

Open-Source Accessibility-Enabled VR360 Player

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ABSTRACT

This paper presents an evolved version of an open-source web-based player that enables the consumption of immersive VR360 content augmented with the personalized presentation of access services, like subtitles, (spatial) audio description and sign language. Likewise, the player integrates additional accessibility and assistive solutions, like voice control, visual feedback and magnification features. It is a key component of an end-to-end platform that allows augmenting traditional broadcast services with the presentation of immersive and access services content delivered via broadband. It can be also integrated in both Hybrid Broadcast Broadband TV (HbbTV) and full web-based multi-screen scenarios. Most of its supported features and personalization options are detailed in the paper, and have been adopted after validation via user-centric activities and user tests. The player is available as an online service (<http://imac.i2cat.net/player/>), and has been additionally integrated in the services offered by European broadcasters. Its source code is available on Github.

CCS CONCEPTS

• Information systems → Information systems applications • Human-centered computing → Human computer interaction (HCI)

KEYWORDS

360° Video, Accessibility, Immersive Media, Spatial Audio, Subtitles, Virtual Reality

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1 Introduction

While the media sector is currently offered a plethora of accessibility solutions and guidelines for classical audiovisual services, this is not yet true when it comes to immersive media. Lack of accessibility hinders the interaction with Virtual Reality (VR) experiences to many consumers, becoming a barrier for global e-inclusion and equality of opportunities. In this context, ImAc (Immersive Accessibility) is an EU H2020 project that has been exploring how accessibility services (like subtitling, audio description and sign language) and assistive technologies (like magnification features and voice control) can be efficiently integrated with immersive media, focusing on VR360 video and spatial audio [1, 2].

This paper presents the evolved version of the web-based player developed within the umbrella of ImAc to enable the consumption of immersive VR360 content in a personalized and accessible manner. While the player was presented in [3], noteworthy innovative features and refinements have been added, in terms of: technological solutions; presentation modes of access services; and user interface aspects. Most of the player features have been validated via controlled user tests and large-scale open pilots in the last year. Likewise, the player is currently available online via different websites, including the ones from two European broadcasters, and has been integrated in both Hybrid Broadcast Broadband TV (HbbTV) [4] and full web-based multi-screen scenarios. A wide sample of immersive VR360 content pieces, augmented with access services, in multiple languages, is additionally currently available.

The player is not just an ad-hoc and isolated media software component, but it can be seamlessly integrated in current media services. As an example of how this integration can be made, the end-to-end platform developed in ImAc to augment traditional broadcast services and workflows with

immersive and accessible content is outlined in Section 3. That overview is preceded by a brief review of state-of-the-art solutions in Section 2. Finally, the main player features, paying especial attention to the novel ones, are presented in Section 4.

The audience will be able to experience with the features provided by the player, by selecting the preferred VR360 content (based on the genre, language, available access services....) and consumption devices. Demos of the player will be provided through an online service: <http://imac.i2cat.net/player/>. Additional URLs will be prepared to be able to directly test the most innovative features. Demo videos will be also provided, like the following ones: http://tiny.cc/imac_player_imx and http://tiny.cc/imac_player_imx2

2 Related Work

As far as authors know, the existing players enabling a personalized consumption of accessibility content have mostly focused on subtitling for traditional media (i.e., 2D video). Relevant examples can be found in [5-7]. In addition, subtitling solutions for VR360 video have been proposed and assessed in [8-9], leaving the door open to further research in this topic. The presented player includes further presentation options for subtitles than the other existing ones, being all of its features derived from user-centric activities and validated via user tests. In addition, it provides innovative solutions for other access services, like audio description and sign language, which had not been yet explored for VR360 content, as reviewed in [1, 2].

3 End-to-End Platform

ImAc has developed an end-to-end platform that allows a seamless integration of immersive and accessibility content in current broadcast-related services. It comprises four parts, including the necessary components and steps from media ingest/authoring to media consumption:

- **Content Production:** web-based tools for the production and editing of accessibility content, including subtitles, audio description and sign language.
- **Content & Service Provider:** components for the management and cataloguing of content, and triggering their publication.
- **Content Preparation & Distribution:** preparation of content (e.g. format conversion, encoding, signaling...) for an appropriate distribution via broadband networks.
- **Content Consumption:** web-based player for the presentation of immersive and accessibility content in an interactive and personalized manner, in both single- and multi-screen scenarios.

All technological contributions have been designed with the premise of guaranteeing backward-compliance with current formats, technologies, infrastructures and practices in the broadcast/media ecosystem. This will maximize re-usability, interoperability and the changes of successful deployment and exploitation. Further details about the developed platform are provided in [1, 2], in the project website, and overviewed in this video: <http://tiny.cc/ImAc>

4 Open-Source Accessibility-Enabled V360 Player

The main technological components and layers of the VR360 player, as well as its key features, are detailed in [2, 3]. This section reviews its key functional features, by highlighting the latest developments and improvements.

The player source code is publicly available at: <https://github.com/ua-i2cat/ImAc>

4.1 Adaptive User Interface (UI)

On the one hand, an intuitive, responsive and accessible web portal (i.e., landing page) has been designed and developed for an initial language selection, settings, content listing and selection (Figure 1, left). On the other hand, the player menu (Figure 1, right) has been refined based on the insights and lessons learned from user-centric activities and user tests. In particular, the improvements include: visual feedback when navigation within the menu and sub-menus, and for the active settings; adoption of magnification features (both for menu elements, and for enabling an enlarged size menu) and zoom features for the video scenes; possibility to open the menu with just one click; possibility to close the menu by clicking outside of it, and after a timeout event; etc. In addition, the voice control feature have been extended with extra commands and languages (Spanish and German, beyond English).

