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International Telecommunication Union
Standardization Sector

Recommendation

ITU-T Y.2249 (09/2023)

SERIES Y: Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities

Next Generation Networks – Service aspects: Service capabilities and service architecture

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Service model for human-centric touring guide with augmented reality

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Recommendation ITU-T Y.2249

Service model for human-centric touring guide with augmented reality

Summary

Recommendation ITU-T Y.2249 specifies a service model for a human-centric touring guide with augmented reality (AR), including the concept, reference architecture, service requirements, and specific application scenarios of the service model. This Recommendation can be used to guide AR-based cultural tourism service providers to develop a service model for a human-centric touring guide with AR.

History [*]

Edition	Recommendation	Approval	Study Group	Unique ID
1.0	ITU-T Y.2249	2023-09-29	13	11.1002/1000/15636

Keywords

Augmented reality, service model.

[*] To access the Recommendation, type the URL https://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents/software copyrights, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the appropriate ITU-T databases available via the ITU-T website at http://www.itu.int/ITU-T/ipr/.

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Service model for human-centric touring guide with augmented reality

1 Scope

This Recommendation specifies a service model for a human-centric touring guide with augmented reality (AR), the scope includes the following aspects:

– Concept
– Reference architecture
– Service requirements
– Service scenarios
– Security considerations

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.

[ITU-T Y.3101] Recommendation ITU-T Y.3101 (2018), *Requirements of the IMT-2020 network.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 augmented reality (AR) [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.

3.1.2 service [b-ITU-T Y.2091]: A set of functions and facilities offered to a user by a provider.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 augmented reality visualization: Mechanism through which non-visual abstract data is processed into digital cognitive information that can be understood in a visual manner, and is presented to the user superimposed onto a physical scenario.

3.2.2 environmental perception: Identification and understanding of the available features in the environment with the objective of using it in software or hardware applications.

3.2.3 virtual-reality integration: Real-time combination of real scenes with virtual scenes generated by a mobile terminal or computer through digital technology so as to make the virtual and real objects appear in the same scene.

3.2.4 physics engine: A simulator used to create a virtual environment that incorporates laws from the physical world.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

3D	Three Dimensions
AAC	Advanced Audio Coding
AI	Artificial Intelligence
API	Application Programming Interface
AR	Augmented Reality
ARSM	Augmented Reality human-centric touring guide Service Model
DCC	Digital Content Creation
FXAA	Fast Approximate Anti-Aliasing
HDR	High-Dynamic Range
KTX	Khronos Texture
LAN	Local Area Network
MP3	Moving Picture Experts Group Audio Layer III
MP4	MPEG-4 Part 14
MSAA	Multi-Sampling Anti-Aliasing
PII	Personally Identifiable Information
PNG	Portable Network Graphics
QR	Quick Response
WAN	Wide Area Network

5 Conventions

The keywords "**is required to**" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

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.

The keywords "**can optionally**" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

In the body of this document and its annexes, the words shall, shall not, should, and may sometimes appear, in which case they are to be interpreted, respectively, as is required to, is prohibited from, is recommended, and can optionally. The appearance of such phrases or keywords in an appendix or in material explicitly marked as informative are to be interpreted as having no normative intent.

6 Concept of human-centric touring guide with AR

The rapid development of artificial intelligence (AI), networks and other related technologies has stimulated improvement in related industry chains. Augmented reality (AR) technology, which was previously confined only to special effects in films and television, is rapidly entering people's work and lives, and is also being applied in the tourism industry.

Based on AR and network technology, this tourism industry service realizes the visualization of all digital information in the human tourism service and registers it in a real-world space, providing tourists and related enterprises with AR content or applications for an AR touring guide. These aspects of an AR service for the tourism industry are shown in Figure 1.

The AR service is the basis for connecting the physical space and the digital world through networks. The AR service breaks through the original bottleneck of AR technology and can be widely used in the human tourism industry.

