Activities at SC 24 WG 9: An Overview

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ISO JTC 1 SC 24 WG9

Mixed and Augmented Reality (MAR)

Mixed Reality Continuum

Physical Reality

Augmented Reality
(Physical > Virtual):
"adds" computer-generated
information to the real world
(Azuma et al. 2001)

Augmented Virtuality
(Physical < Virtual):
"adds" real information to
a computer-generated
environment
(Regenbrecht et al 2004)

Virtual Reality

ISO SC 24 and MAR

- ISO-IEC JTC 1 SC 24

  - Have developed standards for computer graphics and virtual environments such as X3D

  - MAR implementation is much based on VR

  - Natural for MAR standards to grow out of that of VR

    - Formation of WG 9 in 2011 (devoted to MAR)

Current Work Items and Their Status

ISO/IEC DIS 18039 (Joint work with SC 29 WG 11 – JAhG)	MAR reference model	40.60	2018-08-22
ISO/IEC CD 18040	Live actor and entity representation in MAR	30.60	2019-01-25
ISO/IEC AWI 18038	Sensor representation in MAR	20.00	2019-01-25
ISO/IEC CD 18520	Benchmarking of vison-based geometric registration and tracking methods for MAR	30.60	2017-12-10
ISO/IEC AWI 21858	Information model for MAR contents	20.00	2018-08-08

MAR Reference Model (18039)

- Abstract framework or domain-specific ontology consisting of an interlinked set of clearly defined concepts produced by an expert or body of experts in order to encourage clear communication (Wikipedia)

  - Can represent the component parts of any consistent idea, from business functions to system components, as long as it represents a complete set

  - Defines an authoritative basis for:

    (at a proper abstraction level w.r.t. some given purpose = *standardization*)

    - Terms and their precise definitions

    - Generic system model of mixed/augmented reality system

    - Major components and their functionalities

    - Inter-component interfaces (data and control)

    - Use cases, system classes and existing solutions

    - Others …

Purpose: A Model Architecture

- Help develop/extend consistent and comprehensive MAR standards

- Help MAR system designers and information architects and service developers

- Promote fluid communication among MAR practitioners in the field

- Identify and derive strategic areas for standardization

  - MAR sensors (and mirrored world)

  - MAR real character (and augmented virtuality)

  - MAR contents information model (and application file format)

  - MAR API

  - MAR and IoT

  - …

Current Content

- Scope

- Motivation

- Terms and Definitions / Symbols

- MAR Domain and Concepts

- MAR RM Usage Example

- Reference System Architecture

  ○ Viewpoints

  ○ Enterprise

  ○ Computational

  ○ Informational

- MAR Classification Framework

- MAR System Classes

- Conformance

- Performance

- Safety

- Security

- Privacy

- Annex (Informative)

  ○ A: Patent Statements

  ○ B: Use Cases and Coverage by MAR RM

  ○ C: Existent AR Solutions (Research)

  ○ D: Existent AR Solutions (Commercial)

Future Updates?

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- DIS review comments (mostly editorial) and formatting

- Additional technical content (2nd DIS?)

  - System components

    - Multimodal synchronization (MAR Simulator)

    - Script engine (MAR Simulator)

  - External information input

    - Content (MAR Scene, G. J. Kim)

      - Display description (HMD, Mobile, …)

      - Multimodal properties

    - Target object (feature) description (e.g. Marker, Image patch)

- Coverage

  - System classes / Classification scheme / Use cases (SLAM, Spatial AR, Glasses, …)

  - New technologies – SLAM, Deep Learning

Future Updates? *

- Beefing up for details
  - System components
    - Renderer, Display, UI, Sensors (M. Lee), Real world capture
  - Others
    - Benchmarking (T. Kurata), Safety, Privacy, Human Factors, …

- Model refinements
  - Augmented virtuality / Real (video) characters (K. Yoo)
  - Location based AR
  - Optical see through AR
  - Tele-presence collaborative AR

