Projections in Computer Graphics

Projections play a critical role in computer graphics, transforming 3D objects into 2D representations for display on screens. This presentation will explore the key concepts, types, and applications of projections in computer graphics.

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Understanding Projection Concepts

Projection Matrix

A projection matrix is a mathematical tool that defines the projection process, specifying how 3D coordinates are transformed into 2D coordinates.

View Frustum

The view frustum is a pyramid-shaped region in 3D space that determines which objects are visible in the final rendered image.

Orthographic Projection

1 Parallel Lines

Orthographic projection preserves parallel lines, resulting in a non-perspective view where objects appear flat and without depth cues.

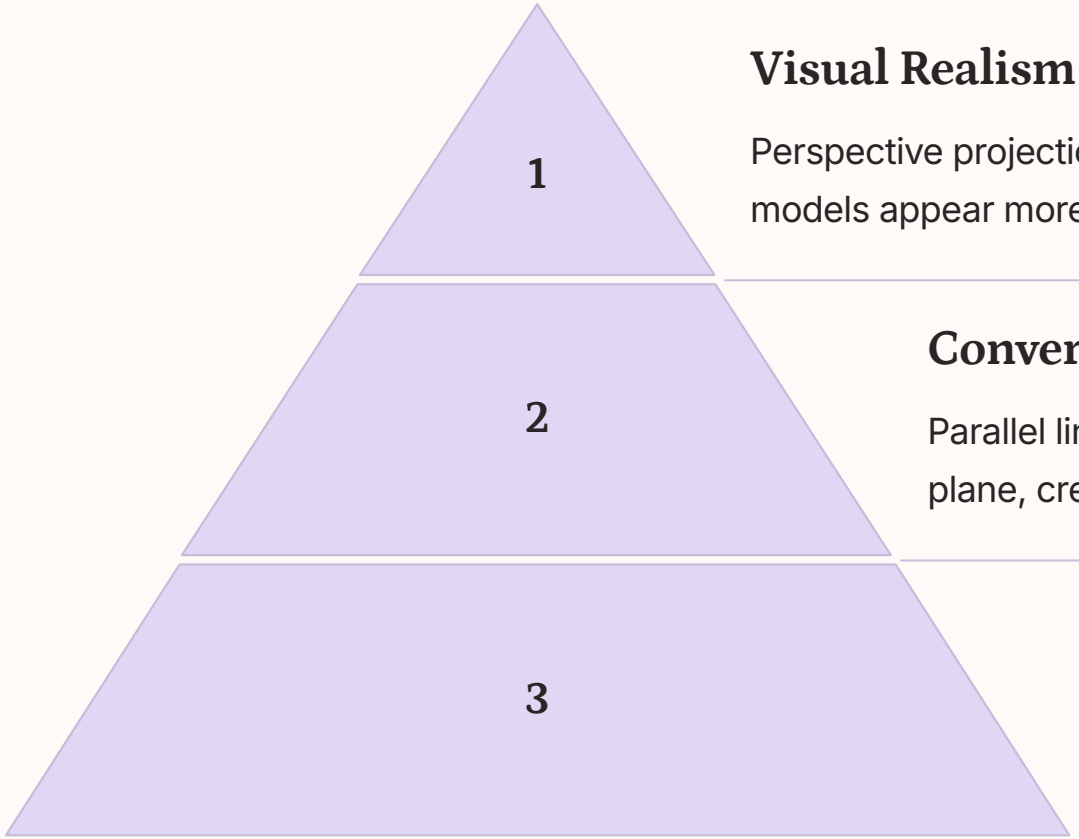
2 Technical Drawings

It's often used for technical drawings and architectural blueprints, as it accurately represents the dimensions and shape of objects.

3 Top-Down Views

It is also commonly used for top-down views in games and simulations, providing a clear overview of the environment.