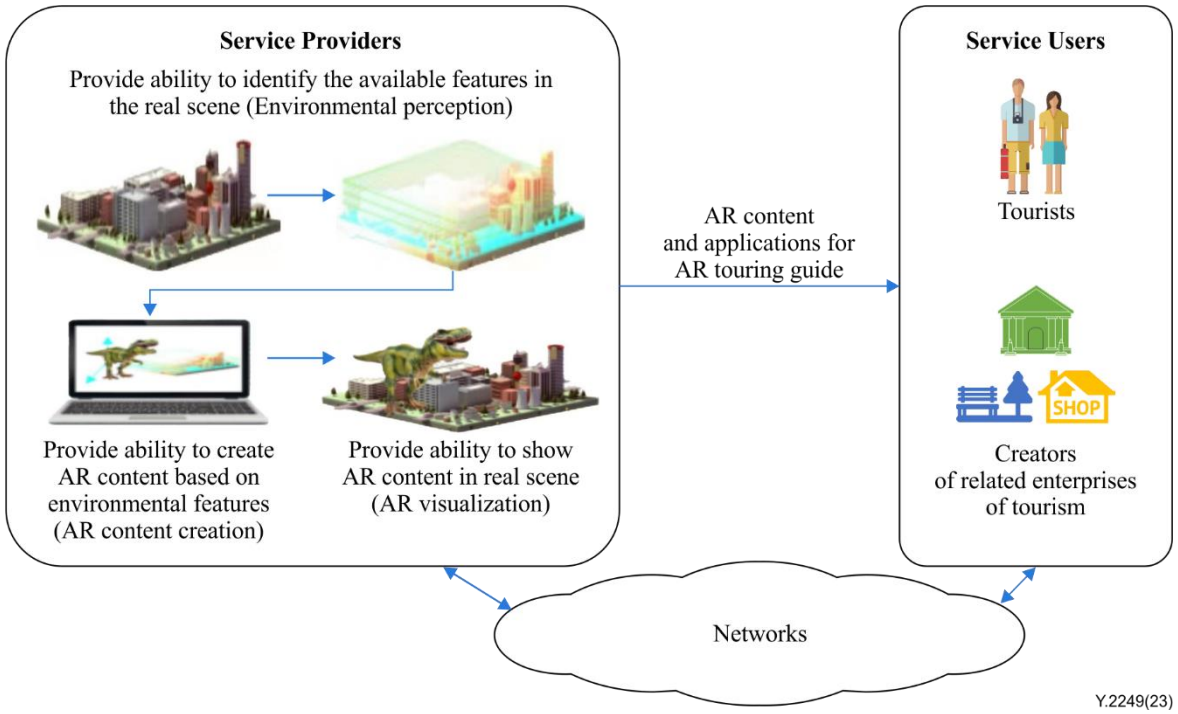

Figure 1 – Conceptual diagram of a service model for a human-centric touring guide with AR

7 Reference architecture

AR is a technology that applies virtual information to real scenes and provides an extraordinary information interaction experience. Service providers of an AR-based cultural tourism service model should have the ability to support the entire process of AR applications, including environmental perception, AR visualization, AR content creation and AR content caching services.

Among said AR applications, environmental perception refers to the ability to perceive the spatial environment and dynamic targets in a real scene through hardware devices such as cameras and sensors. Through environmental perception, smart terminals such as mobile phones or AR glasses can understand the real world visually like people.

AR content creation modules support scene editing, behavioural editing, content production and other functions. Users can use these modules to create AR content to meet the needs of various scenarios.

AR visualization modules are components for presentation and interaction with AR content, and are used to realize the visualization of AR content.

In addition, in order to cope with the actual needs of large-scale applications, providers need to provide AR content caching services. The service providers provide the basic modules and service capabilities required for human-centric touring guide service model application development. The structure includes basic capabilities, functional modules and content caching. Figure 2 illustrates the

reference architecture of the service model for a human-centric touring guide with AR, which is primarily composed of three layers.

