# Low-Cost virtual set using smartphone sensors

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## ABSTRACT

This paper introduces a low-cost method that makes use of the sensors of the smartphones in order to make automatic camera tracking in augmented reality television production. This methods permits to use non-sensorized cameras since it takes advantages of the accelerometers and gyroscopes that most of the smartphones have. Attaching the smartphone to the camera, the orientation and movements of the camera can be known.

## Keywords

Augmented Reality,Virtual Set, Camera tracking

## 1. INTRODUCTION

In an augmented reality application knowing the camera position, the rotation (pan and tilt) and the zoom it is possible to render a virtual background and mix it with the foreground of the camera.There are several solutions for virtual set in the market for this purpose. However, most of them are constrained to fixed cameras where the position, pan, tilt and zoom. The virtual set infrastructures which allow camera movements need the sensorization of studios or cameras aimed to constantly gauge the dynamic camera parameters.

## 2. SYSTEM ARCHITECTURE

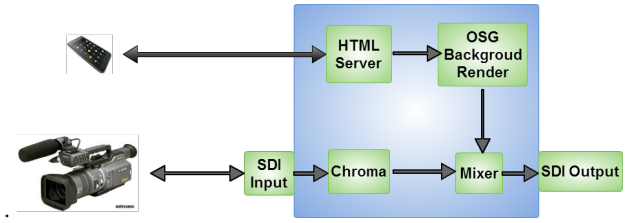


**Figure 1: System Architecture**

The proposed platform employs HD-SDI interfaces as video/audio input and output. The spatial dimension of the camera is added thanks to a HTML server that provides a HTML5 application executed by the connected smartphones and sends the captured devices's gyroscope and accelerometer data to the virtual background render. Going into details, the smartphone connects to HTML server in a local network to keep low latency. Moreover, the smartphone's sensors data are collected using the HTML5 DeviceOrientation events. Attaching the smartphone to the camera and measuring the distance between camera sensor and smartphone, it is possible to calculate camera orientation in order to render virtual background in the same orientation as real camera.

The virtual world rendering is based on Open Scene Graph (OSG). This core block exploits gathered spatial data to create a consistent virtual background according to the real camera pan and tilt. Meanwhile, the real background is segmentated using chroma key technique. Once, both video signals and parameters are ready, they are mixed to build the video output. As more precise will be the mixing of real and virtual images, more realistic would be the experience for the users. For that purpose other parameters of the camara as focal length, image format and principal point must be obtained through camera resectioning process. For realtime camera capture an HD-SDI interface is used. After capture, the Chroma Key technique is applied with OSG extracting the green pixels to the real video. To avoid delays between real foreground and virtual background, there is an adjustable buffer for the real foreground video. The output of this render is an HD-SDI interface with real foreground and virtual backgroud mixed in the same video.

## 3. VALIDATION

We have developed a test set using this method in order to know the viability of the platform in a real production. In our test we have used an Iphone 4S as smartphone. The core develpment deploys an application on top of OSG libraries to handle the HD-SDI input, render a 3D object and mix it with the input video in HD-SDI output. As a result a coherent rendering of the virtual camera regarding the movements of the real camera has been obtained.

## 4. FUTURE WORK

The described method uses a camera in a tripod with a fixed position. This method can be extended to free moving cameras like Steadycams. With Steadycams the position of the camera will be required. This could be solved putting markers at the ceiling of the stage and developing an application in the smartphone that uses computer vision to know the smartphone position in the stage.