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## ► To cite this version:

Christophe Lino, Marc Christie, Roberto Ranon, William Bares. A Smart Assistant for Shooting Virtual Cinematography with Motion-Tracked Cameras. ACM Multimedia, Nov 2011, Scottsdale, United States. hal-00646396

**HAL Id: hal-00646396**

**<https://inria.hal.science/hal-00646396>**

Submitted on 19 Feb 2013

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# A Smart Assistant for Shooting Virtual Cinematography with Motion-Tracked Cameras

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## ABSTRACT

This demonstration shows how an automated assistant encoded with knowledge of cinematography practice can offer suggested viewpoints to a filmmaker operating a hand-held motion-tracked virtual camera device. Our system, called *Director's Lens*, uses an intelligent cinematography engine to compute, at the request of the filmmaker, a set of suitable camera placements for starting a shot that represent semantically and cinematically distinct choices for visualizing the current narrative. Editing decisions and hand-held camera compositions made by the user in turn influence the system's suggestions for subsequent shots. The result is a novel virtual cinematography workflow that enhances the filmmaker's creative potential by enabling efficient exploration of a wide range of computer-suggested cinematographic possibilities.

## Categories and Subject Descriptors

H.5.1 [Multimedia Information Systems]: Animations, Video

## Keywords

Virtual Cinematography, Motion-Tracked Virtual Cameras, Virtual Camera Planning

## 1. INTRODUCTION

Creating camera edits and movements for computer generated animation remains time-consuming and largely manual endeavor requiring cinematographic skill and experience with 3D animation packages. Some technically-savvy filmmakers are now using motion-sensing devices to capture

complex virtual camera movements rather than key-framing the camera [1]. However, these existing devices operate as plugins to animation packages such as Maya that offer an infinity of expressive animation power, but with a corresponding steep learning curve and an interface which is not designed around cinematographic concepts.

Researchers in automated virtual cinematography systems have produced increasingly sophisticated algorithms that can generate virtual 3D camera work that mimics textbook guidelines [4, 2, 3]. But in succeeding to reduce human effort, these automated systems also limit the input of creative human filmmakers and as a result produce cinematography of little creative value. Our *Director's Lens* system introduces a novel workflow that combines the creative human intelligence with the computational power of an automated cinematography system, to enable a filmmaker to explore a variety of automatically suggested virtual camera compositions (see Figure 2), that represent a variety of cinematically distinct ways one might film a given shot and which are consistent in user-specified continuity properties with the previous shot. For computing its suggestions, the system exploits an annotated screenplay which provides the narrative context in the form of text descriptions of locations, subjects, and time-stamped actions, with links to the 3D models employed in the scene. Moreover, the system tries to mimic user's composition from previous shots.

With the help of a motion-tracked virtual camera (see Figure 1), the cinematographer can easily refine and use the suggestions as a starting point to craft his or her own cinematic compositions. Consequently, the expert is able to rapidly consider many more alternatives and the novice is guided towards options that conform to established cinema convention.

## 2. NOVELTY AND BENEFITS

This demonstration represents the very first coupling between motion-tracked camera devices – a fundamental technique in virtual cinematography – and automated viewpoint computation to support a filmmaker in his creative choices. The demonstration highlights both the creative potential the tool provides (movies can be made very rapidly) and the ease to play and explore the cinematic possibilities of a scenario.