Perspective Projection



Visual Realism

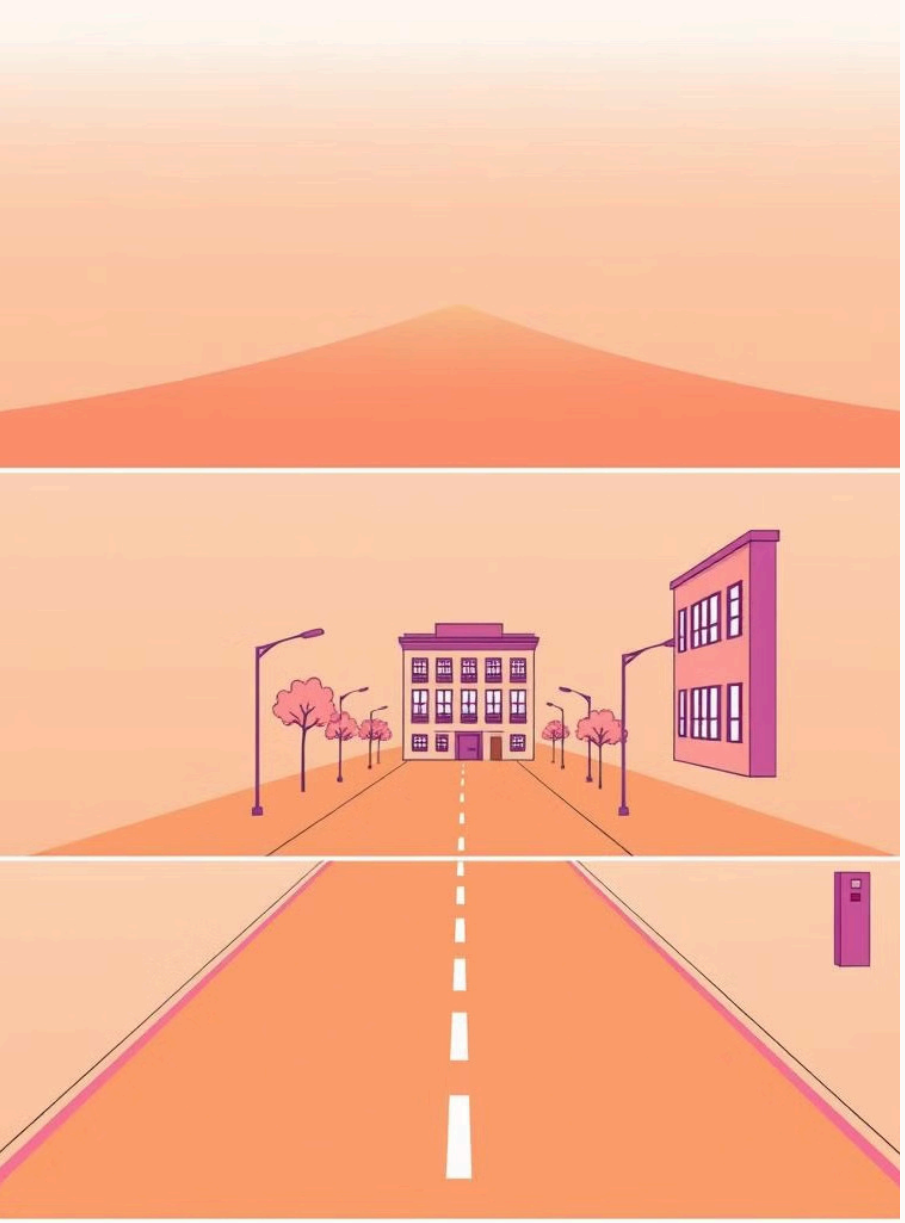
Perspective projection simulates how the human eye perceives depth, making 3D models appear more realistic and immersive.

Converging Lines

Parallel lines in the 3D world converge at a vanishing point in the image plane, creating a perspective effect.

Distance Cues

Objects further away appear smaller and less detailed, adding depth and realism to the scene.