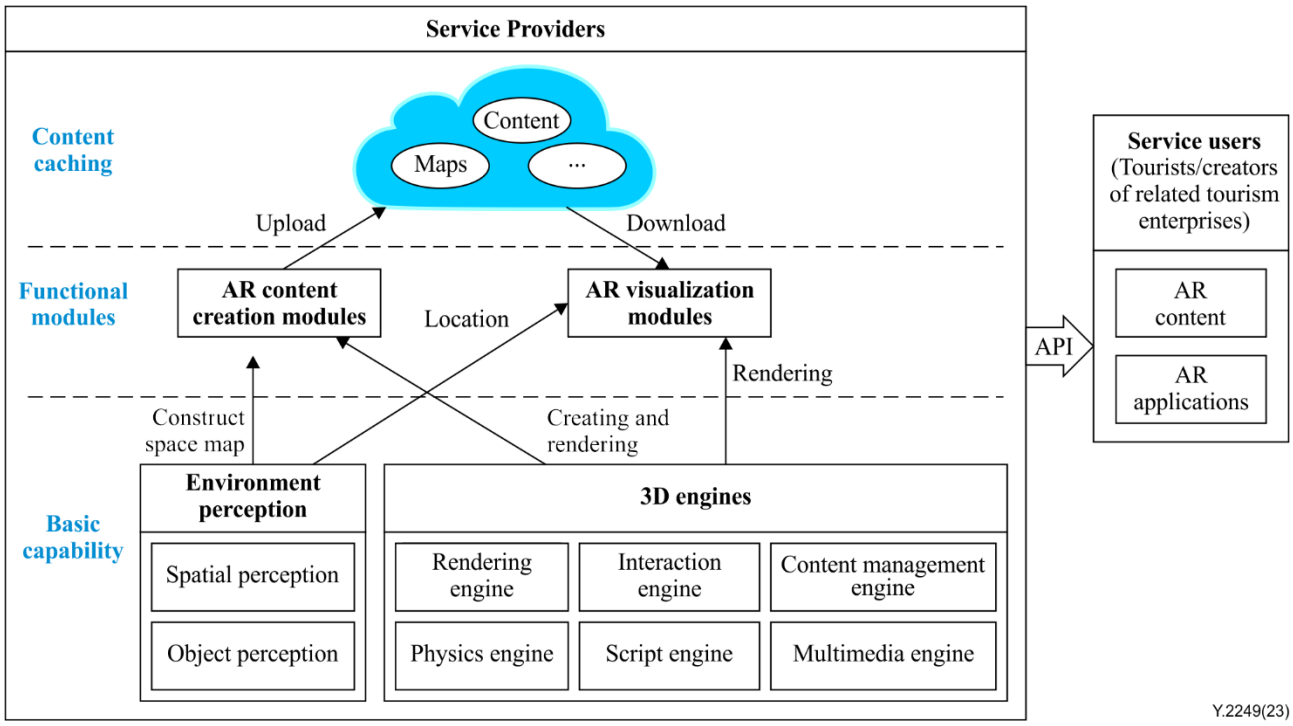

Figure 2 – Reference architecture of service model for human-centric touring guide with AR

The functions of each layer are as follows:

– **Basic capabilities layer**: Provides environmental perception and 3D engine capacity for functional modules. Environmental perception includes spatial perception ability and object perception ability. 3D engines include a rendering engine, interaction engine, content management engine, physics engine, script engine and multimedia engines.

– **Functional modules layer**: Includes AR content creation modules and AR visualization modules:

  • AR content creation modules: For the material exported by the digital content creation (DCC) tool, users create AR scenes with the AR content creation tool and publish the digital content to the caching.

  • AR visualization modules: Based on environmental perception, virtual content is created as real objects by rendering and multimedia, and can interact with real-world objects, and achieve virtual-reality integration.

– **AR content caching service layer**: Effectively organizes and stores perceived contents and AR contents, which provide support for the release of AR content, the perception and identification of the terminal and content applications:

  • The content caching has functions for storage and delivery of AR content.

  • The perception caching provides image retrieval, posture identification and other perception skills based on image recognition, artificial intelligence and other technologies.

8 Service requirements

This clause provides the service requirements for the augmented reality human-centric touring guide service model, including the requirements for environmental perception, requirements for AR

content creation modules, requirements for AR visualization modules, requirements for AR content caching service, and compatibility requirements.

8.1 Requirements for environmental perception

The augmented reality human-centric touring guide service model (ARSM) can identify and understand available features in the environment through environmental perception, which includes spatial perception and object perception. Clauses 8.1.1 and 8.1.2 introduce the requirements of environmental perception from two aspects: requirements for spatial perception and requirements for object perception.

8.1.1 Requirements for spatial perception

Spatial perception is one of the basic capabilities of environmental perception. It is the ability to sense the size, shape, and orientation of the space. It includes the following AR technical aspects: non-marking tracking, visual odometry, visual map construction, map-based motion tracking, dense reconstruction, real-time dense rebuilding, multi-device information synchronization, simple light recovery, environmental light recovery, multi-plane detection, and semantic information identification. The requirements and recommendations for spatial perception are as follows:

– It is recommended for an ARSM to support unmarked tracking and allow recognition and tracking in the physical environment without the need for predefined markers or reference points.

– It is recommended for an ARSM to support real-time tracking of the six-degrees-of-freedom position and altitude of the device in an unknown environment.

– It is recommended for an ARSM to support the reconstruction of the environment to obtain a map that can be used for positioning.

– It is recommended for an ARSM to support real-time tracking of the position and orientation of devices in known environments.

– It is recommended for an ARSM to support the construction of a dense 3D map of the space.

– An ARSM can optionally support real-time construction of dense 3D maps of space.

– It is recommended for an ARSM to support the synchronization of the spatial positioning information of multiple devices based on the constructed map.

– It is recommended for an ARSM to support real-time recovery of light intensity and colour temperature information in the scene.

– An ARSM can optionally support real-time recovery of environment mapping and spherical harmonic lighting in the scene.

– An ARSM can optionally support real-time construction of multiple planes in the scene.

– An ARSM can optionally support the construction of spatial intensive semantic mapping.

8.1.2 Requirements for object perception

Object perception is one of the basic capabilities of environmental understanding. It is an ability to recognize the dynamic target in in the environment. It includes the following AR technical aspects: planar image target identification and tracking, multi-plane image target simultaneous identification and tracking, 3D rich texture rigid targets identification and tracking, multi-objective identification and tracking of 3D rich texture rigid targets, identification and tracking of 3D weak texture rigid targets, local generation of data sets of plane image identification and tracking targets, local generation of data sets of 3D rich texture rigid body recognition and tracking targets, local generation of data sets of 3D weak texture rigid body recognition and tracking targets, hybrid recognition and tracking of plane image and 3D rich texture rigid body, quick response (QR) code recognition, hybrid recognition of QR code, plane image targets, and 3D rich texture rigid targets,

and detection and recognition of gesture, posture and face. The requirements and recommendations for object perception are as follows:

– It is required for an ARSM to support target recognition and tracking of moving plane images.

– It is recommended for an ARSM to support simultaneous recognition and tracking of multi plane image targets at the mobile terminal.

– An ARSM can optionally support the recognition and tracking of 3D rich texture rigid targets.