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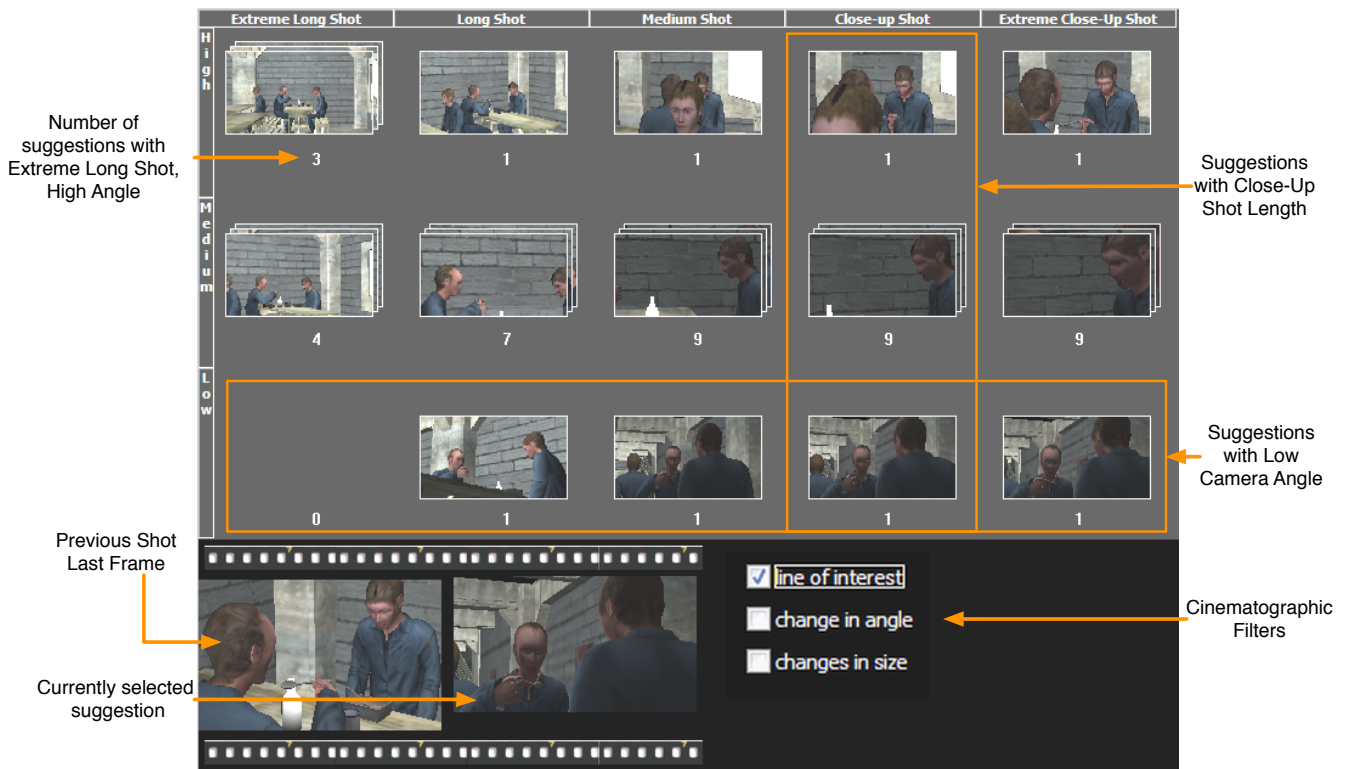


Figure 2: Screenshot of the interface in Explore Suggestions mode. The *Line of Interest* visual filter is selected, and thus only suggestions respecting the line of interest with respect to the previous shot last frame (pictured in the bottom left) are visualized.



Figure 1: Our hand-held virtual camera device with custom-built dual handgrip rig and button controls, a 7-inch LCD touch-screen.

### 3. DEMONSTRATION

In this interactive demonstration of our Director's Lens system, a user operates a small hand-held touchscreen LCD screen equipped with motion sensors and custom-built button and joystick controls (see Figure 1) to record virtual camera movements (i.e., shots) to visualize a recreation of a scene from Michael Radford's film version of Orwell's 1984. The application runs on a notebook PC with a USB cable to communicate with the device's buttons, joysticks, and touchscreen, and an HDMI cable to mirror the PC's display on the handheld LCD. Three optical motion capture cameras mounted on tripods track the position and orientation of a rigid body marker cluster affixed to the device, which

in turn map to the position and orientation of the virtual camera. We will also show a second version built from a Microsoft XBOX 360 gamepad and the same type of LCD touchscreen, but with a gyroscope sensor to drive camera orientation and the gamepad thumb sticks the camera's position.

A user can record a movie by iterating the following workflow: (i) identify the instant in the movie produced so far where a cut should be introduced (initially, at the beginning of the animation); (ii) ask the system to compute suggestion to start a new shot; (iii) browse the suggestions by cinematic properties (see Figure 2); (iv) choose the one that is closest to what the user likes; (v) possibly aim the virtual camera device to refine the composition, and start shooting, moving the the device like a real camera. An alternative, simpler workflow can very rapidly produce a sequence of static shots by simply exploring and selecting suggestions, without using the tracked device.

When browsing suggestions the user explore variations in shot distance, height, and angle in addition to whether or not suggestions conform to or differ from the previous shot in continuity, size, and angle. In this way the user can rapidly explore many different possible ways to film a given shot and assume manual control to improve upon the system's compositions and movements.

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