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SERIES F: NON-TELEPHONE TELECOMMUNICATION SERVICES

Multimedia services

Requirements and reference framework for digital representation of cultural relics and artworks using augmented reality

Recommendation ITU-T F.740.2

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Recommendation ITU-T F.740.2

Requirements and reference framework for digital representation of cultural relics and artworks using augmented reality

Summary

Recommendation ITU-T F.740.2 describes the requirements, application scenarios and reference framework for the digital representation of cultural relics and artworks using augmented reality (AR), which is known as an augmented reality cultural service system (ARCSS). This Recommendation describes the AR digital presentation requirements, cultural connotation interpretation requirements, cultural venue tour guide requirements, platform management requirements and performance requirements for ARCSSs. This Recommendation describes a reference framework of an ARCSS with an AR cloud creation platform, AR cloud management platform and mobile devices. Procedures of augmented reality cultural service are provided in this Recommendation including an AR content creation procedure, AR service management procedure and AR content display procedure.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T F.740.2	2021-06-13	16	11.1002/1000/14679

Keywords

Artworks, augmented reality, cultural relics, cultural venue.

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

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The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

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Requirements and reference framework for digital representation of cultural relics/artworks using augmented reality

1 Scope

This Recommendation describes the requirements and reference framework for the digital representation of cultural relics and artworks using augmented reality (AR).

The scope of this Recommendation includes:

1) Requirements for an AR cultural service system.
2) Reference framework of an AR cultural service system.
3) Procedures of an AR cultural service.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

None.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 augmented reality [b-ITU-T J.301]: A type of mixed reality where graphical elements are integrated into the real world in order to enhance user experience and enrich information.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term.

3.2.1 cultural venue: A public venue generally established and operated by relevant government departments or enterprises to meet the spiritual and cultural needs of the public and carry out public cultural and artistic activities. It basically functions as a place to hold exhibitions, lectures and training, spread scientific and cultural knowledge, carry out social, cultural and art education, collect, sort out and study intangible cultural heritage and conduct relevant general surveys, displays and publicities, etc. Museums, art galleries and community cultural centres are all typical cultural venues.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AR Augmented Reality

ARCC Augmented Reality Content Creator

ARCSS Augmented Reality Cultural Service System

ARCU Augmented Reality Content User

5 Conventions

In this Recommendation:

– The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

6 Background

As a new and emerging media technology, augmented reality (AR) can seamlessly integrate digital virtual content into real scenes and present them on mobile devices when people visit cultural venues. The combination of technology and art will bring new and interactive experiences to the audience and bring the cultural relics and artworks to life. An artistic landscape painting may be quietly hung on the wall, but through the means of AR, it becomes a flowing landscape painting in the visitor's palm (on a mobile device screen). It is like a living scene. In fact, many cultural relics and artworks have historical, social and even political values. Behind them are usually rich cultures and legends which are less known by most of the audience. Without preparation before a visit, visitors at cultural venues often miss some wonderful exhibits and may feel regret when being told of them by others, a common experience for visitors.

6.1 The need for cultural communication through augmented reality

The visual value of cultural relics and artworks can be demonstrated through physical display, but this has neither dynamic effect nor sound. In the absence of explanation, the appreciation effect depends mainly on audience level and imagination. Many visitors often feel bored and unable to understand. In fact, many cultural relics and artworks transmit historical, social and even political values. Behind them are often rich cultures and legends. If we can use technologies to present the stories behind the cultural relics and artworks in a dynamic way, the audience would be able to establish a link between real objects and abstract conceptions and truly understand them. This is very significant for the dissemination of culture and art.

6.2 The need for cultural appreciation through augmented reality

Cultural venues are important places for people to receive cultural influences, and an augmented reality cultural service system (ARCSS) has become a relaxing way to experience cultural venues for them. For example, conveniently, some palm gallery apps have been introduced to help visitors understand stories behind exhibits at any time and place. But due to the lack of on-the-spot experience, there is also a lack of fun and interaction, and it is difficult to inspire the enthusiasm of visitors.

New media practitioners are increasingly applying AR to cultural venues for better results. This Recommendation supports the integration of culture with new media technologies.

6.3 Technical support and standardization requirements of ARCSSs

This Recommendation introduces scenarios of cultural relics and artworks, and then analyses the requirements for the digital representation of cultural relics and artworks. Extracting analysis and analysing and exploring demands from the scenarios are very meaningful. In cultural venues, the demand for representation, especially digital representation of cultural relics and artworks, requires us to satisfy the protection of cultural relics while taking full advantage of digital representation.

