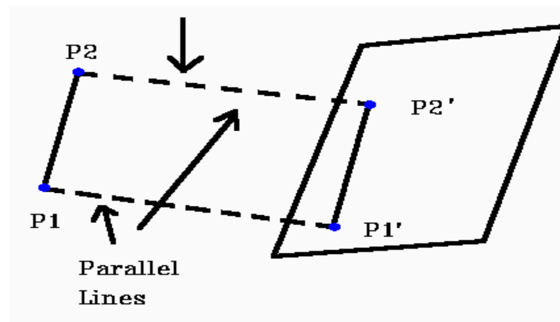
EXPERIMENT NO. 10

AIM: To implement program for projection of 3D object on projection plane.

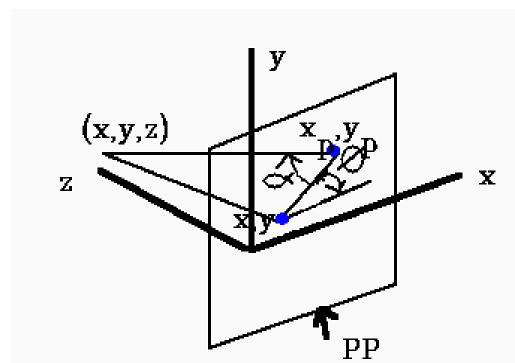
SOFTWARE USED: TurboC

THEORY:



PARALLEL VIEWING PROJECTIONS

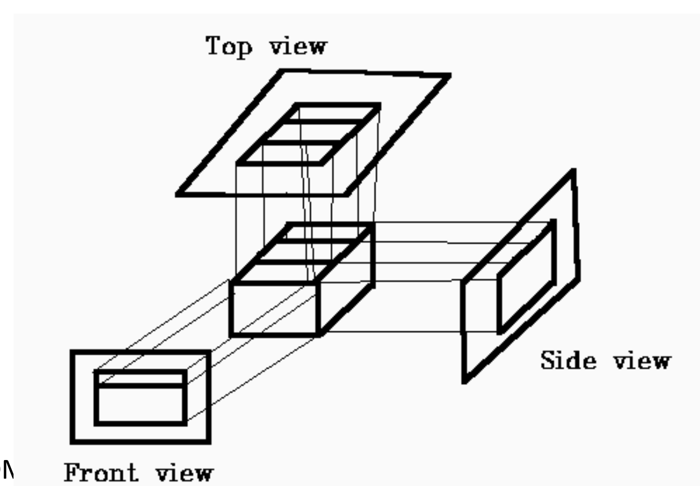
Projection rays (projectors) emanate from a Center of Projection (COP) and intersect Projection Plane (PP). The COP for parallel projectors is at infinity. The length of a line on the projection plane is the same as the "true Length".



There are two different types of parallel projections:
If the direction of projection is perpendicular to the projection plane then it is an orthographic projection. If the direction of projection is not perpendicular to the projection plane then it is an oblique projection.

Look at the parallel projection of a point (x, y, z). (Note the left handed coordinate system). The projection plane is at z = 0. x, y are the orthographic projection values and xp, yp are the oblique projection values (at angle a with the projection plane)

Look at orthographic projection: it is simple, just discard the z coordinates. Engineering drawings frequently use front, side, top orthographic views of an object.
Here are three orthographic views of an object.



Orthographic projections that show more than 1 side of an object are
called axonometric orthographic projections. The most common axonometric projection is an isometric projection where the projection plane intersects each coordinate axis in the model coordinate system at an equal distance.

ISOMETRIC PROJECTION

The projection plane intersects the x, y, z axes at equal distances and the projection plane Normal makes an equal angle with the three axes.
To form an orthographic projection $xp = x$, $yp = y$, $zp = 0$. To form different types e.g., Isometric, just manipulate object with 3D transformations.

