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Foreword

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This document was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC ##, *[name of subcommittee]*.

This second/third/… edition cancels and replaces the first/second/… edition (ISO/IEC #####:####), which has been technically revised.

The main changes compared to the previous edition are as follows:

— xxx xxxxxxx xxx xxxx

A list of all parts in the ISO ##### series can be found on the ISO website.

Introduction

The standard model (ISO/IEC 18040) for live actor and entity (LAE) representation in mixed and augmented reality (MAR) is proposed to define the properties and components which are related to LAE representation based on MAR reference model (ISO/IEC 18039). Furthermore, not only the ISO/IEC 18040 is used for standardization of defining the LAE representation in all applications, games, and systems related to a LAE in MAR, but also it is used to harmonize different kinds of a LAE application, reference model, and base components for representing and controlling a single LAE or multiple LAEs in a MAR scene. However, it is limited on how the information of its components can be stored and can be transmitted. Therefore, the information model for LAE in MAR is proposed to consider on storage and transmission for LAE information among LAE-MAR or applications.

The information model for LAE has been developed to meet the technical requirements for storing and transmitting information of LAE-MAR components. To meet these requirements, the design objectives are described as the following:

- Illustrate the storage architecture of LAE-MAR information
- Define the characteristic and model of each LAE component
- Design LAE-MAR scene graph for supporting functionalities of each component
- Define node definitions for LAE information model
- Allow the specification to be stored and transmitted at varying levels of service
- Provide alternative application programming interface (API)

Information technology — Computer graphics, image processing and environmental data representation — Information Model for Live Actor and Entity in Mixed Augmented Reality

1 Scope

This international standard can be one important item for live actor and entity in mixed and augmented reality which is covered all necessary information components and extended attributes for storing and transmitting LAE information in a LAE-MAR system or among LAE-MAR systems based on ISO/IEC 18040. Moreover, It provides the capability of controlling and managing a LAE or multiple LAEs to perform any activities in MAR scene. The information model for LAE in MAR provides the follows:

- Mix and matching for expressional richness
- Compatibility and extendibility to existing constructs for VR and other mark-up documents
- Standardization for a storage format of LAE information in a LAE-MAR system
- Standardization for streaming or transmitting LAE information among LAE-MAR systems.

2 Normative References

The following referenced documents are indispensable to the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 18038, *Information technology — Computer graphics, image processing and environmental data representation — Sensor Representation in Mixed and Augmented Reality, January, 2018*

ISO/IEC 18039, *Information technology — Computer graphics, image processing and environmental data representation — Mixed and Augmented Reality Reference Model, January, 2018*

ISO/IEC 18040, *Information technology — Computer graphics, image processing and environmental data representation — Live Actor and Entity Representation in Mixed and Augmented Reality, January, 2018*

ISO/IEC 21858, Information technology — Computer graphics, image processing and environmental data representation — Information Model for Mixed and Augmented Reality Contents, January, 2018

3 Terms, Definitions, and Abbreviated Terms

3.1 Terms and Definitions

This standard uses a basic set of terms and definitions defined in ISO/IEC 18040, *Information technology -- Computer graphics and image processing –Live actor and entity representation in Mixed augmented reality,*

and in ISO/IEC 18039, *Information technology -- Computer graphics and image processing –Mixed augmented reality Reference Model,* and, additionally, the following terms and definitions apply.

3.1.1 Augmentation

Virtual object data (computer-generated, synthetic) added onto or associated with target physical object data (live video, a physical world image) in a MAR scene. Equally applies to physical object data added onto or associated with target virtual object data.

[ISO/IEC 18039:2016, definition 3.1]

3.1.2 Augmented object

An object with augmentation.

[ISO/IEC 18040:2016, definition 3.1.2]

3.1.3 Augmented reality system

Type of mixed reality system in which virtual world data is embedded and/or registered with the representation of physical world data.

[ISO/IEC 18039:2016, definition 3.2]

3.1.4 Augmented virtuality system

Type of mixed reality system in which physical world data is embedded and/or registered with the representation of virtual world data.

[ISO/IEC 18039:2016, definition 3.3]

3.1.5 Display

Device by which rendering results are presented to a user. It can use various modalities, such as visual, auditory, haptics, olfactory, thermal, motion, etc. In addition, any actuator can be considered a display if it is controlled by a MAR system.