Live actor and entity representation for MAR (18040)

- Standard constructs for representing captured/reconstructed live beings (human, animal, etc.) and importing them seamlessly into the MAR world
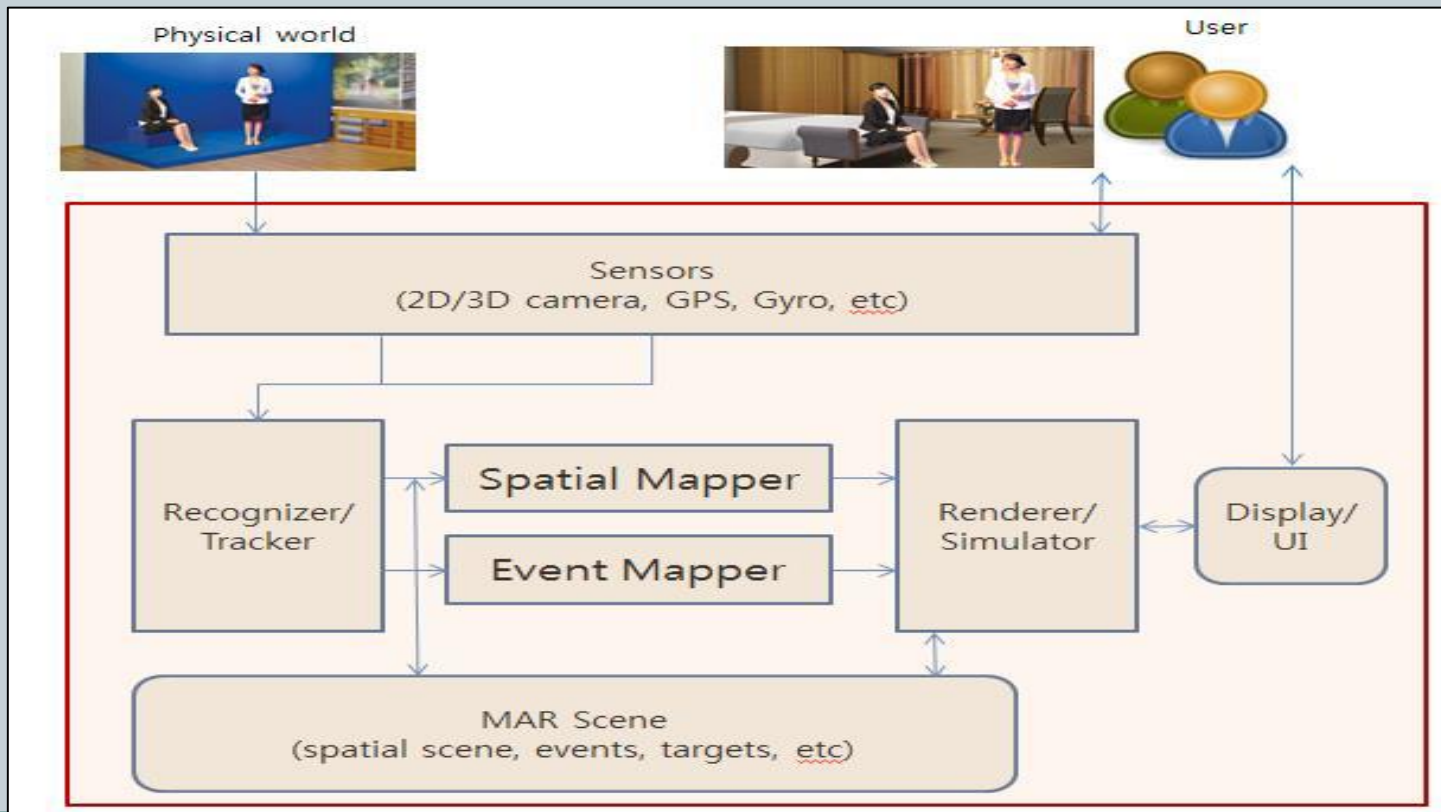
Typical AVR

Live actor and entity representation for MAR (18040)

- Reference information model for representing of:

  - Sensing of real actor and entity in a real world from input devices (e.g. depth camera)

  - Sensing of information for interaction from input sensors.