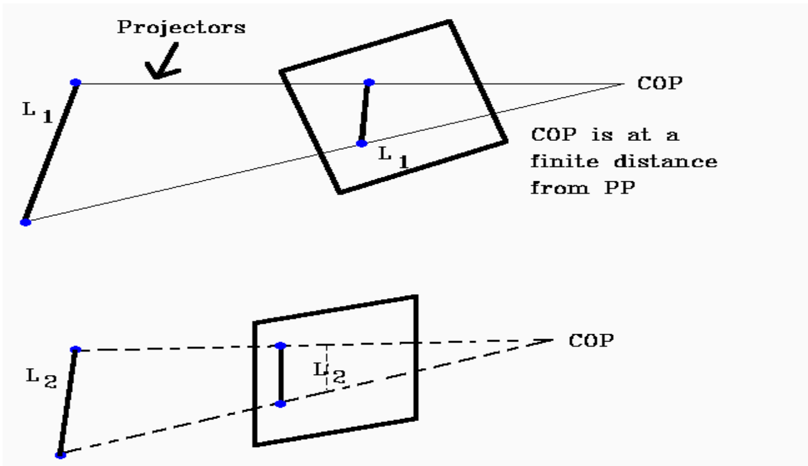
OBLIQUE PROJECTION

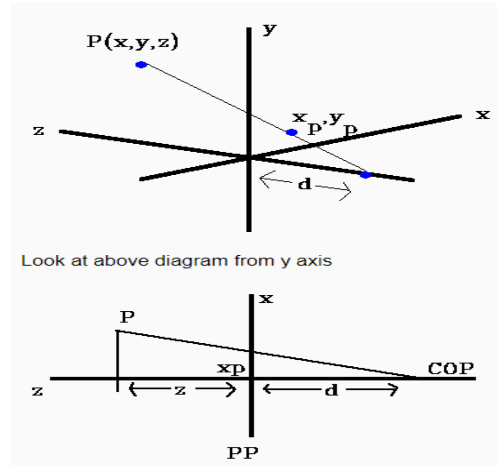
The projectors are not perpendicular to the projection plane but are parallel from the object to the projection plane The projectors are defined by two angles A and d where:
A = angle of line (x,y,xp,yp) with projection plane,
d = angle of line (x, y, xp, yp) with x axis in projection plane
L = Length of Line (x,y,xp,yp).
Then:
$\cos d = (xp - x) / L$ ------> $xp = x + L\cos d$,
$\sin d = (yp - y) / L$ ------> $yp = y + L\sin d$,
$\tan A = z / L$
Now define $L1 = L / z$----> $L = L1\, z$,
so $\tan A = z / L = 1 / L1$; $xp = x + z(L1\cos d)$; $yp = y + z(L1\sin d)$

$$P = \begin{vmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ L1cosq & L1sinq & 1 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

<u>PERSPECTIVE VIEWING PROJECTION</u>

The Perspective viewing projection has a Center of Projection ("eye") at a finite distance from the projection plane (PP).
So the distance of a line from the projection plane determines its size on the projection plane, i.e. the farther the line is from the projection plane, the smaller its image on the projection plane. In the two images above, the projections of L1 = L2 but the actual length of L1 <> L2. Perspective projection is more realistic since distant objects appear smaller.
Computing the Perspective Projection





Now x / (z+d) = xp/d
xp = x[d / (z+d)]
xp = x / (z / d + 1)
Do same for y (look down the x axis) and get
y p = y / (z / d+1)
zp = 0
Note that we can increase the perspective effect by decreasing d (moving closer). We can represent this in matrix form by using homogeneuos coordinates as follows:

$$[xhyhzh\ w] = [x\ y\ z\ 1] \begin{vmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1/d \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

where:
xh = x . yh= y, zh = 0 ,w = (z/d) + 1
And Points on the projection plane are [xpypzp 1] = [xh/w yh/w zh/w 1]
This leads to the same xp, yp as before.

CONCLUSION: Successfully implemented program for projection of 3D given object.

SIGN **GRADE**

DATE