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Anonymous

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Automatic Detection of Video Properties for Playback in Virtual Reality

ABSTRACT

Videos displayed in virtual reality (VR) can include simple quadrangular videos, 180 degree videos, 360 degree videos, etc. Videos can be mono or stereo. If the video does not include metadata indicative of such properties, viewing the videos in VR is a suboptimal experience. This disclosure describes techniques to analyze a subset of frames of a video to determine video properties and automatically select an appropriate configuration to display the video in virtual reality.

KEYWORDS

- 360 video
- 180 video
- Virtual reality (VR)
- Stereoscopic video
- Stereo disparity
- Video player

BACKGROUND

Video content can be viewed in virtual reality, e.g., using a virtual reality headset, in a variety of ways. For example, the layout of the video can be monoscopic or stereoscopic. A monoscopic video is a single video channel that is displayed to both eyes in a VR headset. In a stereoscopic layout, two channels of video are provided in a side-by-side (SBS) configuration or in an over-under (OU) configuration. Fig. 1 illustrates the SBS configuration and Fig. 2 illustrates the OU configuration. The two channels of video can have slightly different perspective that enables the viewer to have a perception of depth.

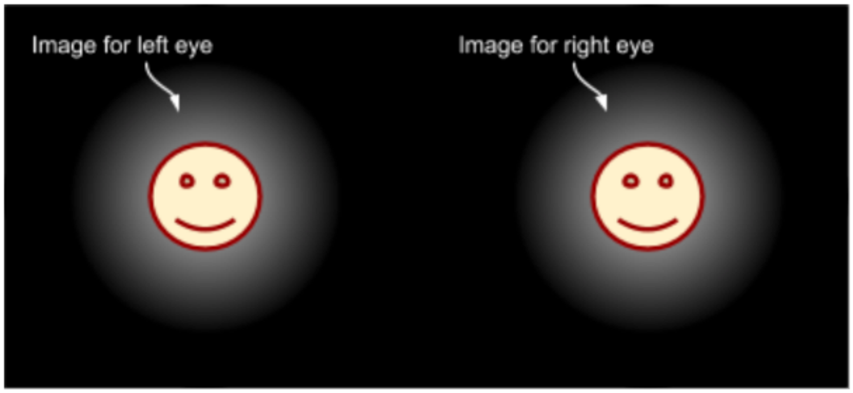

Fig. 1: Stereoscopic video - side-by-side configuration

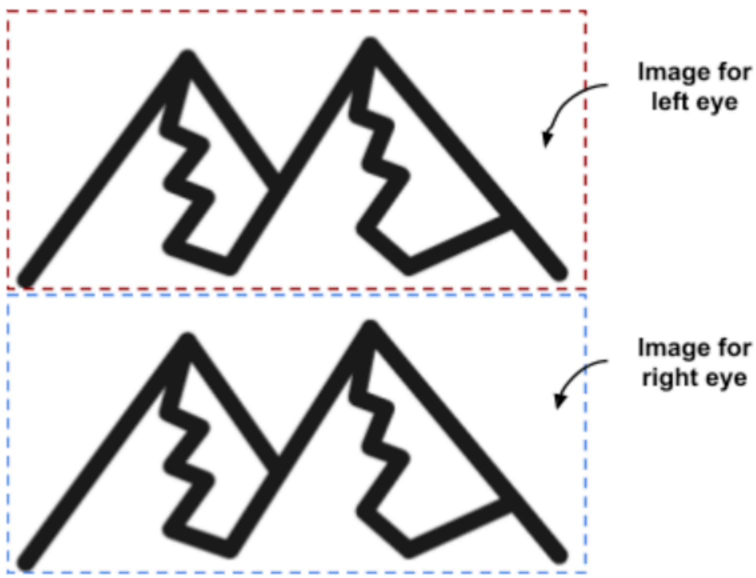

Fig. 2: Stereoscopic video - over-under configuration

Further, a video can also have different fields of view. For example, a video may be viewed as a simple quadrangular video (classic video); as a 360-degree video in which a viewer is positioned at the center of a 360-degree scene; or as a 180-degree video where the viewer can see a front-facing 180-degree field. A 360-degree video may be stored and provided using equirectangular projection or a cubemap (regular cubemap or equi-angular cubemap). A 180-degree video may use a spherical (fish-eye) or equirectangular (lat-long) projection.

For any video, there is a specific VR view that provides the best viewing experience. However, most VR video players cannot automatically determine the view to use to display a particular video, unless the video includes metadata that indicates the view. For videos that do not include metadata, a user often needs to fiddle with display options to view VR videos in a satisfactory manner. For example, online video hosting websites often provide streaming video that includes a stereo stream but does not have the associated metadata. Such videos are therefore presented like a regular 2D quadrangular video to viewers that view the video via a virtual reality headset.

DESCRIPTION

This disclosure describes techniques to automatically detect the properties of a video that is being viewed in VR and to display the video in VR that provides an appropriate viewing experience based on the detected properties. The detection can be performed on-the-fly via inexpensive frame analysis prior to starting playback of the video.

Determine if the video is mono or stereo

The analysis can include computing a stereo disparity histogram for a sample set of frames of the video. For example, the sample set can include frames that are located at the first third, half, and second third of the timeline of a video. If a frame has a high luminance variance histogram (corresponding to the frame not being a single flat color), the stereo disparity can be observed to determine if the video frame has a side-by-side (SBS) or over-under (OU) layout. It is determined if there is a stereo match. If there is a stereo match, the layout is identified (e.g., SBS or OU) based on the stereo disparity. Portions of the video that correspond to left eye and right eye respectively are displayed accordingly to provide a stereoscopic display. If there is no stereo match, the video is treated as a regular mono video.

Determine if the video is 180-degree or 360-degree

The borders of the video are analyzed to determine whether the video is a simple quadrangular video or a 360-degree video. A 360-degree video wraps around at the borders (whether provided as a cubemap or equirect) and therefore, pixels at the borders of the video match other pixels where the video wraps around. Such determination may also include determining that the border pixels depict interesting content, e.g., pixels with a variation in colors. If such a match is detected based on analyzing the borders, it is determined that the video is a 360-degree video. Videos that are 180-degree spherical content have borders that have a circular black region. If a circular black border is detected based on analyzing the borders, e.g., via a radial check, it is determined that the video is a 180-degree spherical video. When the analysis of borders does not indicate that the video is a 360-degree or 180-degree video, it is determined that the video is a simple quadrangular video.

Display video in VR based on video properties

Upon successful detection of the video properties - whether the video mono or stereo and/or whether the video is a simple quadrangular video, 180-degree video, or 360-degree video, the virtual reality video player is automatically configured to display the video accordingly. The user is provided with options to override the detected layout.

CONCLUSION

This disclosure describes techniques to analyze a subset of frames of a video to determine video properties and automatically select an appropriate configuration to display the video in virtual reality.