Further, this Recommendation proposes a reference framework for the digital representation of cultural relics and artworks based on AR. It is the top-level design of the entire system. If it is absent or vaguely defined, there would be differences in the understanding between different departments of

the industry chain, making technical solutions very different and coordination and cooperation with each other difficult.

Mobile terminals based on AR digital representation of cultural relics and artworks undertake important tasks for direct interaction with users. If there is no strict quality requirement, they could not only make cultural relics/artworks appear less appealing but even have the opposite effect to that which they set out to deliver.

7 Overview of ARCSSs

An ARCSS is a service system of cultural venues such as museums or art galleries for audiences, which exhibits and explains additional information on cultural relics and artworks using AR technology. A software is pre-installed on terminal devices including dedicated devices, mobile phones, tablet computers and AR glasses, which superimposes the digital content (such as voices, graphics and videos) on top of a view of the cultural relics and artworks in real time after identifying the cultural object. The corresponding digital content can be stored locally or in the cloud. A unified standard ARCSS can share data and provide unified global services, and using it audiences will feel welcomed and interested.

In an ARCSS, there are four kinds of roles, respectively the cultural venue manager (CVM) role, the platform manager role, the AR content creator (ARCC) role and the AR content user (ARCU) role (i.e., visitor). The cultural venue manager needs to submit the basic information and materials of the AR collection to the ARCSS. The ARCC uses the AR cloud creation platform provided by the ARCSS to create AR content. The platform manager is responsible for the operation and maintenance of the ARCSS, including venue management, AR content management and terminal device management, etc. The ARCU receives AR interpretation services through the terminal device linked to the ARCSS in cultural venues.

8 Requirements for an ARCSS

The Requirements for an ARCSS include but are not limited to the following.

8.1 AR digital presentation requirements

It is recommended that an ARCSS use AR technology including video, sound and other rich media to present stories in a dynamic way, which can enable the audience to feel welcomed, interested and not bored by mobilizing their senses of sight, hearing and touch.

8.2 Cultural connotation interpretation requirements

It is recommended that an ARCSS tell the story behind cultural relics and artworks. The world of virtual and realistic synthesis brings people into the realm of fantasy. Through time and space, enabling the audience to appreciate and listen to stories behind cultural relics and artworks gives the audience not only a deep understanding of the art itself, but also a deeper understanding of the artist's ideological realm.

8.3 Cultural venue tour guide requirements

It is recommended that an ARCSS provide a portable art assistant functionality, and that the navigation system remind people not to miss a classic when they pass by.

8.4 ARCSS platform management requirements

An ARCSS platform runs on the cloud or local server, connects with platform users and terminal devices through a wireless network, receives, stores and distributes AR content, and supports system operation. It is recommended that an ARCSS support user management, venue management, AR content management, terminal device management and other functions.

8.5 ARCSS performance requirements

It is recommended that an ARCSS provide visitors with high-quality AR interpretation services, and that the management platform support a large number of terminal device concurrent service requests, venue service statistics and hotspot analysis. It is recommended that the terminal device support the smooth playback of AR content, sensitive interactive operation, and battery life to support the general visiting process. It is recommended that AR content support image, text, voice, video, 3D model and other multimodal media forms, with moderate duration and accurate content.

9 ARCSS reference framework

Based on the requirements and model analysis, the reference framework for the digital representation of cultural relics and artworks using AR is shown in Figure 9-1.