– An ARSM can optionally support multi-target recognition and tracking of 3D rich texture rigid targets.

– An ARSM can optionally support the recognition and tracking of 3D weak texture rigid targets.

– It is required for an ARSM to support local generation of data sets of plane image recognition and tracking targets.

– An ARSM can optionally support local generation of data sets of 3D rich texture rigid body recognition and tracking targets.

– An ARSM can optionally support local generation of data sets of 3D weak texture rigid body recognition and tracking targets.

– An ARSM can optionally support hybrid recognition and tracking of plane image and 3D rich texture rigid body.

– An ARSM can optionally support QR code recognition.

– An ARSM can optionally support hybrid recognition of QR code, plane image targets, and 3D rich texture rigid targets.

– An ARSM can optionally support gesture detection and recognition, which includes the estimation of the bounding box of hand detection and real-time tracking and recognition of the hand area.

– An ARSM can optionally support human posture detection and recognition.

– An ARSM can optionally support face detection and recognition.

8.2 Requirements for AR content creation modules

AR content creation modules are used to create AR content. They can provide scene editing, behaviour editing, content production and other functions. Users can create AR content through this module and meet the needs of various tourism scenarios. The requirements and recommendations for AR content creation modules are as follows:

– It is required for an ARSM to provide capabilities of visual editing tools, which support visualization of effect preview, object editing, scene editing, and undo and redo operations.

– It is recommended for an ARSM to support importing scripts in editing tools and to support convenient script editor schemes.

– It is recommended for an ARSM to support content data exchange and importing of standard model formats.

– It is recommended for an ARSM to provide capabilities of content creation and editing:

  • It is recommended for an ARSM to support the creation and editing of a visual scene system.

  • It is recommended for an ARSM to support animation effect editing.

  • It is recommended for an ARSM to support the generation of an atlas.

- It is recommended for an ARSM to support the creation and editing of graphical interfaces.
- It is recommended for an ARSM to support the creation and editing of lights.
- It is recommended for an ARSM to support the editing of physical systems.
- It is recommended for an ARSM to support texture related capabilities, including visual editing of material effects, modifying the shading, maps and parameters of texture.

– It is recommended for an ARSM to provide capabilities of a construction of reality perception system:
  - It is recommended for an ARSM to support the editing function of reality perception workflow.
  - It is recommended for an ARSM to support the editing of the parameters of object perception targets.

– It is recommended for an ARSM to provide capabilities of content diagnosis and debugging:
  - It is recommended for an ARSM to support preview of real-time effects.
  - It is recommended for an ARSM to support the display of current resources usage.

– It is recommended for an ARSM to provide capabilities of content optimization tools:
  - It is recommended for an ARSM to support grid data compression.
  - It is recommended for an ARSM to support map compression.

– It is recommended for an ARSM to provide capabilities of content publishing tools:
  - It is recommended for an ARSM to support data encryption.
  - It is recommended for an ARSM to support the packaging of editing resources into running data packages.

– It is recommended for an ARSM to provide capabilities of an interface system for content creation and editing:
  - It is recommended for an ARSM to support the creation of common controls such as sprite, text, button and raw-image.
  - It is recommended for an ARSM to support an anchor point system and user-defined anchor point.
  - It is recommended for an ARSM to support users to customize the canvas system and create multiple canvases.
  - It is recommended for an ARSM to support the parent-child structure of controls.
  - An ARSM can optionally support a screen adaptation mode of a user-defined interface system.

8.3 Requirements for AR visualization modules

An AR visualization tool uses rendering engines and multimedia technology to produce virtual content that resembles real objects, and interacts with real-world objects through perception to achieve virtual-reality integration. AR visualization modules mainly include rendering engines, interaction engines, content management engines, physical engines, and multimedia engines.

8.3.1 Requirements for a rendering engine

The requirements and recommendations for a rendering engine are as follows:

– It is recommended for an ARSM to provide a rendering engine with programmable material, such as customization of surface models and lighting models, and customization of *Vertex Shader* and *Fragment Shader*.