  - Recognizing and tracking of live actor and entity in a real world (and their interaction)

  - Spatial control of live actor and entity into a 3D virtual world

  - Event interface between live actor/entity and a 3D virtual world

 - Composite Rendering of live actor/entity into a 3D virtual world

Sensor representation for MAR (18038)

- Standard constructs for representing sensors in real and virtual world and how to associate them as conduits between mirrored and correspondent VR/MAR words

  - General MAR contents, IoT and VR/MAR , Mirrored worlds

- CD text now ready for submission

  - Concepts have been updated and clauses revised according to comments given in the previous meetings

  - Will seek consensus in this meeting

Sensor representation for MAR (18038)
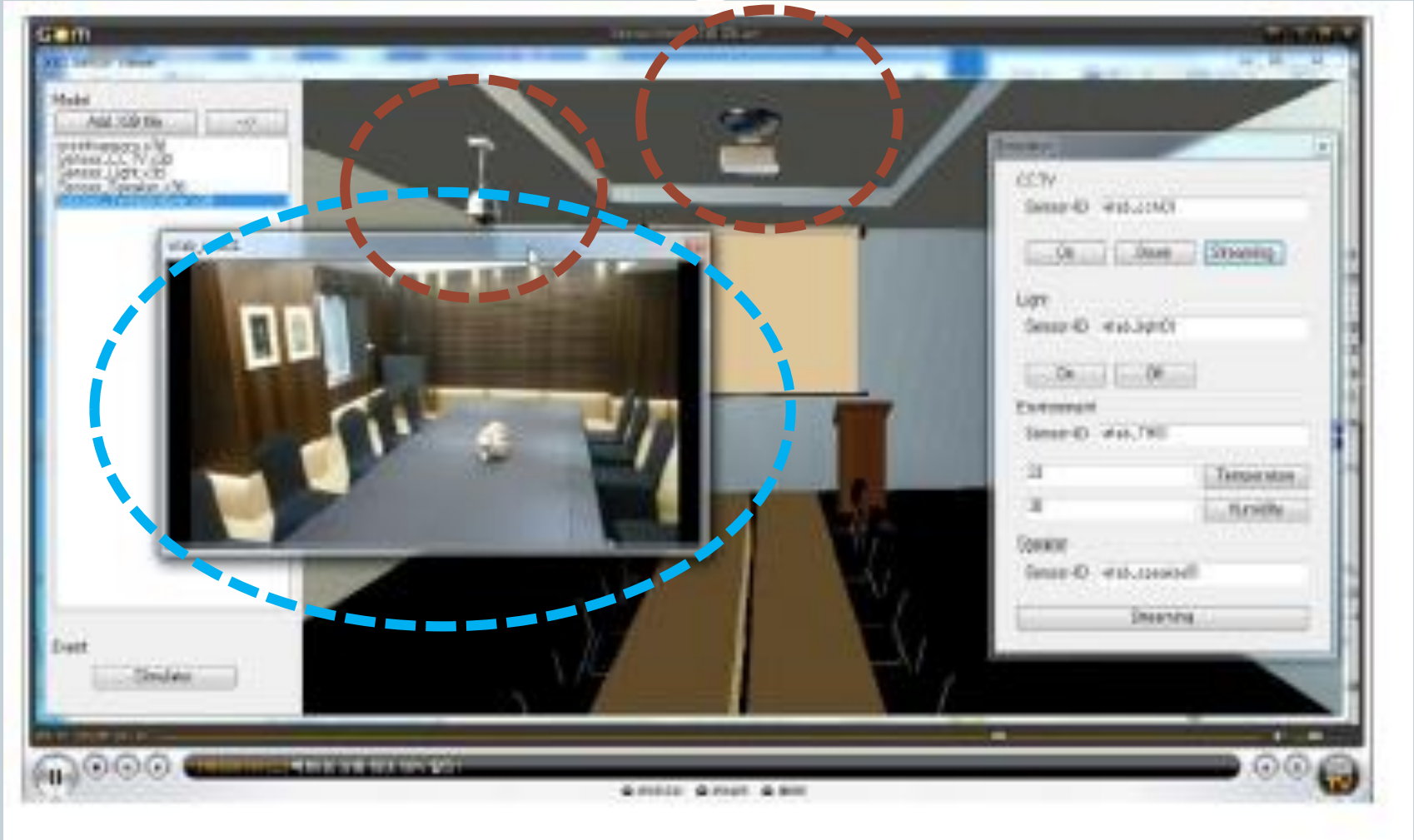
Benchmarking of vison-based geometric registration and tracking methods for MAR (18520)

