MAR Visualization Style Specification

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Information displayed through MAR?

- Content itself
  - Associate target object (in real or virtual environment) with
  - Augmentation object (which is virtual or captured/reconstructed from the real)
- Expectation
  - Augmented and composited display will be "visible", "natural", "seamless" and "consistent"
  - Is it?
- MAR is used in a dynamic condition
  - User/target is moving (mobile)
  - User/target is in different environments / timings
    - Under different lighting condition
  - This not really aspect of the "content" (or is it?)

Augmentation

- Which – Target object / Location, …
- What – Objects, Tools, Directions, Instructions, …
- When – Interactive, Pre-specified, Live, Pre-recorded, Dark/Bright, …
- How - Style?

→ Varying the style or adapting to external condition can adjust the trade-off point e.g. between *Naturalness and Visibility …*

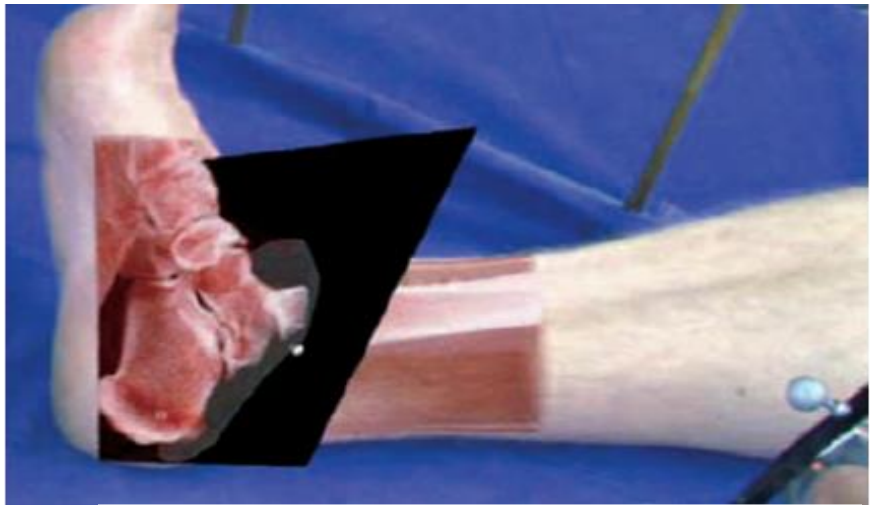
MAR Viz. Requirement 1: Naturalness

- The user is not puzzled about the imagery - it is not too much deviant from the mental model of the user's understanding of the world
  - 3D alignment: augmentation should be registered into the 3D space in a "physically plausible" way and/or provide depth cues
  - Realistic – The augmentation should look as realistic and harmonious with the real world as possible

Assumption: Spatially Registered AR

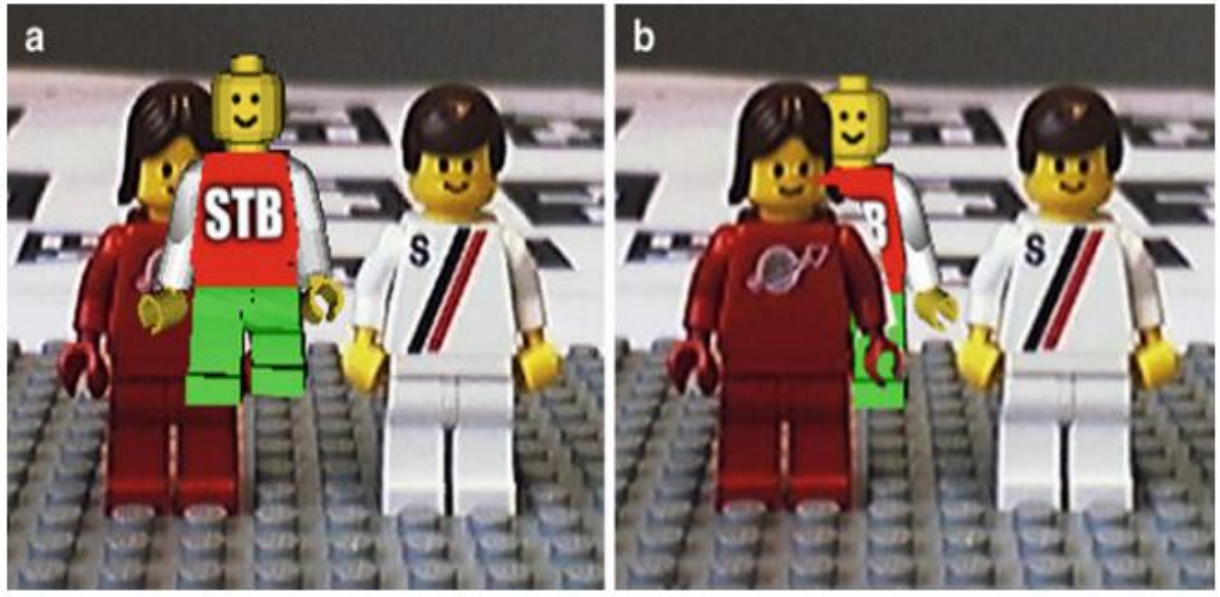
3D DEPTH CUES

Transparent overlay of 3D structures
[Azuma et al.]