– It is recommended for an ARSM to support material parameter binding for the rendering engine, such as camera parameters (position, orientation), global parameters (time) and serialized custom parameters.
– It is recommended for an ARSM to provide a rendering engine with a lighting system, such as basic light sources (ambient, point, spot, directional), and modification of the colour and intensity of the light source, combination of various lighting and material surfaces and simultaneous rendering of multiple light sources.
– It is recommended for an ARSM to provide a rendering engine with post-processing visual effects, such as floodlights and blur, and to support post-processing visual effect customization.
– It is recommended for an ARSM to provide a rendering engine with anti-aliasing effects, such as multi-sampling anti-aliasing (MSAA) and fast approximate anti-aliasing (FXAA).
– It is recommended for an ARSM to provide a rendering engine with visual particle effects, such as multiple particle shapes (box, sphere, cylinder, cone) and control and rendering methods for multiple particles.
– It is recommended for an ARSM to provide flare visual effects for a rendering engine.
– It is recommended for an ARSM to provide an interface system for a rendering engine, support common controls (label, sprite, button, raw-image), the material of custom interface controls, and an anchor point system and canvas system.
– It is recommended for an ARSM to provide an animation system for a rendering engine, to support skeletal animation, rigid body animation, animation layering and mixing and an animation state machine.
– It is recommended for an ARSM to provide transparent view for a rendering engine, to support transparent background mode and cascading of the transparent views to other views.
– It is recommended for an ARSM to support the model as a triangular mesh, and the vertex of the mesh can contain attributes such as vertices, plane, normals, tangents, vertex colours.
– It is recommended for an ARSM to support reading of common texture formats such as portable network graphics (PNG), texture filtering modes (bilinear and trilinear), texture wrap modes (repeat and clamp), Mipmap and Cubemap, and to optionally support high-dynamic range (HDR) and EXR format texture reading.
– An ARSM can optionally support reading of compressed texture formats such as Khronos texture (KTX).
– It is recommended for an ARSM to provide a rendering engine with virtual camera, which supports orthographic projection and perspective projection modes, camera culling settings, parameter settings of the near and far clipping plane, simultaneous operation of multiple virtual cameras, and to optionally support HDR camera.
– It is recommended for an ARSM to support automatic rendering sorting and user-defined rendering order.
– It is recommended for an ARSM to support forward rendering.
– It is recommended for an ARSM to provide real-time shadow for a rendering engine, which supports soft shadows, double-sided shadow effects and modification of the shadow resolution.
– It is recommended for an ARSM to support entities with collider information, box collider and sphere collider, and provide object selection and detailed information about collision detection.
– An ARSM can optionally support multithreading and multithreaded rendering optimization.

– An ARSM can optionally support spherical harmonic lighting.
– An ARSM can optionally support switching between high, medium and low display levels, allowing automatic switching of display levels according to different hardware performances or mobile operating system versions.

8.3.2 Requirements for interaction engine

The requirements and recommendations for an interaction engine are as follows:

– It is required for an ARSM to support single touch gestures, multi-touch gestures, and that it can optionally support key input.
– It is recommended for an ARSM to support camera equipment control and camera parameters setting.
– It is recommended for an ARSM to support user control of camera and support the user to input the data stream as real image information, which will affect the real environment display and perception.
– It is recommended for an ARSM to support the display of real environment information on non-transparent devices.
– It is recommended for an ARSM to support real-time updating of spatial transformation information of real equipment and recognition targets, which needs to reflect the real spatial relationship in reality.

8.3.3 Requirements for content management engine

The requirements and recommendations for the content management engine are as follows:

– It is required for an ARSM to provide a content management engine that supports hot updating of resources, loading resources from the network and playing content generated by the editor correctly.
– It is recommended for an ARSM to support classification of entities,
– It is recommended for an ARSM to support dynamic addition and deletion of entities through scripts.
– It is recommended for an ARSM to support modification of the entities' parent-child structure and properties such as translation, zoom, rotation.

8.3.4 Requirements for physics engine

The requirements and recommendations for the physics engine are as follows:

– It is required for an ARSM to provide a physics engine.

8.3.5 Requirements for script engine

The requirements and recommendations for the script engine are as follows:

– It is recommended for an ARSM to provide a script engine to support the dynamic control of lighting, cameras, models, model animation, model materials, model texture, environment texture, animation state machine, particle system, operation gesture, physical engine, and interface system, without updating the application program.
– It is recommended for an ARSM to support automatic management of script life cycle and provide a clear and complete life cycle.

8.3.6 Requirements for multimedia engine

The requirements and recommendations for the multimedia engine are as follows:

– It is recommended for an ARSM to support the playback of commonly used MP4 video files, control of the start, pause, stop of video, and support the playback of transparent video.
– It is recommended for an ARSM to support the playback of commonly used MP3/AAC audio files, control of the start, pause, stop of audio, and support of 3D sound effects.
– It is recommended for an ARSM to support video recording, control the start and stop of video recording, and support adjustable video recording resolution.
– It is required for an ARSM to support 2D text display and common rich text expressions.

8.4 Requirements for AR content caching service

The AR content caching service is responsible for organizing and storing perception content and AR content, providing support for the release of AR content, perception and identification and content applications on a terminal. AR content caching service mainly includes the management of large-scale identification, identification library management, identification map management, resource management and storage. The requirements and recommendations for AR content caching service are as follows:

– It is recommended for an ARSM to support large-scale recognition capabilities.
– It is recommended for an ARSM to support management systems of the identification library.
– It is recommended for an ARSM to support management systems of image identification.
– It is recommended for an ARSM to support the management and storage of resources such as pictures, video, audio, model, AR application package and other resources.
– It is recommended for an ARSM to support efficiency and scalability of resources.
– It is recommended for an ARSM to support binding management of identification targets and resources.

8.5 Compatibility requirements

Compatibility of ARSM can support cross-operating systems and be compatible with common graphics library application programming interfaces (APIs). The requirements and recommendations are as follows:

– An ARSM can optionally support running on different operating systems.
– An ARSM can optionally support compatibility of the common versions of operating systems for different mobile terminals.
– The rendering engine of an ARSM can optionally support the compatibility of graphic library APIs.

