

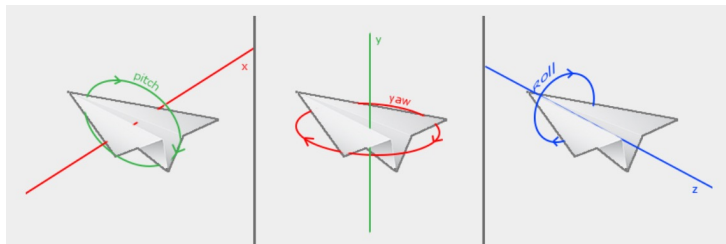
fps camera control

using: <https://learnopengl.com/Getting-started/Camera>

Mouse Movement → Camera Movement

- want mouse move up/down to cause camera to look up and down
- want mouse move L/R to cause camera to look left and right

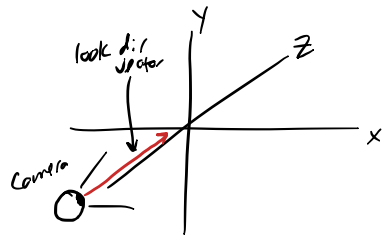
Yaw, Pitch, Roll



- so want up/down mouse movements to pitch
- want L/R movements to yaw
- roll isn't used in fps camera

Look Direction Vector

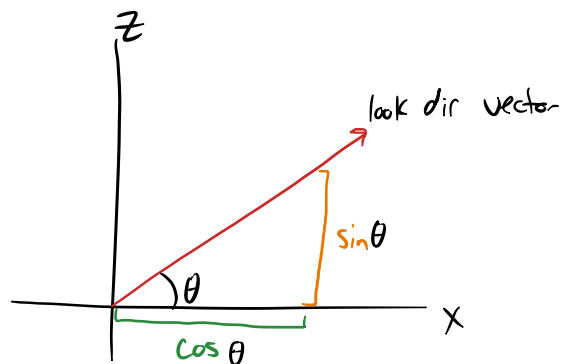
- to get our look at matrix to transform world coords into view coords we need a target "forward" vector for where the camera is looking
- initially, think of look at vector as staring down +z axis



- mouse movements cause the look dir vector to pitch and yaw to look in other directions

Accounting for Yaw

- Yaw is a rotation around the Y-axis so imagine we're viewing the 3D coordinate system from the top w/ the camera "yaw'd" around the y-axis by some θ



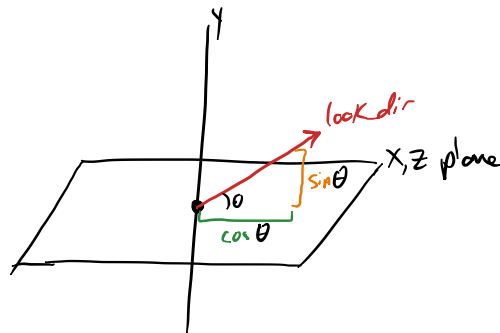
- want to get the components of the look dir vector in X and Z directions so use sin/cos
- so in our look dir vector:

$$\text{look_dir} = \langle \cos \theta, 0, \sin \theta \rangle$$
- haven't yet included pitch so look_dir still assumes on

"ground"

Accounting for Pitch

- X, Z components of look_dir vector covered so now focus on Y component



- now concerned about pitch angle from XZ plane and can use same process to get how much of look_dir should be in Y-dir but also how much should be in both X and Z-dirs
- modify X, Z b/c yaw only took into account when look_dir on XZ-plane and not elevated off it so less overall in X, Z dirs the higher the elevation \rightarrow so scale X, Z by $\cos(\text{pitch})$
- the overall look_dir vector is:

$$\text{look_dir} = (\cos(\text{yaw}) \cdot \cos(\text{pitch}), \sin(\text{pitch}), \sin(\text{yaw}) \cdot \cos(\text{pitch}))$$

Camera Movements w/ WASD

- if press w/s, want camera to move along look_dir
- if press a/d, want camera to move along $\text{perp}(\text{look_dir})$
- look_dir can be elevated from XZ plane but we want to restrict movement to "ground" so don't want any vertical component of look_dir only horizontal
- use projection to get components of look_dir in X, Z dirs

$$z_dir = \langle 0, 0, 1 \rangle \cdot \text{look_dir} \text{ } \} \text{ dot w/ z axis}$$

$$x_dir = \langle 1, 0, 0 \rangle \cdot \text{look_dir} \text{ } \} \text{ dot w/ x axis}$$

since both unit vectors proj formula \uparrow

- to get $\text{perp}(\text{look_dir})$ take cross product w/
up vector $\langle 0, 1, 0 \rangle$ and look_dir to get \perp vector
in XZ plane \perp to look_dir

$$\perp = \langle 0, 1, 0 \rangle \times \text{look_dir}$$