- ISO/IEC 18520 "Benchmarking of Vision-based Geometric Registration and Tracking Methods for MAR" identifies the reference framework for the benchmarking of vision-based spatial registration and tracking (vSRT) methods for MAR.

- The framework provides typical benchmarking processes, benchmark indicators, and trial set elements that are necessary to successfully identify, define, design, select, and apply benchmarking of vSRT methods for MAR.

- It also provides definitions for terms on benchmarking of vSRT methods for MAR

- The next stage for ISO/IEC 18520 is "DIS registered (40.00)." The target date is in September 2017 andthe due date is on December 10, 2017.

Benchmarking of vison-based geometric registration and tracking methods for MAR (18520) *

- Standard process and metrics for evaluating system performances (e.g. tracking) for MAR systems

  - Tracking accuracy: One of the most important performance indicators for MAR

  - Associated with the TrakMark work from Japanese NB

- Process: Vision-based geometric registration

- Data set: Image sequence

  - Ground truth of camera intrinsic/extrinsic parameters

  - Ground truth of image feature correspondences

- Criteria for performance evaluation

  - (Re)Projection error of virtual objects (points) / Position and posture errors

  - Latency and frame rate (Frequency, Computational cost (time))

Benchmarking of vison-based geometric registration and tracking methods for MAR (18520)