9 Network capabilities

The requirements and recommendations for the network to support the service model for human-centric touring guide with AR are as follows:

– It is recommended for an ARSM to support load entities from resources at runtime, getting new resources from the network and replacing old resources through content distribution.
– An ARSM can optionally support the function of uploading through the network, and uploading data through the network interface.
– An ARSM can optionally support the function of sharing resources through the network, and can realize the sharing and synchronization of data among multiple people through the network interface.

– An ARSM can optionally support local area network (LAN) and wide area network (WAN) network modes, and connect the ports of LAN and WAN through network interfaces.
– An ARSM can optionally support the capability of transmission resuming at break-points. When the network is disconnected, the resource download process will continue after reconnecting.
– An ARSM can optionally support hot updating of resources, loading resources from the network and playing content generated by the editor correctly.

10 Service scenarios

This clause explores specific service scenarios that demonstrate the practical applications of the proposed human-centric touring guide service model using AR. These scenarios are examined from the perspective of both creators and tourists, highlighting their different roles and interactions within the system. Creators, who have full access to all system functionalities, use the modules to create and publish AR content. Tourists, on the other hand, can download, view, and edit this content, personalizing their touring experience based on their individual interests and needs. The detailed workflows and information flows for creators and tourists are described in clauses 10.1 and 10.2.

10.1 Service scenario for creators

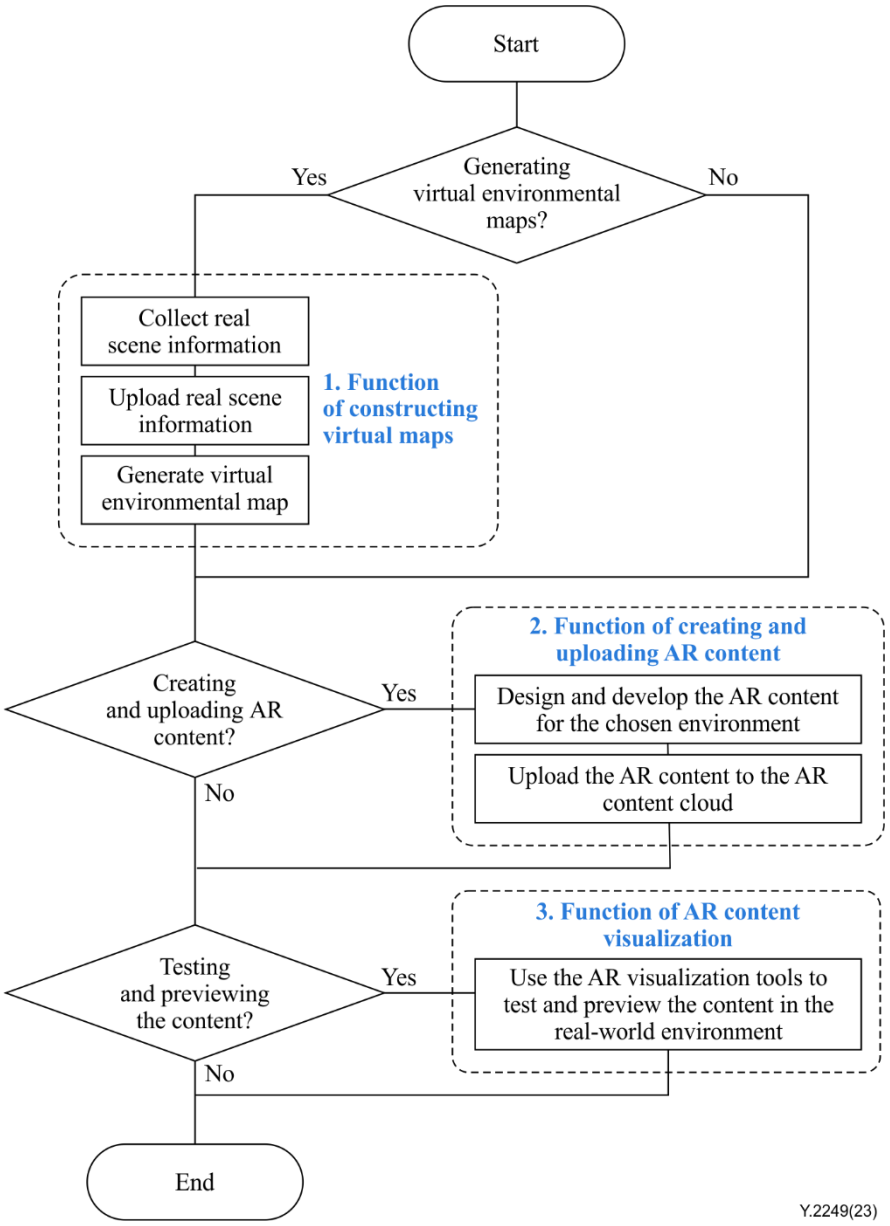

Figure 3 – Creators workflow

As shown in Figure 3, there are three main functions that the service model for human-centric touring guide with augmented reality provides to creators:

1) Function of constructing virtual maps;

2) Function of creating and uploading AR content; and

3) Function of AR content visualization.