Types of Perspective Projection

One-Point Perspective

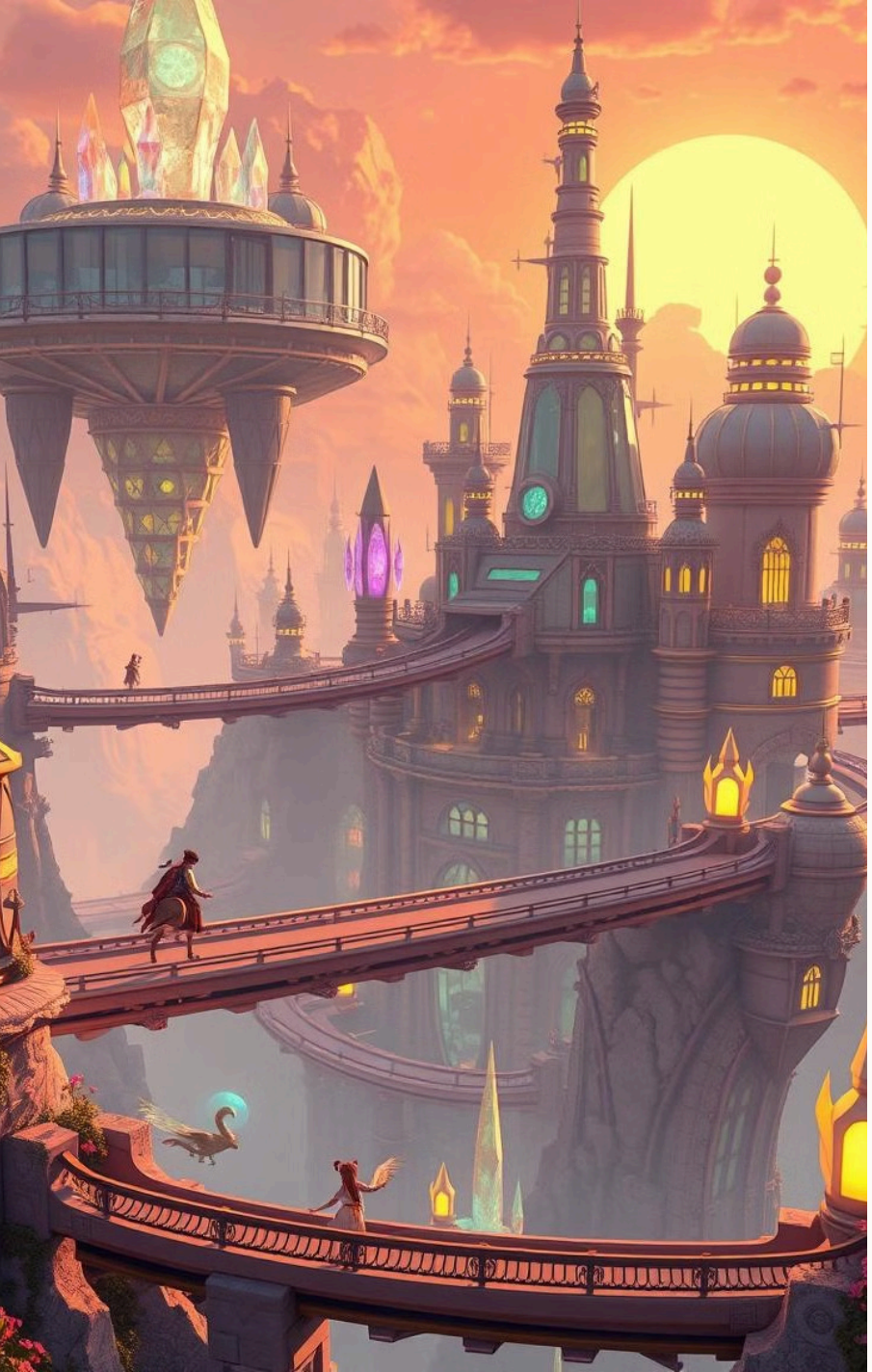
One-point perspective is used for objects where only one face is parallel to the viewer, creating a sense of depth with one vanishing point.

Two-Point Perspective

Two-point perspective is used for objects where two faces are parallel to the viewer, with two vanishing points creating a more complex perspective effect.

Three-Point Perspective

Three-point perspective is used for objects where none of the faces are parallel to the viewer, resulting in a strong perspective effect with three vanishing points.



Rendering with Projections

Camera Model

The camera model defines the position and orientation of the virtual camera, which determines how the scene is projected onto the image plane.

Lighting Effects

Projections influence how light interacts with objects, creating shadows, reflections, and other visual effects that enhance realism.

Texturing and Shading

Projections are crucial for applying textures and shading, which add detail and visual interest to rendered objects.

Projection Distortions and Artifacts

1

Distortion

Perspective projections can distort objects near the edges of the image, particularly when the field of view is wide.

2

Artifacts

Artifacts, such as shimmering or jagged edges, can arise due to limitations in the rendering process or improper projection settings.

3

Optimization

Understanding distortions and artifacts helps in optimizing rendering techniques and minimizing their visual impact.

Applications of Projections

1

Video Games

Creating immersive and realistic environments in games relies heavily on perspective projections.

2

Architectural Visualization

Architects use projections to create compelling visualizations of buildings and spaces.

3

Medical Imaging

Projections are essential in medical imaging for visualizing internal organs and structures.

4

Animation

Animators use projections to create realistic movement and camera effects in animation films.