[ISO/IEC 18039:2016, definition 3.4]

3.1.6 Dynamic object

An object which can be translated, rotated, and scaled in a physical world or a virtual world.

[ISO/IEC 18040:2018, definition 3.1.6]

3.1.7 Feature

Primitive geometric elements (e.g., points, lines, polygons, colour, texture, shape, etc.) and/or attributes of a given (usually physical) object used in its detection, recognition, and tracking.

[ISO/IEC 18039:2016, definition 3.5]

3.1.8 Geographic coordinate system

[ISO/IEC 18040:2016, definition 3.1.8]

A coordinate system which is provided by sensor devices for defining a location of LAE.

3.1.9 Head mounted display (HMD)

[ISO/IEC 18039:2016, definition 3.5]

A device which displays stereo views of virtual reality, such as Samsung Gear VR, Oculus Rift, Google Cardboard, etc. It has two small displays with lenses and semi-transparent mirrors which can adapt to the left and right eyes.

3.1.10 Live actor and entity (LAE)

A representation of a living physical or real object, such as a human being, animal, or bird, in the MAR content or system. A live actor can be animated, moved, and interacted with virtual objects in a MAR scene by capturing gesture from a camera. Entity refers to 3D objects and entities that exist in MAR content.

[ISO/IEC 18040:2018, definition 3.1.10]

3.1.11 LAE recognizer

A MAR component that recognizes the output from a LAE capturer and a LAE sensor, then generates MAR events based on conditions indicated by the content creator.

[ISO/IEC 18040:2018, definition 3.1.11]

3.1.12 LAE capturer

A MAR component that captures a LAE in a virtual world and a physical world, which includes depth cameras, general cameras, 360^{o} cameras, etc. A LAE's information will be processed by a LAE recognizer and LAE tracker to extract background or skeleton.

[ISO/IEC 18040:2018, definition 3.1.12]

3.1.13 LAE sensor

A device that returns values related to a detected or measured condition or property related to a LAE. A LAE sensor may be an aggregate of LAE sensors.

[ISO/IEC 18040:2018, definition 3.1.13]

3.1.14 LAE tracker

A MAR component (hardware and software) that analyses signals from LAE capturers and sensors and provides some characteristics of a tracked LAE (e.g., position, orientation, amplitude, profile).

[ISO/IEC 18040:2018, definition 3.1.14]

3.1.15 MAR event

An event which is triggered by the detection of a condition relevant to MAR content and augmentation (e.g. detection of a marker).

[ISO/IEC 18039:2016, definition 3.6]

3.1.16 MAR execution engine

A collection of hardware and software elements that produce the result of combining components that represent, on the one hand, the physical world and its objects, and on the other hand, those that are virtual, synthetic, and computer generated.

[ISO/IEC 18039:2016, definition 3.7]

3.1.17 MAR experience

The human visualization of and interaction with a MAR scene.

[ISO/IEC 18039:2016, definition 3.8]

3.1.18 MAR scene

The observable spatiotemporal organization of physical and virtual objects. It is the result of a MAR scene representation being interpreted by a MAR execution engine. A MAR scene has at least one physical object and one virtual object.

[ISO/IEC 18039:2016, definition 3.9]

3.1.19 MAR scene representation

A data structure that arranges the logical and spatial representation of a graphical scene, including the physical and virtual objects that are used by the MAR execution engine to produce a MAR scene.

[ISO/IEC 18039:2016, definition 3.10]

3.1.20 Mixed and augmented reality system

Term synonymous with *mixed reality system*[1].

[ISO/IEC 18039:2016, definition 3.11]

3.1.21 Mixed reality continuum

Spectrum spanning physical and virtual realities according to a proportional composition of physical and virtual data representations (originally proposed by Milgram et al. [1]).

[ISO/IEC 18039:2016, definition 3.12]

3.1.22 Mixed reality system

[1] The word “augmented” is often used together with the word “mixed”.

A system that uses a mixture of representations of physical world data and virtual world data as its presentation medium.

[ISO/IEC 18039:2016, definition 3.13]

3.1.23 Marker

In the context of a MAR system, a marker consists of metadata embedded in a MAR background that specifies the location of a superimposed object.

[ISO/IEC 18039:2016, definition 3.27]

3.1.24 Movable volume

A volume in which a LAE is movable in a physical world or in a virtual world.

3.1.25 Natural feature

A feature that is not artificially inserted for the purpose of easy detection/recognition/tracking.

