

CameraBots: Cinematography for Games with Non-Player Characters as Camera Operators

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ABSTRACT

Cinematography describes principles and techniques pertaining to the effective use of cameras to film live action. The correct application of these principles and techniques produces filmed content that is more engaging, compelling and absorbing for the viewer. 3D computer games employ *virtual cameras* in order to provide the player with an appropriate view of the game world. These virtual cameras can simulate all of the functionality of their real-world counterparts yet little effort is usually made to incorporate cinematographic techniques and principles into their operation. We introduce *CameraBots*, autonomous camera operators modelled closely on the *non-player characters* (NPCs) or *bots* already present in many games. CameraBots can perform a larger set of operations than their real-world counter parts since they need not be subject to physical restraints. Thus, cinematographic principles can be applied to camera work with relative ease by reusing bot program code already present in a game.

Keywords

Virtual Camera, Virtual Cinematography, Non-Player Characters, Bots

INTRODUCTION

Cinematography can be defined as the art of film making [2]. It includes guidelines for lighting arrangements, the positioning of actors and props and also for operating the camera. By using the extensive set of camera operations such as close-ups, pans, tilts and zooms afforded by cinematography, a game has the potential to: add dramatic emphasis where necessary; elucidate

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unclear events in the plot; ensure that the player does not become disorientated; and even evoke emotional responses in the same way as a motion picture does. A motion picture may have one or a number of cameras operating at any given time [1]. The footage from the cameras is edited after filming to produce a series of moving pictures from a number of different angles. We aim to achieve the same effect in a game by placing a number of CameraBots in the virtual world.

A number of papers consider the issue of automatic camera work for virtual environments other than games such as interactive narratives [3] and interactive learning environments [4]. Nieuwenhuisen & Overmars [7] present a camera system that plans paths through a virtual environment. Christianson et al. [5] generate camera configurations off-line for pre-animated non-interactive scenes. Other works consider real-time automatic camera work for games but with a single camera rather than multiple cameras [6, 8].

In the following section we introduce the aspects of cinematography that are relevant to 3D computer games. Next we discuss the camera work used currently in games. Following this we consider the relevance of bots to cinematography and outline our virtual cinematography model. Finally we conclude and outline our future work.

CINEMATOGRAPHY

Using cinematography as a guide for filming subject matter results in a coherent depiction of the action with both static and moving viewpoints [1, 5]. Knowing whether to use a static or moving camera and where to place it relative to the subject at each instant are the principal issues that cinematography addresses. Given the arrangement of characters and props in the scene, camera work can portray the action in a number of different ways.

A common approach is to begin with a distant view and use gradually nearer and nearer views. With this method a *scene* (a single setting and its depiction) is introduced with one or a number of *establishing shots* (a shot is a continuous view filmed by one camera without interruption). To film an establishing shot, a camera is usually placed at an elevated height such that it can take in a large portion of the scene. This gives the viewer a good idea of the relative positions of the various characters and props. Next *character shots* are used to depict the characters in the scene. *Full shots* might be used first to depict some characters in their entirety. Following this, *medium shots* may be used to introduce the main characters. A medium shot frames characters from the thighs up. After a number of medium shots, the camera can move in for close-ups where an individual character is depicted from the waist, or higher, to above the head. Close-ups are particularly important for dramatic emphasis and to film a character's reaction to the events occurring in the scene. As the characters move around the scene and after a certain time duration it may be necessary to use another establishing shot to allow the viewer to regain their bearings.

As the camera moves closer in this way from establishing shots to close-ups, the views become more subjective and the audience tends to identify more with the characters. As such, dramatic emphasis can be added to certain events and the emotional state of the characters portrayed. The greatest subjectivity is achieved with first-person perspective. This is when the camera simulates the viewpoint of one of the characters and so the viewer sees the scene through that character's eyes. To counteract the possibility of the viewer becoming disorientated due to numerous close-ups in sequence, for example, film makers ensure that *screen direction* [1] is preserved. Screen direction refers to, among other things, the relative positioning and direction of movement of

characters from the viewer's perspective. For example, if character A is to the left of character B at the end of a shot, these relative positions should be the same at the start of the next shot. Likewise, if a character is walking towards the right of the screen at the end of a shot, the camera should be positioned such that they are still walking to the right when the following shot begins.

A single camera or multiple cameras may be used to film a motion picture. A single camera is used where the action is planned in advance and so the scene is set up for each shot. Where the action is unplanned or improvised multiple cameras are used to film multiple angles of the events. In both cases the resulting footage is edited afterwards. On a film set, it is director who chooses the events to film and the *director of photography* or *cinematographer* who decides the style of filming and coordinates the camera operators.

VIRTUAL CAMERAS IN GAMES

Recently released computer games generally depict the game play with only a subset of the options available from cinematography and with only one virtual camera. Since the action during game play is unplanned, cinematography dictates that multiple cameras should be used. With the synchronisation of multiple cameras, the view can switch between multiple camera angles thereby exploiting a fundamental feature of cinematography.

Two camera configurations used in a large number of games are:

- *First-Person Camera*: The camera adopts the viewpoint of the player's avatar and so the player sees the game world through her/his avatar's eyes.
- *Over-The-Shoulder Camera*: The camera keeps a fixed distance above and behind the avatar so as to position the avatar in the lower portion of the view. With this view the player can see their avatar's animations in addition to other parts of the scene.

