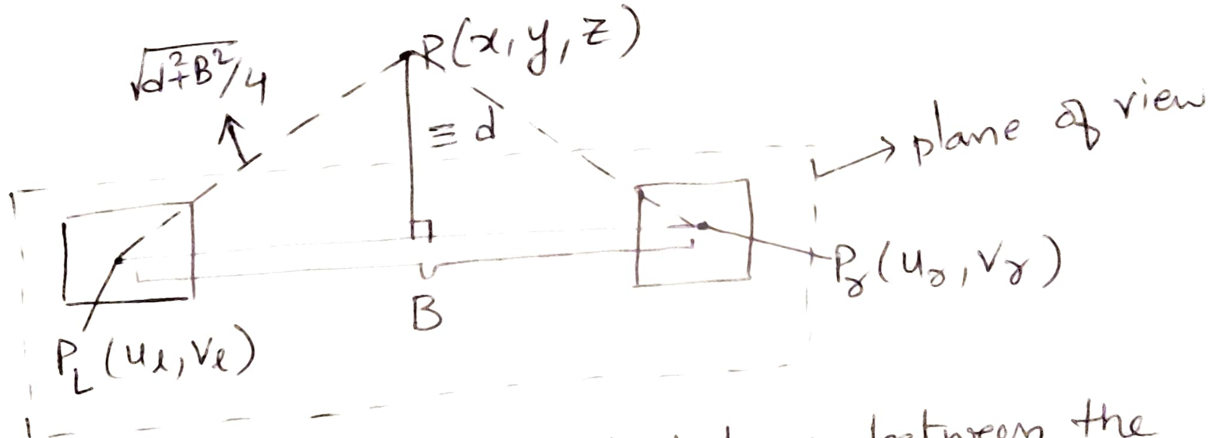
Q4 Depth estimation in sterio Vision theory :-

The main goal of this experiment is to understand how desparity and depth are related and to derive an expression for calculating depth from desparity.
In this case, we deal with two or more perspectives of the same object.
The Assumptions made here are that the dimensions are absolute with the following criterion:
Let us consider the object is at $P(x, y, z)$ with B as the Baseline



B is defined as the physical distance between the two camera centers $P_L(u_l, v_l)$ and $P_r(u_r, v_r)$ which can be defined as

$$P(x,y,z) \rightarrow B : Z = \text{depth } d$$

Here since we are dealing on the same plane, we assume $V_r = V_L$

From the above set up, we get

$$u_l = \frac{f_l x_l}{z_l} + O_l \qquad u_r = \frac{f_r (x_l - B)}{z_r} + O_r$$

here $Z_l = Z_r = d$

and $f_l = f_r = f$ (focal length)

$O_l \simeq \frac{1}{2} O_r$ and hence get cancelled for resolution through camera caliberation

here, we get $x_L = \frac{(u_L - O_L) d}{f_l}$

$$u_l = \frac{f_l \times x_l}{d} \quad -① \qquad u_r = \frac{f_r * (x_l - B)}{d} \quad -②$$

We also get

$$x_l = \frac{u_l d}{f_l}$$

$$d = \frac{B * f_l}{u_l - u_r} \quad -④$$

here $(u_l - u_r)$ is the desparity,

B is the Baseline measured in metres

f is the focal length measured in pixel units.

For the considered example:

d = 13cm from the camera center O

B is baseline placed as 30cm

The focal length of the camera chosen is $f = 0.5$cm from Equation (4), we get desparity

$$(u_l - u_r) = \frac{B \times f}{d}$$

$$= \frac{30 \times 0.5}{13}$$

Desparity = 1.15cm