Figure 4 shows the information flow of the entire process of creators using ARSM.

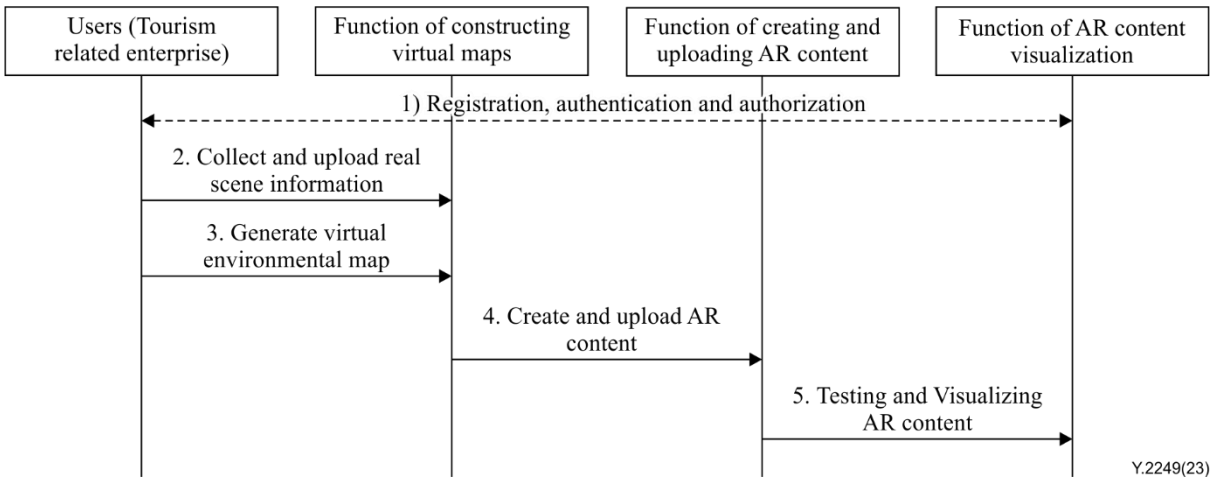

Figure 4 – Creators information flow

The detailed flow descriptions are as follows:

1) The creators have completed the registration, authentication and authorization process.

2) The creators collect real scene information using spatial information collection devices (such as mobile phones and cameras).

3) Real scene information is uploaded to construct a virtual map of the chosen environment (historical site, nature trail, city route, etc.) using the environmental perception ability, and the generated maps are uploaded to AR content caching.

4) Using the AR content creation modules, creators design and develop the AR content for the chosen environment. This may include virtual reconstructions, informational overlays, narratives, etc. Once the AR content is ready, it is uploaded to the AR content caching service for storage and later access by tourists.

5) Once the AR content is ready, creators use the AR visualization modules to test and preview the content in the real-world environment. This ensures that the AR content functions correctly and provides the intended experience.