More elaborate camera work is used in *cut-scenes* inserted at intervals throughout the game play in some games. However, these are non-interactive pre-rendered scenes: Our focus is on the camera work during the interactive game play.

CAMERA BOTS

Bots [9, 10, 11, 12] are autonomous entities that can freely move about a game world. It is possible to give them specific instructions regarding their position and their movement in such a way that they mimic the behaviour of camera operators on a film set. The game engine can then present the action from the viewpoint of any of these bots. In particular, bots are capable of taking up a position and looking in a certain direction; they can find a path through a virtual environment that avoids obstacles [13, 14]; they can crouch, turn, follow a subject, approach a subject and retract from a subject. These are all qualities that are expected of a camera operator on a film set. Real world filming, however, also requires the use of special wheeled structures for moving cameras smoothly; cranes and purpose-built scaffolding are needed for elevated camera placement; special camera housing must be used for under water shots and so on [2]. With bots, these problems do not exist. Bots can move smoothly or in a jerky fashion as required; a bot can be any height, easily achieving so-called doggie-cam shots or crane shots; bots can fly and swim and so provide footage from otherwise difficult angles.

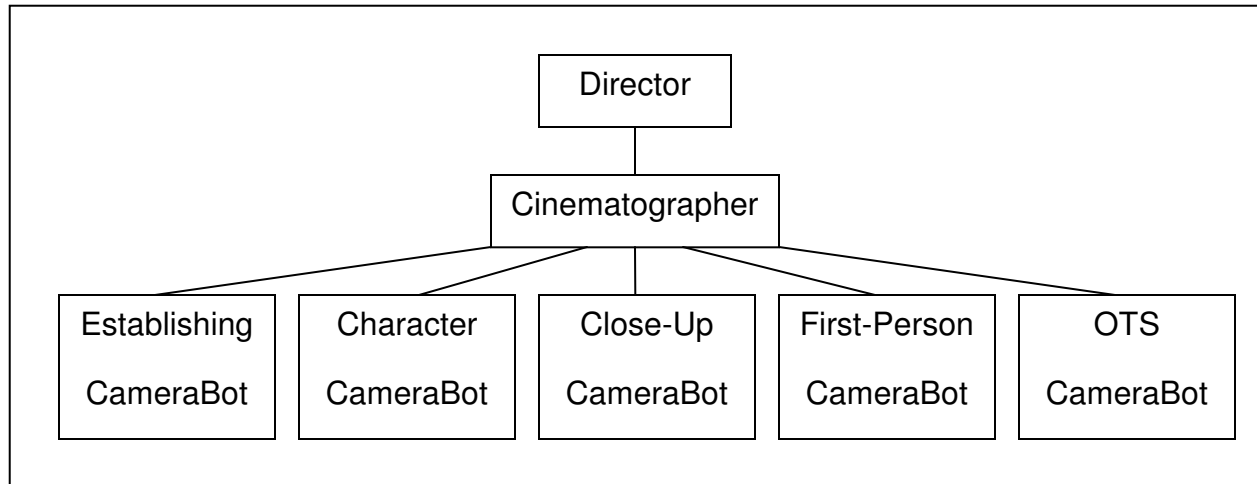


Figure 1: Virtual Cinematography Framework

We use bots functioning as camera operators, CameraBots, within an operational framework (figure 1) similar to that on a real-world film set. A *director* module decides what subject matter is to be filmed, a *cinematographer* module decides how it is to be filmed and a number of CameraBots film it. More specifically, the director examines the action occurring in the game world and decides what events are to be filmed. The cinematographer examines these events and the arrangement of characters and props in the setting in which they occur and selects a suitable model or *idiom* to employ in its filming. At this stage, the director can provide feedback if there are a number of candidate idioms. The cinematographer now ensures that the necessary CameraBots are in the game world and provides them with instructions such as the characters to film as indicated by the idiom. There are a number of different CameraBots that may be selected and each specialises in providing certain views:

- *Establishing CameraBot*: An Establishing CameraBot shoots establishing shots as mentioned in the Cinematography section.
- *Character CameraBot*: A Character CameraBot shoots long shots and medium shots but not close-ups.
- *Close-Up CameraBot*: As mentioned, close-ups have the special role of providing dramatic effects and, as such, there is a specialist CameraBot to film them.
- *First-Person CameraBot*: The first-person CameraBot is used where accuracy is important.
- *OTS CameraBot*: An Over-The-Shoulder CameraBot is used for, among other things, navigation of the game world.

Our modular approach means that new types of CameraBots can be added to our virtual cinematography system with ease. The CameraBots observe the continuity of screen direction as discussed in the Cinematography section. Real-time editing of the footage provided by the bots is performed by the cinematographer. The cinematographer will continue to use the current idiom until the events change sufficiently to warrant a new selection or until the director decides that

different events are to be filmed. What the player sees is a number of static and moving views from different angles suited to the events occurring.

CONCLUSION

The use of multiple camera operators in the form of CameraBots provides for a more engaging gaming experience with less user disorientation arising from inappropriate camera work. By using the AI portion of a game engine, i.e. the bot program code, resources and code are reused. Our virtual cinematography system can be applied to both the player's view and to spectator views allowing others to watch a more engaging depiction of the game play.

Presently, we are implementing our virtual cinematography system as a modification to the Quake II game engine. The code is written in a modular way to allow portability to other game engines. In the future we plan to add new types of CameraBots to our framework and increase the functionality of the existing ones to allow for a wider range of cinematic camera work.

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