[ISO/IEC 18039:2016, definition 3.14]

3.1.26 Physical Camera coordinate system

A coordinate system which is provided by a camera for capturing LAE(s) in physical world.

3.1.27 Physical object

A physical object that is designated for augmentation with virtual data representation.

[ISO/IEC 18039:2016, definition 3.15]

3.1.28 Physical reality

Term synonymous with the physical world itself or a medium that represents the physical world (e.g., live video or a raw image of the physical world).

[ISO/IEC 18039:2016, definition 3.16]

3.1.29 Physical world

Spatial organization of multiple physical objects.

[ISO/IEC 18039:2016, definition 3.17]

3.1.30 Point of interest

A single target location or a collection of target locations. Aside from location data, a point of interest is usually associated with metadata, such as an identifier and other location specific information.

[ISO/IEC 18039:2016, definition 3.18]

3.1.31 Physical coordinate system

A coordinate system that enables locating a LAE and is controlled by a geospatial coordinate system sensing device.

3.1.32 Spatial registration

The establishment of the spatial relationship or mapping between two models, typically between a virtual object and a target physical object.

[ISO/IEC 18039:2016, definition 3.21]

3.1.33 Static object

An object which cannot be translated, rotated, or scaled in a physical world or a virtual world.

3.1.34 Target image

A target object represented by a 2D image.

[ISO/IEC 18039:2016, definition 3.22]

3.1.35 Target object

A target physical object designed or selected to allow detection, recognition, and tracking (and, finally, augmentation).

[ISO/IEC 18039:2016, definition 3.23]

3.1.36 Virtual actor and entity

A virtual reality representation of a LAE. The virtual actor and entity is obtained by a 3D capturing technique and can be reconstructed, transmitted, or compressed in the MAR scene. A virtual actor and entity can be captured in one place or transmitted to another place in real time using holography technology.

3.1.37 Virtual object

A computer-generated entity that is designated for augmentation in association with a physical object data representation. In the context of MAR, it usually has perceptual (e.g., visual, aural) characteristics and, optionally, dynamic reactive behaviour.

[ISO/IEC 18039:2016, definition 3.25]

3.1.38 Virtual world or environment

Spatial organization of multiple virtual objects, potentially including global behaviour.

[ISO/IEC 18039:2016, definition 3.26]

3.1.39 World coordinate system

A universal system in computer graphics that allows model coordinate systems to interact with each other.

3.2 Abbreviated Terms

This standard uses a basic set of abbreviated terms defined in ISO/IEC 18039, *Information technology -- Computer graphics and image processing – Mixed and Augmented Reality Reference Model,* and, additionally, the following abbreviated terms apply.

3.2.1 D-camera

Depth camera

3.2.2 EID

Event identifier

3.2.3 FOV

Field of view

3.2.4 GNSS

Global navigation satellite system

3.2.5 HMD

Head mounted display

3.2.6 LAE

Live actor and entity

3.2.7 LAE-MAR

Live actor and entity representation in mixed and augmented reality

3.2.8 MAR

Mixed and augmented reality

[ISO/IEC 18039:2016]

3.2.9 MAR-RM

Mixed and augmented reality reference model

[ISO/IEC 18039:2016]

3.2.10 RGB

Red green blue

3.2.11 S-camera

Stereo camera

3.2.12 SDK

Software development kit

3.2.13 SID

Sensor identifier

3.2.14 UI

User interface

3.2.15 UTM

Universal transverse mercator

3.2.16 VAE

Virtual actor and entity

3.2.17 VR

Virtual reality

4 Concepts

4.1 Overview

A live actor and entity (LAE) defines as a representation of a physical living actor and an object in a MAR content or system in ISO/IEC 18040. An actor is an individual who portrays a character in a performance that can be animated, moved, or interacted with virtual objects in MAR scene. Moreover, the actor is captured by a depth or general camera and can perform actions in the physical world. And, the capturing information of the live actor will be processed, tracked, and embedded into a MAR scene. A 3D object that exists in a MAR scene can be interacted by a live actor, called an entity. The LAE can be not only defined to human being, but it also can be defined as birds and animals.