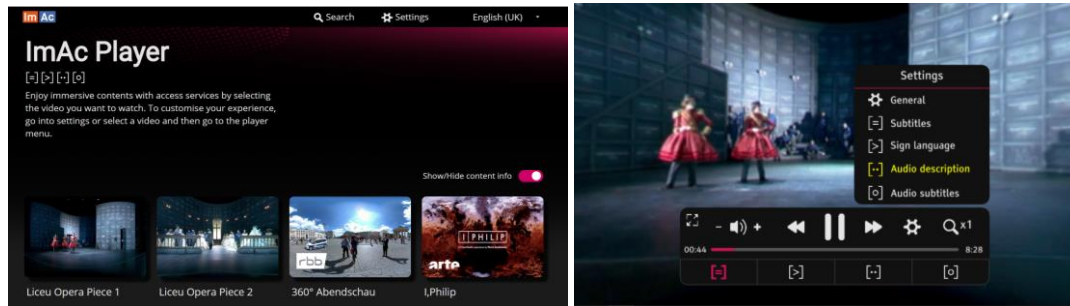


Figure 1: Evolved User Interface of the accessibility-enabled VR360 player

4.2 Presentation of Access Services

The player enables a personalized presentation of access services, like subtitles, sign language, audio description and audio subtitles. The main features and options are detailed next.

4.2.1 Subtitles

The player support a personalized presentation of subtitles, in terms of: size (three size levels); background (outlined text or a semi-transparent background box); position (top and bottom); and language. In addition, three presentation modes for subtitles have been implemented and evaluated: 1) user-referenced subtitles, which are always-visible regardless of where the user is looking at (Figure 2); 2) world-referenced subtitles, by placing them equally spaced every 120°; and 3) world-referenced subtitles, but attached to the speaker for a better identification (Figure 3). In all these cases, always-visible guiding methods (e.g. arrows or a radar) indicate where the speaker is, if he/she is outside of the user's FoV (Figure 2). As long as the speaker is within the user's FoV, the visual indicator is automatically hidden. In addition, the presentation of Easy-to-Read subtitles is now supported, after proving their benefits with user tests, in particular with elderly users [10].

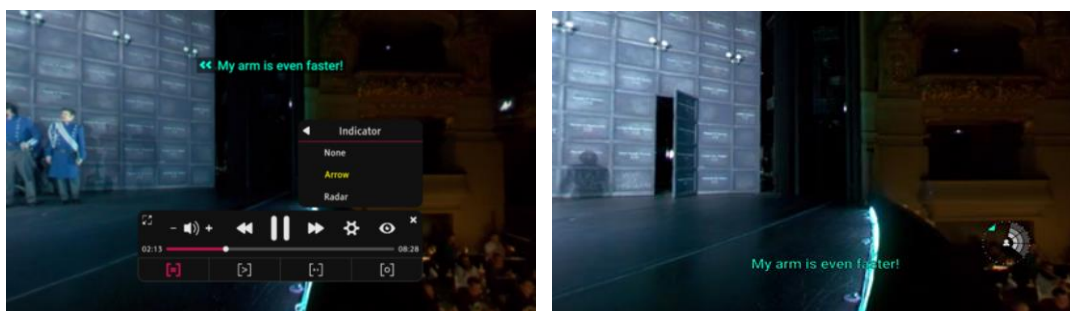


Figure 2: Always-visible subtitles at different positions (left figure: at top; right figure: at bottom) and with different visual indicators (left figure: arrows; right figure: radar)

4.2.2 Sign language

Sign language interpreting is provided via an overlay Picture-in-Picture (PiP) video window positioned at the bottom right of the field of view, as in typical video services. The evolved version of the player includes many personalization options for the presentation of sign language, in terms of: size (three

levels); presentation mode (user-referenced, world-referenced), position (bottom right and left); and indicators (arrows and radar). In addition, the name of the speaker (or another descriptive text) can also be added below the video window for a better identification (Figure 4). Another innovative feature can be also activated. It consists of automatically hiding/showing the sign language video, based on the speaker's activity (thanks to metadata provided at the production side). Unlike other existing VR360 players, the player additionally supports the simultaneous presentation of subtitles and sign language (Figure 4, right). Finally, another innovative feature, applicable to all visual elements on screen, is the ability to move the elements to the preferred position, via drag & drop actions (Figure 4, right, with the yellow outline to the radar indicating that it is being displaced). While visual elements are being moved, the video is paused.

4.2.3 Audio Description & Audio Subtitles

For audio description, the player leverages the potential of spatial audio formats (Ambisonics) to provide support for different presentation or audio placement modes, which in turn can be complemented with different narratives or scripting modes. This can contribute to both a better accessibility and immersion, as users can better interpret the 360° space and story via auditory cues. The implemented audio presentation modes are:

- Classic Mode: no positioning.
- Static Mode: audio from a fixed point in the scene.
- Dynamic Mode: audio dynamically coming from the direction of the action.

Likewise, the evolved version of the player provides support for extended audio description tracks (for specific scenes, actions or objects), which can be optionally activated to get extra information (e.g., via clicks or voice commands). Independent volume settings for the audio description and main audio tracks are supported as well. Similar features and settings are provided for audio subtitles.



Figure 3: Subtitles attached to the speaker with always-visible visual indicators



Figure 4: Presentation of a sign language video together with a visual indicator and info text (e.g. name) about the speaker (left); simultaneous presentation of subtitles and sign language with radar as indicator

4.3 Multi-Screen Scenarios Support

The appropriate technology has been developed to integrate the player in multi-screen settings, both as part of HbbTV services and by using full web-based scenarios. Example implementations can be checked at <https://www.ccma.cat/experiencia-immersiva-accessible/>

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