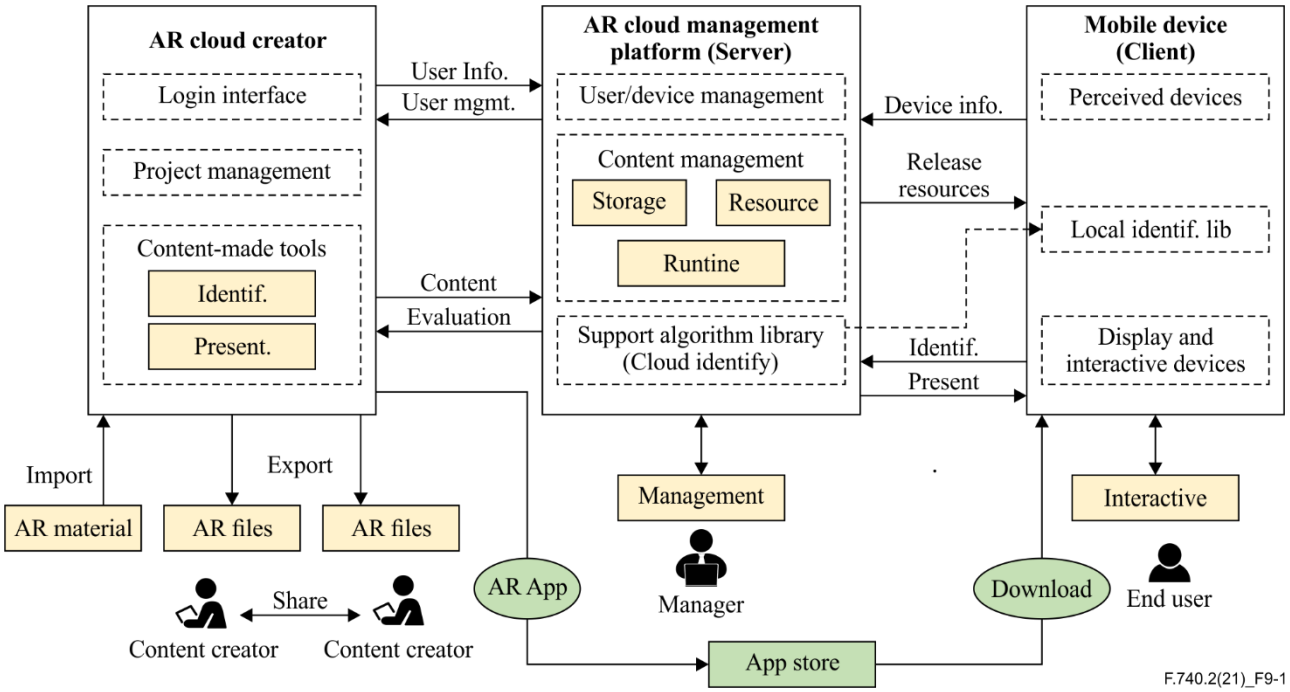

Figure 9-1 – Reference framework of ARCSS

The entire system includes the AR cloud creation platform (creator), the AR cloud management platform and a mobile device. These three parts cooperate with each other to complete the content creation, content release and content rendering to the final presentation in front of the audience.

9.1 AR cloud creation platform

The AR cloud creation platform provides the ARCC with content production tools, object recognition and presentation tools, AR content management tools and AR project management tools through the login interface. The ARCC can import AR material to the platform to build a material library and make an AR file with the platform tools. The AR file is a unified AR format file that supports sound, video, text, animation, 3D model and other elements in the AR App. The ARCC can share these files and improve AR application productivity. When the content creator is packaged into an app, it is distributed to the app store, and the ARCU can download the corresponding app according to their device's own operating system.

9.2 AR cloud management platform

AR cloud management platform is the core of an ARCSS, which is operated and managed by the platform manager. It provides content management, resource management and runtime management

services for ARCCs, user management and device management services for mobile devices, and cloud services for AR object recognition, and tracking and rendering for AR applications by building a supporting algorithm library.

9.3 Mobile devices

Mobile devices can be either a special perceived device, such as a tour guide in a cultural venue or a business display device, or a general mobile terminal for users. The ARCU scans the target object through an AR application and combines the services provided by the local recognition library and the AR cloud management platform to obtain the experience of combining the virtual with reality based on AR.

10 Procedures of augmented reality cultural service

Based on the reference framework of the ARCSS, the typical procedures of an AR cultural service are specified for the AR cloud creation platform, the AR cloud management platform and mobile device.

10.1 AR content creation procedure

AR content creation is the main function of the ARCC platform. Figure 10-1 describes the AR content creation procedure.