A MAR scene consists of 2D and/or 3D virtual world that can be described in scene representation. The types of LAE in MAR scene are determined according to the camera types and capturing information. First, a LAE in the 2D virtual world can be embedded into a 2D image or 2D video background. Second is the representation in the 3D virtual world. This scenario can be applied in various situations, such as news studios, education services, virtual surgical operations, game and another 3D virtual scene. And, third is the representation in 360^{o} VR scene. The 360^{o} panorama can be used to construct the scene for the virtual reality visualization. Furthermore, the head mounted display (HMD) device is used to display the 360^{o} VR scene including real-time and real-like actions. The LAE also can represent as a virtual actor and entity (VAE). That is, the capturing information of LAE in the physical world is represented as a virtual avatar or the 3D model.

ISO/IEC 18040 introduces the system for implementing a MAR scene with LAEs which includes several components necessary for processing the representations and interactions of the LAEs to be integrated into a MAR scene as shown in Figure 4.1.

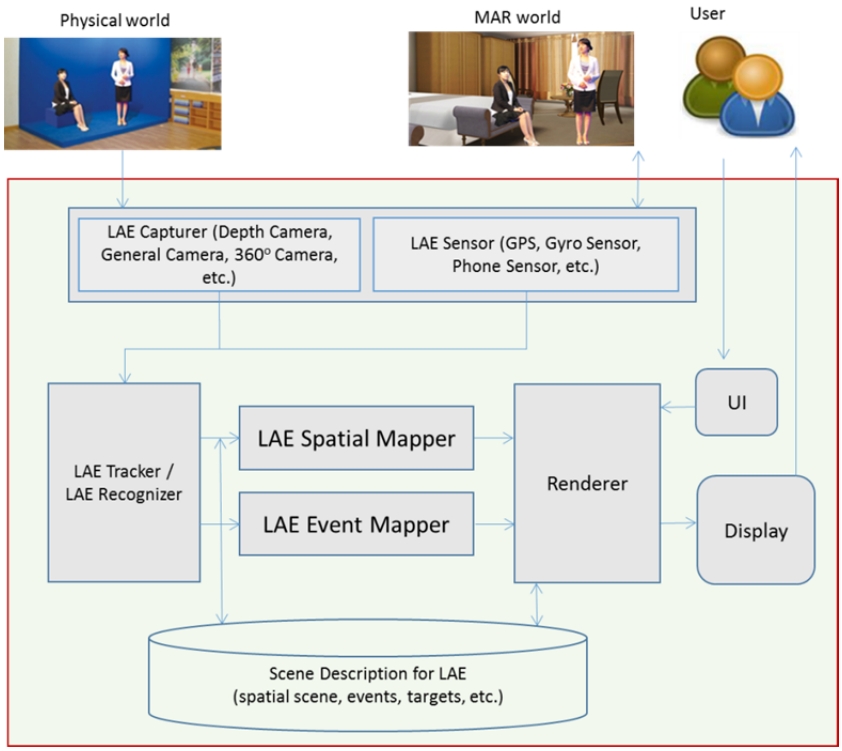

Figure 4.1 Components for constructing a LAE-MAR system

ISO/IEC 21858 focuses on information model for mixed and augmented reality contents. This draft focuses on information model for LAE components in a LAE-MAR system based on ISO/IEC 18040, what to provide about the each component, what each component can do, and the reason why each component needs this specification. When providing LAE information for each component in a LAE-MAR system, the information should be able to be represented and be processed well. Through the work, a LAE-MAR system can provide information of all components. The components are composed of LAE Capturer, LAE Sensor, LAE Tracker, LAE Recognizer, LAE Spatial Mapper, LAE Event Mapper, and Scene Representation for a LAE. A MAR scene should be able to be changed by the function of a LAE, and shall be simulated accordingly. The reason why such information is needed is to provide LAE information with capabilities that can manage and control various LAE actions, for information services or security purposes.

5 Scene Graph for Live Actor and Entity

A LAE-MAR scene that includes a LAE or LAEs is created using a scene graph which consists of MAR scene components and appearance properties. Components include objects and a LAE or LAEs in the MAR scene. All components in a LAE-MAR scene are inherited from information model defined in ISO/IEC 21858. The organization of a LAE-MAR scene is as follows:

- MAR scene: Define a MAR including MAR objects processing and visualization
- LAE models : Define the model for a LAE, which is captured from LAE capturers.
- LAE components: Define information model of components for a LAE-MAR system. They consist of a LAE Capturer, a LAE Sensor, a LAE Tracker, a LAE Recognizer, a LAE Spatial Mapper, a LAE Event Mapper, and Scene Representation for a LAE.
- MAR Display and MAR renderer : Define the data model of representing sensor devices and their functional properties in 3D worlds
- Interfaces with physical sensor devices: Define interfaces for sensor information processing using sensor stream data. In addition, define a connection to or access information for a physical sensor device.