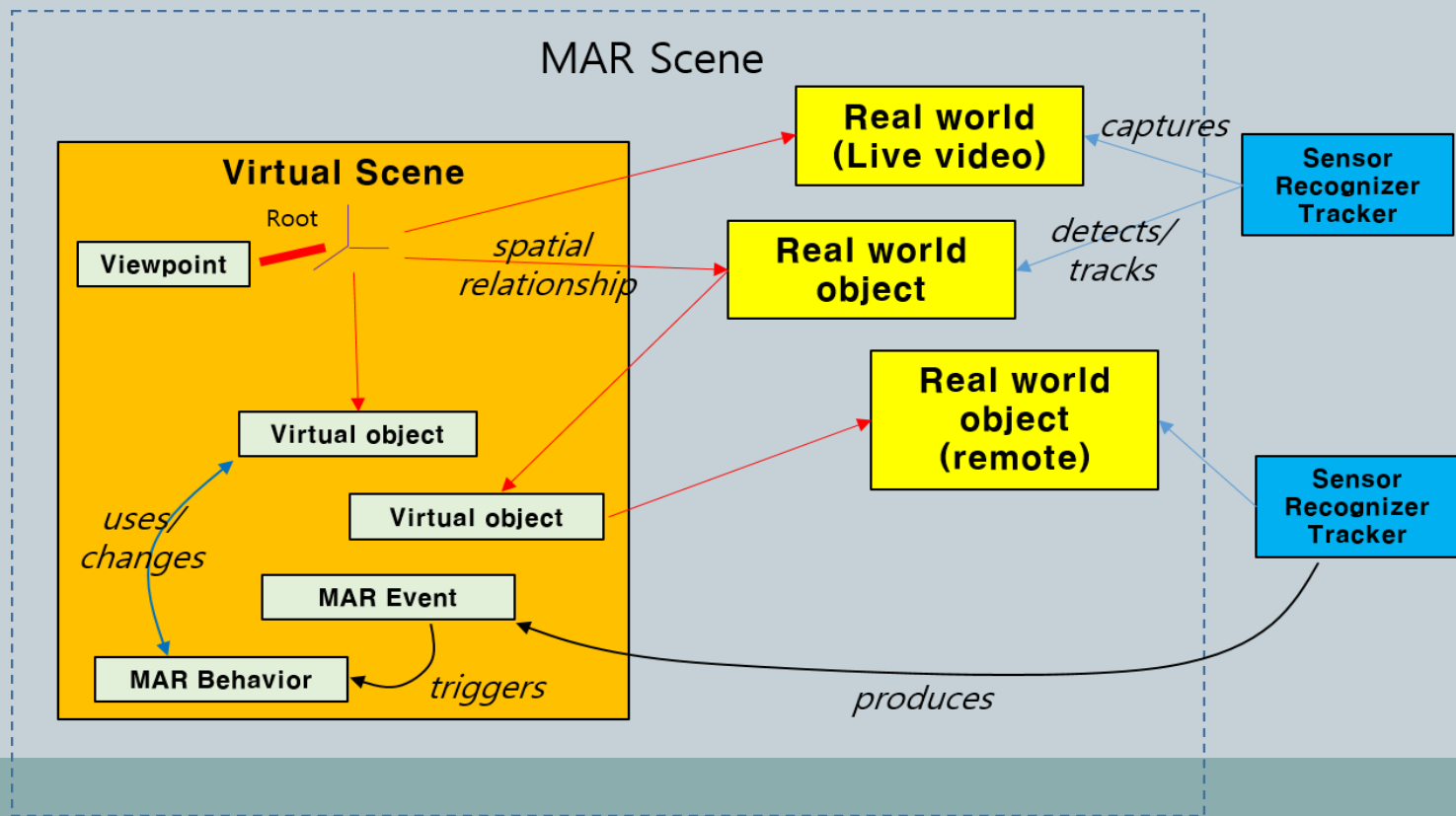Sample image sequence with features to track
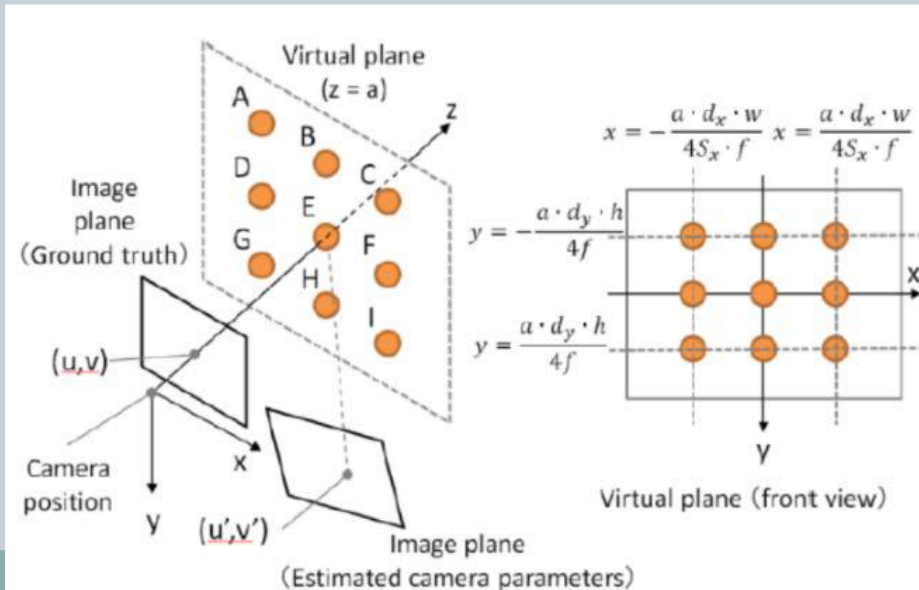
Re-projecting tracked features

