Poster: Touch-controlled panoramic video streaming for film directing

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ABSTRACT

This paper describes the initial development of Stageview, an hardware and software infrastructure for real-time 360º video streaming in support of video production. The system, designed to deliver an auxiliary panoramic video source to film directors, offers an interactive and comprehensive view of the stage surpassing the limit of the operator's camera frame. In relation to traditional video production this implies a certain margin of innovation: streaming technologies allow, in fact, a new form of remote direction that can transform the traditional construction of a film, because actors and operators in different locations can be simultaneously controlled by the director through an Internet connection, whereas before the entire troupe had to share the same physical space. Moreover this video stream, intended as an addition to the main footage, including both the scene of the fiction and the set constructing this fiction in one signal, records what cinema - and more in general television, always tried to hide, breaking the membrane that separates object perceived and subject perceiving, in other words fracturing the classical narrative dominated by the point of view. Technical issues, current standards, objectives and decisions are discussed throughout the paper, while creative potential and future perspectives are outlined in the last part and the conclusions.

Categories and Subject Descriptors

H.4 [**Information Systems Applications**]
; D.2.8 [**Software Engineering**]: Creative Industries—
Communities and culture

General Terms

Theory

General Terms

panoramic, video, streaming, real-time, touch

1. INTRODUCTION

Stageview is a software module for Stagebox, an IP camera-back[1] device developed at BBC in 2012. The main case-study for this system imagines a director receiving different camera feeds live directly in the broadcast centre using Stagebox with Stageview. For each camera the director will receive two video signals, both sent by Stagebox: the main HD video, shot by the operator, and a lower quality one, shot by the Stageview, the 360º micro-camera placed on top of the box. Using an iPad to receive it, the director will freely observe what happens in the surrounding of the main scene and suggest the operator relevant framing or camera movements.

When a subject looks through a camera becomes, inevitably, vulnerable, fragile. In fact the absorbtion into another world, that of representation, creates a space of disarray, that space in between image and fact, object and sign. And that's why, behind a camera, the unknown extends its territory, becoming increasingly mysterious, eventually threatening. For this reason very often camera operators, videographer and documentarists need at least a second person to accompany them, sort of angel that can look behind their back. According to popular culture a guardian angel is an angel assigned to a particular person as guide and protection; in short the angel is looking after the person, and common imaginary depicts it as a floating entity satelliting around the person, often seeing what the person is missing. But technology tends to fulfill the metaphor of our inner wishes, so...

Stageview is a system composed of two main parts: the emitter and the receiver. In the prototype, the emitter is a Linux Angstrom operating system running on Gumstix FireStorm (an open source computer-on-module) directly connected to Stagebox. As a receiver an Apple iPad was chosen, and an iOS application for it will be eventually developed. The emitter uses a camera module by e-con Systems[2] and a catadioptric optical system[3] to capture a 360º side view. The catadioptric lens encodes a 360° view in a toroidal

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[1]Stagebox is a box for HD video streaming that can be connected to the back of any professional video camera.
[2]e-CAM50 CU35x GSTIX or e-CAM32 OMAP GSTIX.
[3]Kogeto Dot!, http://www.kogeto.com/. Catadioptric optical systems combine lenses and curved mirrors to provide a

configuration inside a standard rectangular video frame. We stream the video frame, presently at 640x480 resolution, using GStreamer, a pipeline-based multimedia framework; the Ti Gstreamer plugin developed by Texas Instruments allows access to the DSP. This plugin uses DMAI (DaVinci Multimedia Application Interface), an utility layer on top of the operating system and the codec engine that simplifies the interaction between the application and the underlying hardware. The memory is mapped in regions of RAM divided between the kernel, the camera driver, CMEM[4] that passes data between the DSP and the ARM, and the rest of the Linux system.

The iPad application, currently under development, through a double conversion cartesian to polar and polar to cartesian, will unwrap the relevant image to a rectangular shape; the idea is to provide a video image that can slide horizontally through the frame following the director's touch, allowing horizontal navigation of the 360º space.

2. DEVELOPMENT

We develop using Open Embedded, the open source build framework for embedded Linux which offers a cross-compile environment to create Linux distributions for embedded systems. Bitbake is the main tool at the heart of OE which resolves dependencies between different software packages in order to build a complete software system; its function can be compared to that of *make* with source code. Bitbake includes a collection of recipes that contain instructions on how to build a particular package; these include package dependencies, sources, configurations and compile options.

Building a kernel image supporting video streaming with GStreamer and the DSP is not a simple operation: the process is well described by JumpNowTek [5] but requires some adaptations according to the Gumstix specific model, the Kernel version and the SD card size.

The main difficulty is to know what dedicated memory region the DSP uses, so to avoid a conflict between the kernel, the camera driver, the CMEM module that manages the communication between the ARM and the DSP, and the rest of the Linux system. Given the state of current technological standards, the U-Boot parameters that specify regions of physical memory the kernel should use need to be calculated and manually passed to the boot environment.

Consequently, streaming live video from a micro camera connected to an embedded Linux system such as the Gumstix is a non trivial operation that requires extensive testing and some research.

3. REFLECTIONS

Compared to other broadcasting techniques, the Internet offers an intimacy that was not present in previous communication technologies; the entire Internet can be seen as a sort of Panopticon, if from each point in the Net it's possible to access and see all the other existing points[6]. This extension of physical presence is made even more real by the introduction of real-time technologies and touch-controlled

interaction. This entails the risks to extend the previous principle, should the world be suddenly streamed: from any point in the Internet you can see any point in the world. Streaming, in fact, implies two movements of transmutation: on the one hand the real becomes virtual, crossing the ontological membrane of materiality in one sense, on the other hand and in the opposite sense the virtual invades the world, conquering its own digital, tangible materiality.

Stageview, beside showing more than what the director (or the narrative contract that ensures the fiction) is supposed to see, constructs a simple infrastructure that allows a very simple gesture: a remote environment can (almost) be touched from the distance, extending the influence of a body over another body to distant places.

At the same time the distance between subject and object that shaped the development of audiovisual language starts a slow erasure: if a subject is the eye that films the world, and the world becomes object, the subject is contained in this world represented as an object because this representation is made of a point of view: while the object can be seen, the subject contained into it is perceived as a point of view on the object. Stageview's panoramic image fractures the narrative dominance of the point of view, which becomes a multiplicity. The viewer abandons a passive role and reestablishes a form of subjectivity through the independence of a perspective. Perspective, that in the history of figurative and abstract arts defined the distribution of a visual narrative, is suddenly substituted by gesture, and through this gesture the viewer establishes an active engagement with the image, that acquires new characteristics. And the emergence of this other subject pushes the ontology of the virtual, of virtual space in real time, through another layer of constant deformation.

4. CONCLUSIONS

Stageview is a panoramic video streaming system for broadcasters and TV and film directors. It provides a low quality 360º video image for each video camera taking part of a set. This additional video image can be controlled by touch and allows directors to expand the normal view that each camera offers, favoring a more precise modulation of the operators. Until now the vision of the director was limited to the frame shot by the operator, whereas with Stageview the director can preview any possible camera panning. Additionally this method provides footage that can enrich the filmic experience producing images where the point of view is surpassed. The use of this camera, from an initial phase in a local space, can be extended to create interconnected narratives and dislocated sets where actors and director can be in different cities while working on the same film.

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panoramic view.

[4]CMEM is an API and library for managing blocks of physically contiguous memory providing address translation services and user-mode cache management.

[5]http://jumpnowtek.com/.

[6]Obviously excluding Darknet and access restricted areas.