An overall scene structure necessary for organizing a LAE-MAR scene is defined as follows:

- LAE-MAR scene
--------- MAR Scene
---------- Object
---------- Shape
---------- Material
---------- Geometry
--------- LAEModel
---------- LAE2D
----------LAE3D
---------- LAEDepth
---------- LAESkeleton
---------- LAECapturer : MARCapturer
---------- LAECamera
---------- LAEGeneralCamera
---------- LAEDepthCamera
---------- LAE360Camera
----------LAESensor: MARSensor
---------- LAEHMDSensor
---------- LAEPCHMD
---------- LAEMobileHMD
---------- LAECotrollerSensor
---------LAETracker: MARTracker
---------- LAEBodyTracker
---------- LAEFaceTracker
---------- LAEHandTracker
---------- LAEEnvironmentTracker
--------- LAERecognizer: MARRcognizer
---------- LAESpatialMapper: MARSpatialMapper
---------- LAEEventMapper: : MAREventMapper
---------- LAESceneRepresentation: MARSceneRepresentation
---------- LAESpatialMappingInform (spatial relation between LAE and MAR scene)
---------- LAEEventMappingInform (event relation between LAE and MAR scene)
--------- MAR Display

The scene graph for a LAE MAR scene is represented as follows (Figure 5.1):

Figure 5.1 A LAE-MAR scene graph

The hierarchical scene graph in Figure 5.1 represents the data structure of a LAE-MAR scene that consists of a set of MAR scene, and LAE nodes for handling all components in a LAE-MAR system. A MAR scene is composed of a 2D scene, 3D scene and 360° virtual reality scene. The components of LAE nodes are extended from standard model of LAE, but the different are about defining properties, data types, and information model of each components. For example, LAE capturer which described in standard model is referred to the capture devices to capture LAE in physical world. However, the capture devices need to be distinguished from depth and general camera. Moreover, the information model such as camera information, FOV, resolution, image quality, etc. are needed for describing the LAE representation. The characteristic of LAE models are defined according to camera type and can be described as follows:

- LAE2D is referred to a LAE who captured by general camera and/or depth camera and generate the output as 2D videos/images then map and represent into MAR world.

- LAE3D is the reconstruction of the 3D model to be represented as LAE. This kind of characteristic is required 3D capturing technology and using 3D capturing device.

- LAEDepth is the representation of LAE as depth frame to be represented in MAR scene. It provides depth information and distance of the surfaces of objects and LAE from a viewpoint.

- LAESkeleton refers to the representation as skeleton or avatar (Virtual LAE) in MAR. The capture information is used to construct and create the bone or model hierarchy to map with LAE's character in physical world.

6 System Architecture for Live Actor and Entity

When a LAE-MAR scene is generated, a LAE-MAR scene graph manager controls all necessary data for the scene. The MAR scene can be stored in a MAR document file. The file contains all data for generating and transferring a LAE-MAR scene through a network. The LAE-MAR data file specifies a LAE-MAR scene using the following components:

・LAE-MAR data file

・LAE-MAR parser

・LAE-MAR node manager

・LAE-MAR scene graph manager

・LAE-MAR scene access interface

・Event controller

・User interface

Figure 6.1 shows the overall architecture for controlling a LAE in a LAE-MAR scene. A parser reads the data from a LAE-MAR document file and interprets it as various LAE-MAR components. LAE-MAR components consist of MAR scene and LAE nodes that are controlled by a LAE-MAR node manager. Events generated by an external device program are transferred to an event controller through LAE actions. The event controller sends the events to be represented by a scene to a LAE model that is controlled by a LAE-MAR node prototype manager. A LAE-MAR scene access interface comprises event data so that LAE events obtained from the event controller can be represented in a scene. A LAE-MAR scene graph manager comprises a scene graph which is defined as geometry, properties, and events using visual objects, LAE models, and LAE embedding and events. When a change occurs in a scene from LAE actions, it is transferred to the event controller by the MAR node manager, and then to the external device program. The LAE-MAR architecture is shown in Figure 6.1.