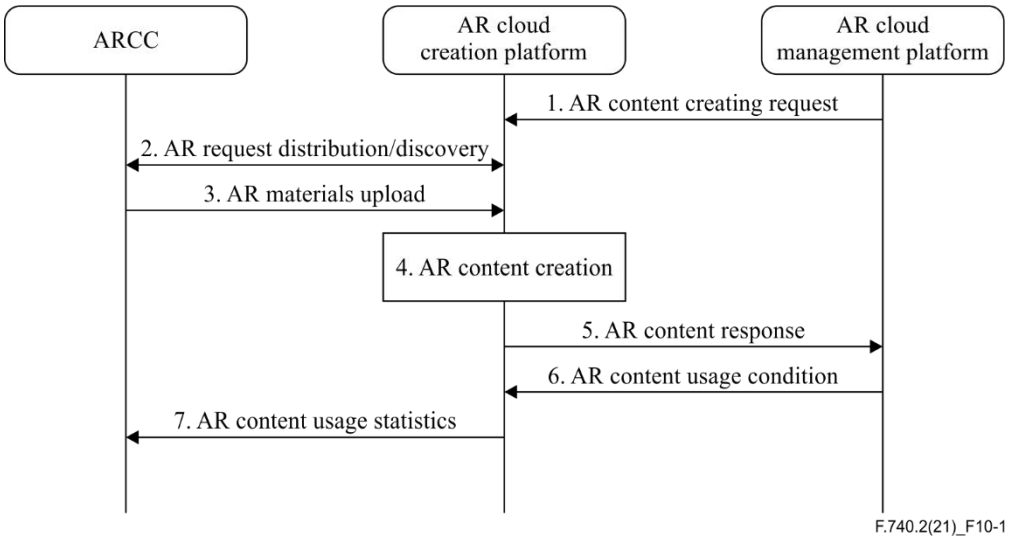

Figure 10-1 – AR content creation procedure

In this procedure:

1) The AR cloud creation platform receives a request for creating specified AR content. It is noted that the request should contain sufficient target identification diagrams and necessary AR content creation requirements.
2) The AR cloud creation platform publishes AR content production requirements, completes the docking with the ARCC, and realizes the discovery and distribution of AR content creation requirements.
3) The ARCC makes and uploads the basic materials of AR content to the AR cloud creation platform according to the requirements and completes the preparation work for AR content creation.
4) The ARCC makes use of AR content production tools and basic materials provided by the AR cloud creation platform to complete AR content creation.

5) The AR cloud creation platform will feed back the AR content produced to the AR cloud management platform in the form of cloud service.

6) The AR cloud management platform feeds back the usage of AR content to the platform, including the number of times AR content is used, the number of users, frequency and other data.

7) The AR cloud creation platform collects statistics on the use of AR content and feeds the results back to the ARCC corresponding to the AR content.

10.2 AR service management procedure

AR service management is the main function of the AR cloud management platform. Figure 10-2 describes the AR service management procedure:

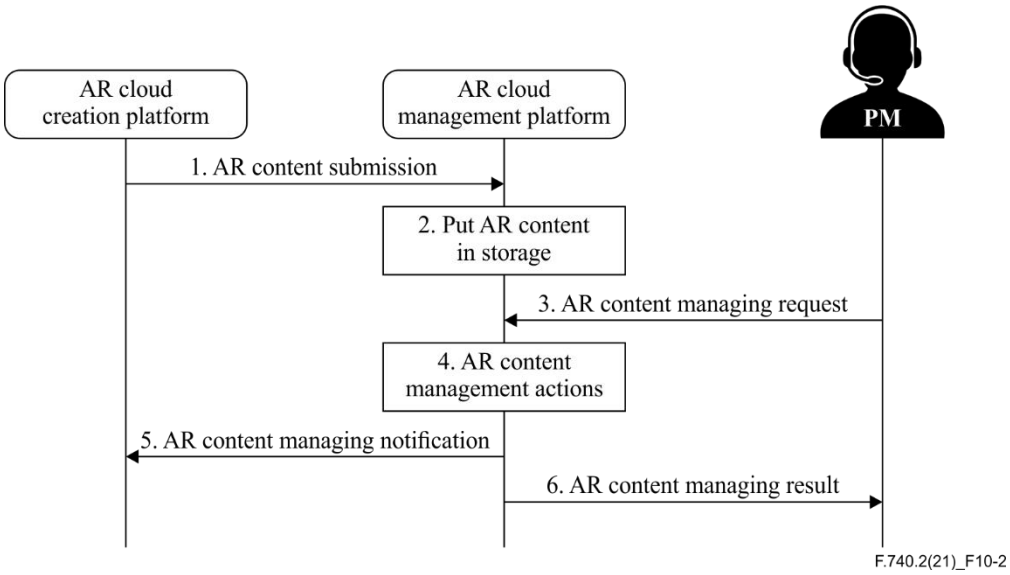

Figure 10-2 – AR service management procedure

In this procedure:

1) The AR cloud management platform receives the AR content submission from the AR cloud creation platform. It is noted that the submission should contain necessary resources such as target identification diagrams.