Information model for MAR contents (21858)

- Extending virtual environment (content) representation for mixed reality

- First major and important application level standard to be pursued after the MAR reference model

Information model for MAR contents (21858)

- New components/attributes for MAR

  - MAR Scene

  - Real world objects/scenes

  - Virtual/Augmentation scenes/objects

  - MAR event and behaviors

  - Sensors, Tracker, Recognizer

  - Real world capture

  - Other support

    - Multimodality and synchronization

    - Remote access

    - User interface

    - Display specification / adaptation

Hello World

```
<scene id = 'scene_1' />
 <viewpoint id='arview'>
 <transform DEF = 'root' … >
</scene>

<sensor id = 'camera_1' … >
<background camera = 'camera_1' scale = '1' … >

<robject id = 'm1' type = marker file = 'hiro.dat'
        parent = 'root' translation = … rotation = … >

<h1 id = 'aug1' parent='ph1'>
 "Hello World"
</h1>

<MAR_Event id = 'e1'
            type 'object_presence'
            marker = 'm1'
            value = … translation = … rotation = … >

<MARbehavior id = 'b1'
            type = 'show'
            event = 'e1.value'
            object = 'aug1'

            where = 'e1.translation' … >
```
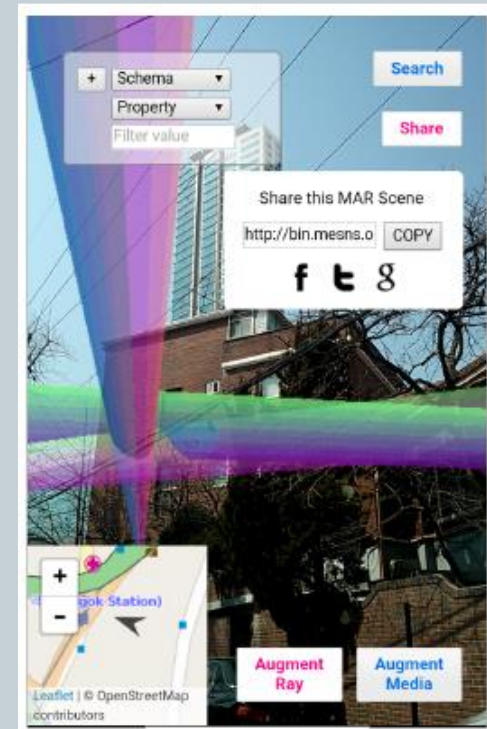
Future Work Items

- IoT and MAR

- Webizing MAR contents (with W3C)

- Telepresence support

- Ergonomics for MAR

- MAR visualization and environment dynamics

- Representing multimodal properties (WG 6)

- Image based rendering support for VR (WG 6)

User A   User B

Coordination with other SDO's

- X3D / Web3D (SC24)

  - Already has a rich and mature 2D/3D representation scheme and file format

  - Can be used as scene representation for AR (which is really VR space)

  - Can be used for 2D/3D object representation and their behaviors (X3DOM, Behavior nodes, etc.)

  - Working closely with Web3D AR WG

- W3C / HTML 5

  - POI Working Group ?

  - WebGL / Declarative 3D

  - Trend: Web is "housing" everything

    - Video, Audio, 3D Virtual, Documents, Interactivity, ...

    - Web browser vs. MPEG browser vs. X3D browser

Conclusion

- Reference model fulfilling its role as the basis and starting point for standardization

- AR/MR is exploding

  - Much more expert participation is needed

  - Need to address the widening needs of the industry

  - Much more active publicizing our efforts and results is needed

- Application standards need to be derived for immediate industrial impact

- VR and MR/AR is merging!

  - E.g. Glasses that can switch between VR and MR modes