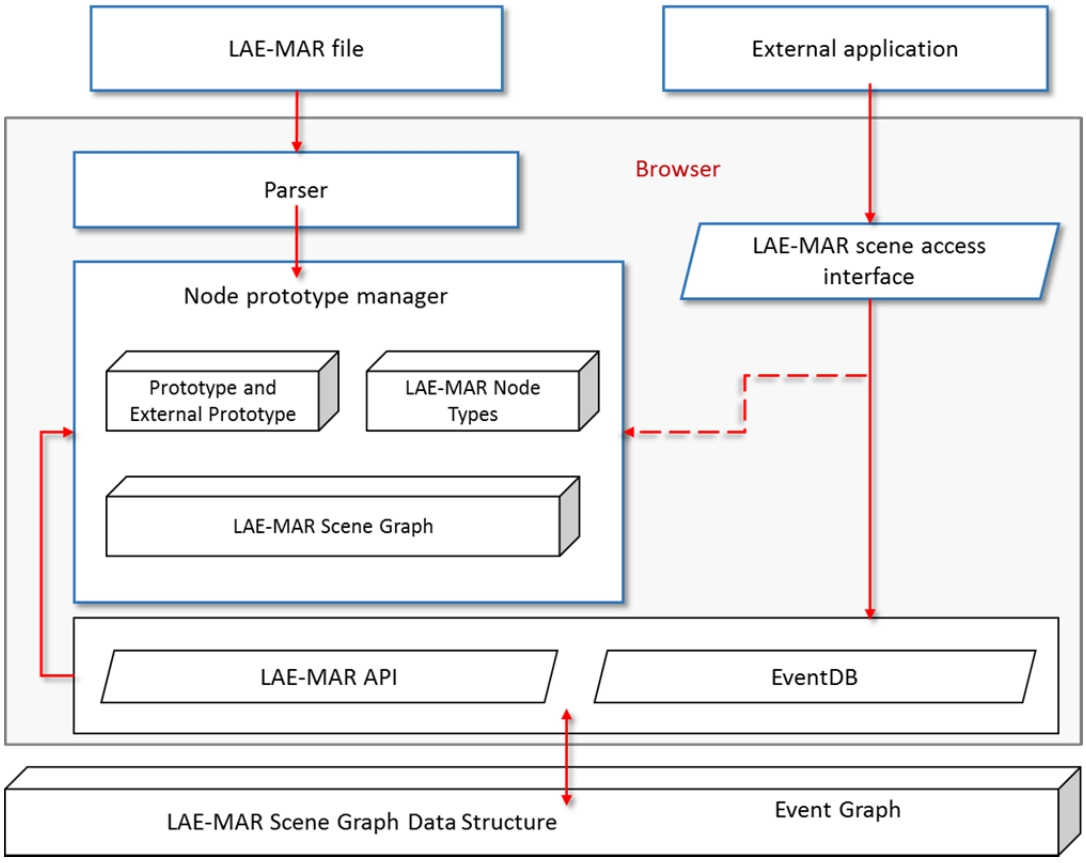

Figure 6.1 LAE-MAR architecture

7 XML Node definitions for LAE information model

7.1 Overview

A LAEMARScene is the root node and consists of a set of MAR objects, 3D objects, shapes, material, geometry, etc. including LAE-MAR nodes. This node can access and control whole MAR system which include LAE representation.

```
<LAEMARScene id= “mar1” description= “MAR for LAE representation” width= “1920” height= “1080”>
    <MARScene></MARScene>
    <LAE-MAR></LAE-MAR>
</LAEMARScene>
```

LAE-MAR consists of LAE, LAECapturer, LAESensor, LAETracker, and so on. which are the components of LAE representation system in MAR scene. This node provides the capabilities of accessing and controlling whole LAE representation system.

```
<LAE-MAR id= “lae1” description= “LAE Representation” visible= “true”>
    <LAE></LAE>
</ LAE-MAR >
```

7.2 LAE Model Node

LAEModel is an abstract node that provides all functionalities of the LAE representation. This node consists of LAE2D, LAE3D, LAEDepth, and LAESkeleton.

```
<LAEModel id="lae1" description="LAE model" type="LAE2D" visible="true" showFPS="true">

    <LAE2D id="lae2D" laeX="0" laeY="0" visible="true"></LAE2D>

</ LAEModel>
```