10.2 Service scenario for tourists

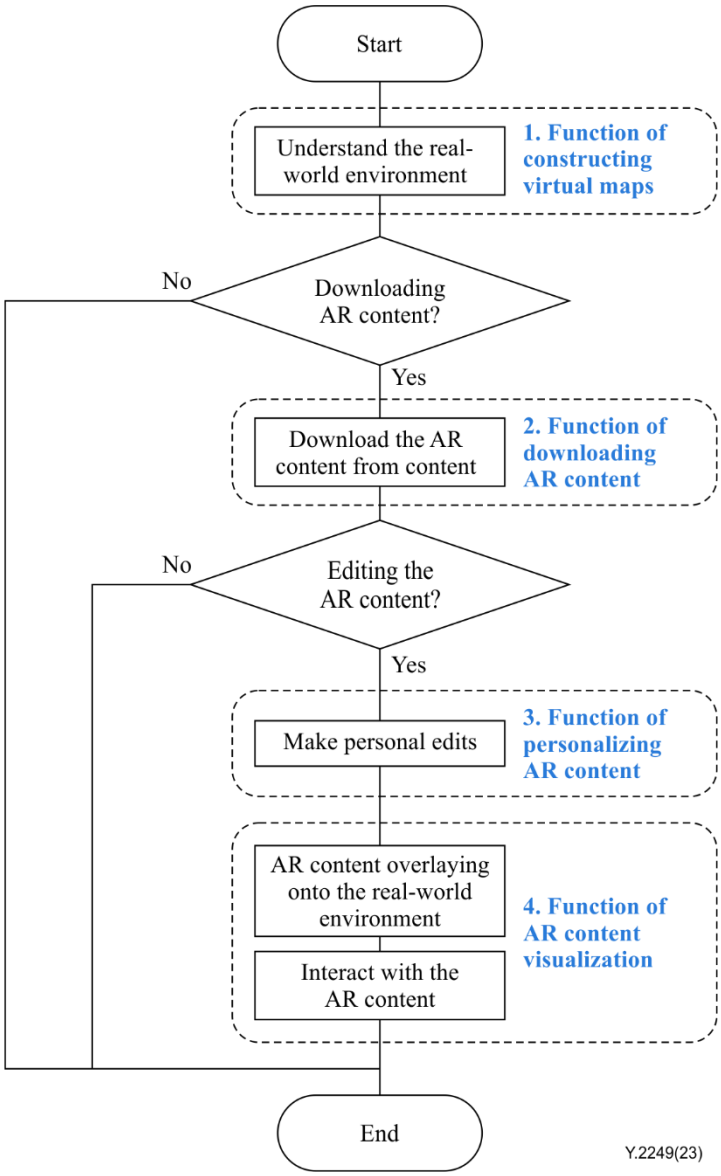

Figure 5 – Tourists workflow

As shown in Figure 5, there are four main functions that the service model for human-centric touring guide with augmented reality provides to tourists:

1) Function of constructing virtual maps;

2) Function of downloading AR content;

3) Function of personalizing AR content; and

4) Function of AR content visualization.

Figure 6 shows the information flow of the entire process of tourists using ARSM.

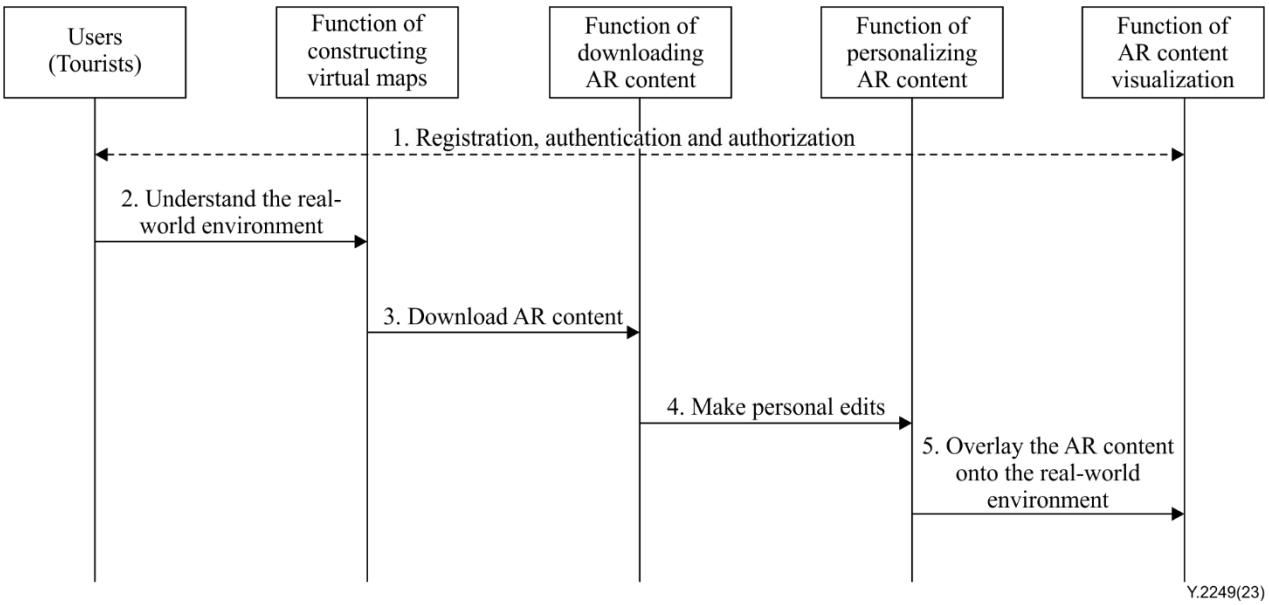

Figure 6 – Tourists Information flow

The detailed flow descriptions are as follows:

1) The tourists have completed the registration, authentication and authorization process.

2) After logging in, tourists' devices use the environmental perception ability to understand the real-world environment of the chosen tour site.

3) Tourists access the AR content caching service and download the AR content created for their chosen tour site.

4) After downloading the AR content, tourists have the option to make personal edits. These edits could include moving AR elements, adding personal annotations, or adjusting settings.

5) The AR visualization modules render the virtual content as real objects, overlaying the AR content onto the real-world environment. Tourists can interact with the AR content, enhancing their touring experience with additional information, virtual reconstructions, and more.

11 Security considerations

While implementing the requirements related to the service model of human-centric touring guide with AR, the best practices of security should be adopted, such as authentication, authorization and access control. It is required to consider the following security considerations when constructing an AR-based touring guide service model:

– Provide data and information services to authorized users;

– Provide assurance that information is not disclosed to unauthorized individuals, processes, or devices. It is required that personally identifiable information (PII) is not requested and not stored. This area also includes data protection and privacy requirements. Use anonymization or pseudonymization when needed and use the minimum set of data needed for the use case.

This Recommendation describes the service model for human-centric touring guide with AR. Thus, it is assumed that security considerations in general are based on the security of IP-based networks and general network security requirements, and mechanisms in IP-based networks should be applied [ITU-T Y.3101].

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