Q12 WORKING WITH CAMERA ON VIRTUAL FILM MAKING

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Abstract

We introduce a method of camera work for creating the desired shots in virtual 3-D environment for the film director. The system has the flexibility to design any kind of shot with the use of virtual characters which are previously developed. It is the director, user, who creates the appropriate shots for a scene using mouse and keyboard. Director provides with the input for the positions of the actors and their orientations. Besides, the characters' positions on image plane are also given. As there is always a center of interest (focus point) at the middle of a scene, we find a vector from this point to the horizontally farthest position of the actor. This key vector's transformation in horizontally and vertically determines the appropriate camera position for a certain shot. In this paper, we discuss some basic heuristics of camera works and show how these ideas are encoded to create a shot.

Introduction

In real world of cinematography, cinematographers use their sense in creating scenes from their experience on different camera lenses and from experience in looking through the movie cameras for compositional purpose. Over the years, filmmakers have developed a set of rules and conventions that allow actions to be communicated comprehensibly and effectively [1]. But the virtual camera work is totally based on linear formula of vision, graphics and projection. So, it's essential to equip the virtual camera with the kinds of camera movements relative to the placement of actors and objects to create a proper composition.

This system guides a director as the same way as a perspective camera works. It helps the director to communicate easily with the basics of camera movements and shoot a shot using these basics. It introduces the camera's freedom of movements in different degree, without which, it is difficult for a user to understand the basic camera work in a virtual 3-D environment.

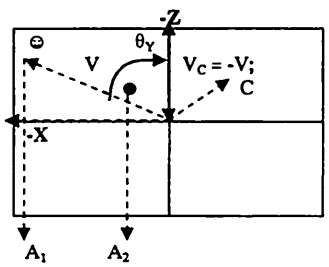

Figure 1: Calculation of camera orientation in scene coordinate; A_1 & A_2 are the positions of two actors, C is the center of focus (0.0, 0.0), V is vector for geometric transformation, θ_Y is the vector rotation angle and V_C is the vector of camera orientation, opposite direction of V.

In this paper, we discuss an implementation of a shot in openGL which are constructed by C programming language. We demonstrate its operation after placing the required actors at the given places on negative z-axis. The key vector's opposite direction indicates initial camera orientation and so the coordinate transformation of camera rotation about y-axis is determined by the vector's rotation towards the direction cosine on negative z-axis. We start this research following exactly the same philosophy as the real world's live action shooting. So, after the placement of actors, we position the camera and use a lens appropriate for the shot.

Related Work

The Virtual Cinematographer: A Paradigm for Automatic Real-Time Camera Control and Directing by He *et al.* [1] 'presents a paradigm for automatically generating complete camera specifications for capturing events in virtual 3-D environments in real time'[1]. He *et al.* describe taking shots in the form of film "idioms" following the grammar of film language of a certain situation. As it happens automatically, the system lacks flexibility to work as a movie camera with its distinctive freedom in various capabilities. In this paper, by contrast, we are concerned with camera movements which provides with at least six degree of freedom and a director uses this freedom to shoot shots.

Placing Camera

As camera is placed at the origin of world co-ordinate and looking at negative z axis, the default camera position of openGL, the initial camera position on positive z-axis incidentally follows the "180-degree rule" of camera placement. This is 'the *line of action* as an imaginary partition running through the space in front of the camera' [2]. Moreover, while the center of interest is at the middle of a scene, we realize the camera's position on x-axis is at 0.0. To find out the camera's distance and placement, we use the key vector which is a line from focus point to the farthest actor position on x-axis. The angle the vector makes with the negative z axis, by coordinate transformation camera rotates this much angle about y-axis rotation as to place the camera on positive z-axis.

After calculate an appropriate focal length factor for the desired scene and the given point of image placement on x-axis, we derive the equation from the formula of projection:

$$Z_c = [X' \{(X_a - X_c) \sin \omega_y + Z_a \cdot \cos \omega_y\} - (f.S_z / A.SR) \{(X_a - X_c) \cos \omega_y - Z_a \cdot \sin \omega_y\}] / [X' \cdot \cos \omega_y + (f.S_Z / A.SR) \sin \omega_y], \quad (1)$$

where Z_c is unknown, the distance from actor to camera; X_a and X_c are the x-positions of actor and camera respectably and both are known. ω_y(0.0°) is the rotation angle of coordinate transformation about y-axis is determined to make the value of X_c is at 0.0 and Z_a is the z-position of actor. Here A is the horizontal distance from the origin which refers the given horizontal position whether it is the position of farthest actor, SR is the squeeze ratio is known before hand, S_Z is the vertical height of the screen which equals to SR, f is the focal length is to be decided earlier and the focal length factor,

$$f_c = (f.S_Z / A.SR), \quad (2)$$

is explained in next section. X' is the x-position on image space mentioned by director. Visual extents in image space are usually standardized into the minus one to plus one range in x and y [3].

Finding View Angle

To find the proper view angle, we have to deal with *aspect ratio* as films are made in different formats. To calculate the focal length factor, we use the formula of calculation of lens angle and field of view and the formula to find out the view angle in computer vision:

Tangent ½ viewing angle = (½ A* Squeeze Ratio) / f [4] (3)

Tangent ½ viewing angle = 1/ focal length factor (4)

Because of the squeeze and the placement of the actor on origin, the size of standardized screen is changed to new screen size and the formula is:

Tangent ½ viewing angle = ½ S_Z / focal length factor (5)

So, formula (2) is derived from the formula (3) and (4).

As openGL does not deal with focal length, the view angle we achieved from equation (5) is used for vertical angle.

Result

We have been successful in finding the proper position of camera on x and z-axis for the desired image.

In figure 1 to get the image of figure 2, at first we input the positions of the actors – A_2 (-11.0, 0.0, -90.0), A_1 (-33.0, 0.0, -270.0) and we decide to place an actor of same size at the center of focus, C (0.0, 0.0, 0.0). After we normalize the vector V for x-z plane, an objective transformation about y-axis rotation (θ_Y) places the vector on negative z-axis. While the opposite direction is the orientation of camera, to keep the camera at the center of the scene, the rotation angle for coordinate transformation is 0.0. Having the lens focal length as input, the system creates the image on the basis of x and z position of camera with the image factor on x.

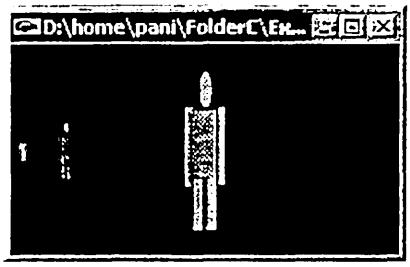

Figure 2: Image - Where actors' are same sizes (28); Camera's elevation is at 14.0 on y-axis and the focus point is at (0.0, 14.0, 0.0) with 50mm lens. Actors (except the center one) are moved to 3 times left on negative x-axis from their initial position on x-axis to get the desired image.

Conclusion and Future Work

This research has demonstrated a certain type of flexibility for the users although the determination of y-axis camera placement is crucial for establishing the other degree of freedom for camera movements like tilt up, tilt down, pan, crane, and tracking. A user can move the actors after the creation of an image as we have done in here. Moreover the focal length can be changed if the image is not the desired one. The elevation of camera at the half height of the actor and the focusing at the point of same height on the origin places the actors almost at the middle of the screen. If this is a standard image, the changing of camera placement up or down and keeping the focus point at the same level or the tilting up or down disclose some interesting phenomenon of projections. The phenomenons are the key factors responsible for the desired placement of the characters mainly on y-axis of image screen. The research has been going on.

References

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