LAE2D is the node for LAE representation as 2D image/video frame which is captured from general camera and/or depth camera and mapped into MAR scene.

```
<LAE2D id="lae2D" description= "lae2D representation" LAE_ID= "0" laeX="0" laeY="0" laeWidth="1980" laeHeight="1080" visible="true" >

</LAE2D>
```

LAE3D is the node for representing 3D reconstruction model of LAE. This node allows to use 3D model and texturing for creating the LAE model.

```
<LAE3D id="lae3D" description="lae3D representation" LAE_ID="0" color="0.0 0.3 1.0 0.0 0.3 1.0 0.0 0.5 0.1 0.2 0.6⋯" coord= "0.0 0.1 1.0 0.0 0.1 1.0 …" texture="human.jpg" visible="true" >

</LAE3D>
```

LAEDepth refers to LAE representation as depth frame which inferred to depth image/video of live actor. Moreover, it provides depth information and distance of the surfaces of objects and LAE from a viewpoint.

```
<LAEDepth id="laeDepth" description= "laeDepth representation" LAE_ID= "0" laeX="0" laeY="0" laeWidth= "512" laeHeight= "424" visible= "true" >

</LAEDepth>
```

LAESkeleton is referred to the representing of LAE as skeleton type. This node provides skeletal information of LAE and skeleton stream.

```
<LAESkeleton id="laeSkeleton" description="laeSkeleton representation" LAE_ID="0" boneCoord="0.0 0.3 1.0 0.0 0.3 1.0 0.0 0.5 0.1 0.2 0.6⋯" skinCoord= "0.0 0.1 1.0 0.0 0.1 1.0 …" drawMode="skeleton" laeX="0" laeY="0" laeWidth="512" laeHeight="424" visible="true" >

</LAESkeleton>
```

7.3 LAECapturer Node

LAECapturer is an abstract node used for providing capturing functionalities and mechanism for capturing children nodes to capture LAE in the physical world.

```
<LAECapturer id="laeCapturer" description= "Capturer using for capture LAE">

    <LAECamera></LAECamera>

</LAECapturer>
```

Additionally, LAECamera is an abstract node for providing abstract camera functionalities for children nodes.

```
<LAECamera id="laeCamera" description= "Abstract node for camera devices" cameraType= "depth" deviceID="0" enable="true">

    <LAEDepthCamera></LAEDepthCamera>

</LAECamera>
```

LAEGeneralCamera is used for providing mechanism and functionalities of the general camera such as webcam to capture LAE2D in the physical world.

```
<LAEGeneralCamera id="laeGCamera" description= "General camera devices" fov="45.0" framerate="20" audio="false" resolution="fullHD" aspectRatio="1.5" filter="none" cameraMode="user" enable="true">

</LAEGeneralCamera>
```

LAEDepthCamera is used for depth camera functionalities in order to capture a LAE in advanced functions.

```
<LAEDepthCamera id="laeDCamera" description="Depth camera devices" cameraSDK="Kinectv2" framerate="20" latency="0" audio="false" resolution="fullHD" enable="true">

</LAEDepthCamera>
```

And, LAE360Camera node refers to a camera that used for capturing 360 degrees of images/videos.

```
<LAE360Camera id="lae360Camera" description="360 camera devices" framerate="20" latency="0" audio="false" resolution="fullHD" generatedImage="equirectangular" enable="true">

</LAE360Camera>
```

7.4 LAESensor Node

LAESensor is an abstract node for providing measure mechanism and returns values related to a detected or measured condition or property related to a LAE. Since there are many types of sensors, the sensors can generate different results depending on their properties, such as position, direction, geographic coordinate system, time, motion, etc.

```
<LAESensor id="laeSensor" description="Sensor devices" sensorType="HMDSensor" sensorID="0" isConnected="false" hasPosition="false" hasOrientation="false" enable="true">

</LAESensor>
```

LAEControllerSensor is used for connecting controller to HMD devices in order to provide additional sensing information such as remote control, joystick, and controller.

<LAEControllerSensor id="controllerSensor" description="Controller Sensor devices" sensorOutputType="ratiometic" position="0 0 0" orientation="0 0 0" twist="0 0 0" vibration="false">

</LAEControllerSensor>

7.5 LAETracker Node

LAETracker is a node used for tracking a variety of information that related to LAE such as camera information and LAEs themselves in the physical world.

<LAETracker id="laeTracker" description="using for tracking LAE properties" LAECapturer="laeCapturer" LAESensor="laeSensor" LAEModel="lae1" trackingType="body">

</ LAETracker

LAEEnvironmentTracker can be used to track the environment of physical objects around LAE which is performing in the physical world.