2) The AR cloud management platform puts the submitted AR content in storage, including AR overlay content storage, AR target identification diagram storage and AR creator information storage, etc.

3) The platform manager sends AR content management requests to the AR cloud management platform, including the request for basic management of AR content information, such as editing, query and deletion, and the request for AR content state management and AR content resource management.

4) The AR cloud management platform will take actions according to the management request sent from the platform manager.

5) The AR cloud management platform will issue management action notification to the AR cloud creation platform if necessary.

The AR cloud management platform will send the AR content managing result to the platform manager as the response to management actions.

10.3 AR content display procedure

AR content display is the main function of the AR mobile device. Figure 10-3 describes the AR content display procedure:

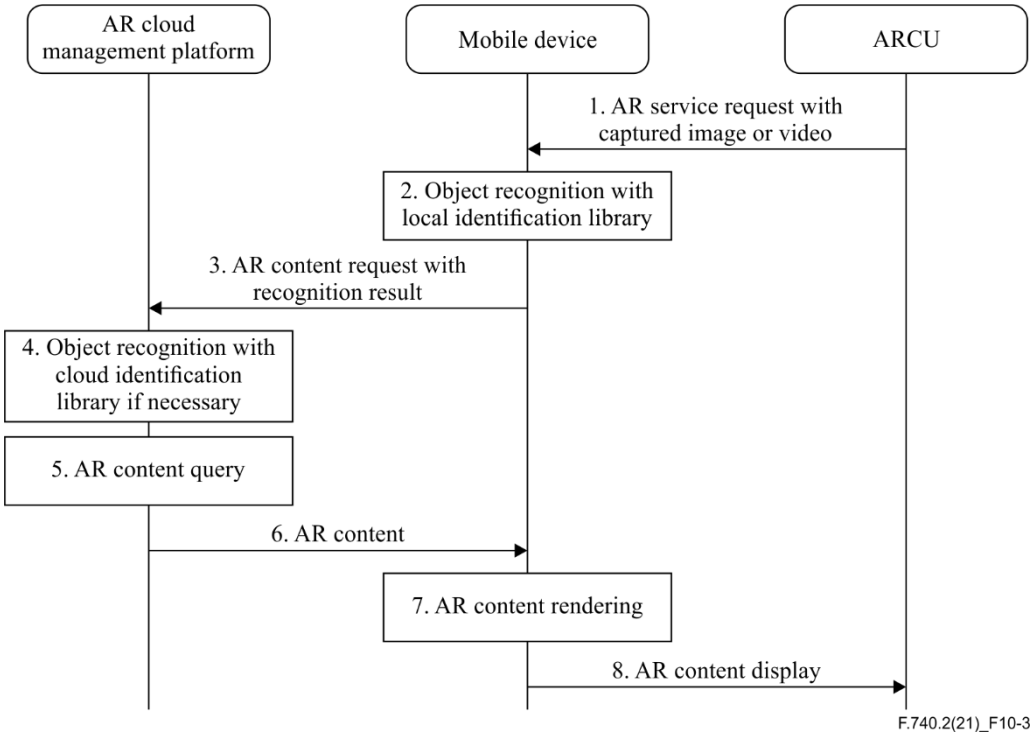

Figure 10-3 – AR content display procedure

In this procedure:

1) A mobile device receives an AR service request with camera captured images or video stream of cultural relics and artworks from the ARCU.
2) The mobile device performs the calculation and comparison with the local identification library and the AR object recognition result is obtained.
3) An AR content request with object recognition result is transmitted to the AR cloud management platform.
4) The AR cloud management platform will perform the object recognition with the cloud identification library if the mobile device cannot identify the target.
5) The AR cloud management platform will query the AR content database with identification information.
6) The corresponding AR content will be transmitted to the mobile device.
7) The mobile device will render the AR content for target cultural relics and artworks.
8) The ARCU sees virtual content superimposed on real objects on the screen.

Bibliography

[b-ITU-T J.301] Recommendation ITU-T J.301 (2014), *Requirements for augmented reality smart television systems*.

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