<LAEEnvironmentTracker id="laeEnvironment" description="using for tracking environment properties" environmentType="marker" environmentInfo="' LAEModel="lae1" LAECapturer="laeCapturer" LAESensor="laeSensor" >

7.6 LAERecognizer Node

LAERecognizer is a component node that analyzes sensing data related to the representation of an LAE in a virtual world and recognizes the events and data activated from the LAE through the comparison with LAEEventMapper.

<LAERecognizer id="laeRecognizer" description="using for recognize LAE events and properties" eventide="0" eventInputType="hand" eventType="swipe" LAECapturer="laeCapturer" LAESensor="laeSensor" enable="true">

</ LAERecognizer>

7.7 LAESpatialMapper Node

LAESpatialMapper is the node which used to provide the spatial relationship information (position, orientation, scale, and unit) between the physical world and virtual world. Moreover, it also provides the mapping mechanism for LAE to be mapped in the virtual scene.

<LAESpatialMapper id="laeSpatialMapper" description="provide spatial mapping properties and functionalities for embedding lae" position="0 1 0" direction="0 0 1" scale=" 1 1 1" laeDrawX="0" laeDrawY="0" laeDrawWidth="1920" laeDrawHeight="1080" isCollision="false" spatialInfo="" LAETracker="laeTracker" LAESceneRepresentation="laeScene">

7.8 LAEEventMapper Node

LAEEventMapper is a node which uses to create the relationship between an event recognized by LAERecognizer and the LAE's performing event in the physical world. This node provides the functionalities of the VR events creating and comparing with eventDB.

<LAEEventMapper id="laeEventMapper" description="provide event mapping machanism" eventide="0" eventDB="eventDB" eventHandling="" LAERecognizer= "laeRecognizer" LAESceneRepresentation="laeScene">

</ LAEEventMapper>

7.9 LAESceneRepresentation Node

LAESceneRepresentation is the abstract node which uses for a scene that represents a virtual reality and placeholders. Additionally, it serves as the implementation of combining the physical world objects and the virtual objects. There are three kinds of scene representation such as 2D scene, 360^{o} VR scene, and 3D scene representation.

<LAESceneRepresentation id="laeScene" description="provide scene representation" eventide="0" sceneType="360VR" enable="true">

</ LAESceneRepresentation>

8 Conformance

The conformance in this standard is focused on information model which refers to the development stage of live actor and entity representation in MAR scene. Therefore, in this conformance of information model for LAE representation is focused on defining the common usage and properties of LAE's components.

8.1 Conformance criteria

The following points should be considered.

- Information model which is described the properties and input/output information for the LAE representation's components in MAR scene:

  - LAECapturer - Capturing devices are used for capturing a LAE in the physical world. LAECapturer provides capturing mechanism to capture a LAE in a physical world. Capturing devices includes depth cameras, general cameras, 360^{o} cameras, etc. The information model for LAECapturer can be defined according to camera type.

  - LAESensor - Measure and return values related to a detected or measured condition or property related to a LAE. There are many types of sensors that can be used to control virtual objects, virtual cameras, and augmented objects by a LAE in a MAR environment. These sensors can generate different results depending on their properties, such as position, direction, geographic coordinate system, time, motion, etc.

  - LAETracker - track a variety of information that related to LAEs such as real camera information and LAEs themselves in the physical world.

- LAESpatialMapper - provide spatial relationship information (position, orientation, scale, and unit) between the physical world and the world of the MAR scene by applying the necessary transformations for the calibration of LAEs.

- LAERecognizer - analyse sensing data related to the representation of an LAE in a MAR world and produces MAR events and data activated from the LAE through comparison with a local or remote target signal.

- LAEEventMapper - creates the relationship between a MAR event of LAE that obtained from the LAE Recognizer and/or LAE Tracker.

- LAESceneRepresentation - refers to a scene that represents a virtual scene and placeholders. It serves as the implementation structure that combines the physical world scene/objects and the virtual scene/objects.

- LAERenderer - used for rendering the LAE-MAR system for each component of LAE nodes.

- The movement of LAE in the physical world for controlling the virtual camera and the LAE's gesture for controlling the objects and augmented objects in MAR scene.

- The implementation of LAE representation conforms to the concept and architectural components for LAE in ISO 18040.

Bibliography