3D cutting planes [Navab et al.]

(consider shadows, size, motion, ground, …)



Phantom objects for physical plausibility/occlusion
(3D model of real objects)
[Kalkofen et al.]

VISUAL REALISM / LIGHTING

Supan et al.

MR360: Mixed Reality Rendering for 360° Panoramic Videos

Victoria University of Wellington
Taehyun Rhee, Lohit Petikam, Benjamin Allen, Andrew Chalmers

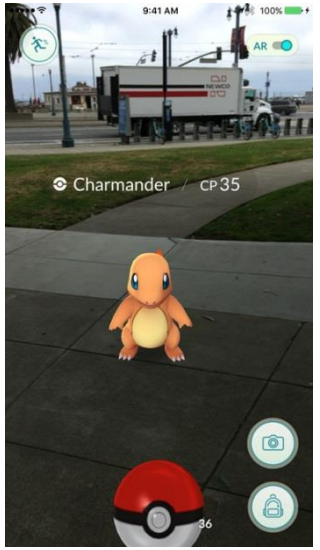
TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

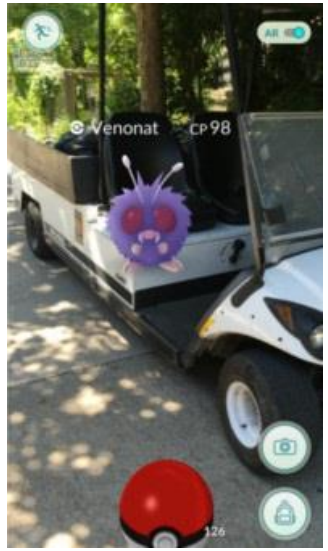
Rhee et al.

PHYSICAL PLAUSIBILITY


vs.


Avatar adaptation to remote environment [Jo and Kim et al.]



vs.


Floating Pokemons

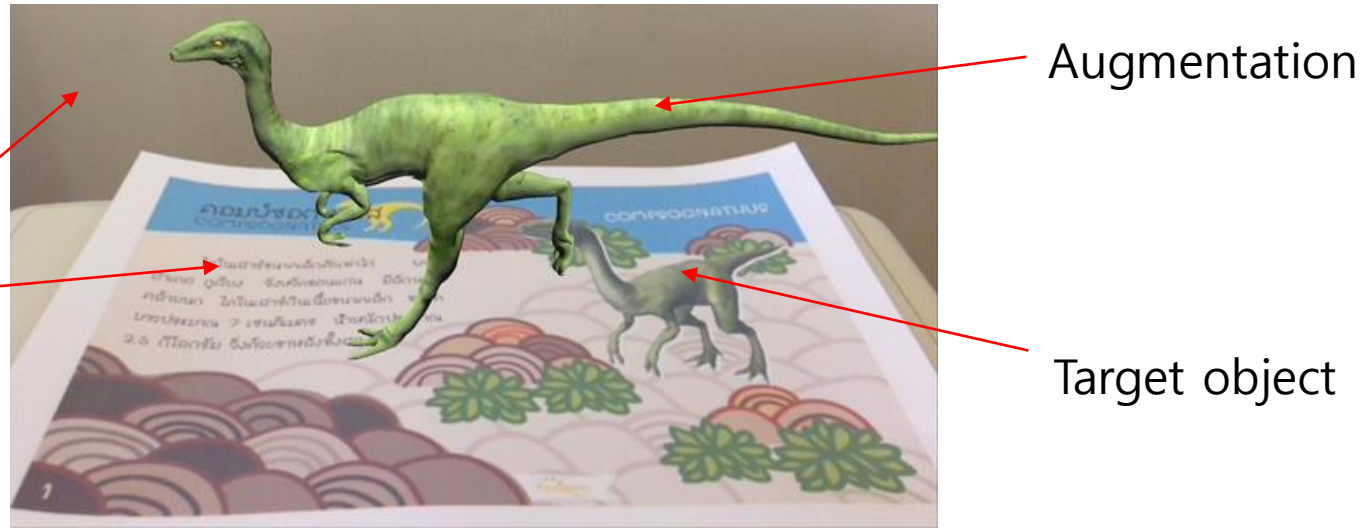

vs.


Conspicuous but unnatural?

Natural but not so outstanding

MAR Viz. Requirement 2: Visibility

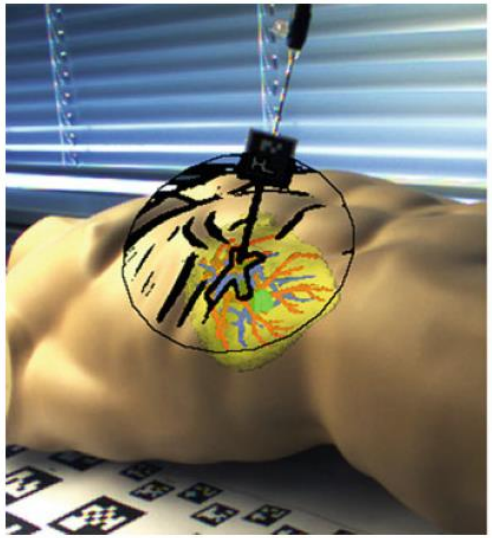
- The visibility of information should be maximized
- There are three types of information to consider



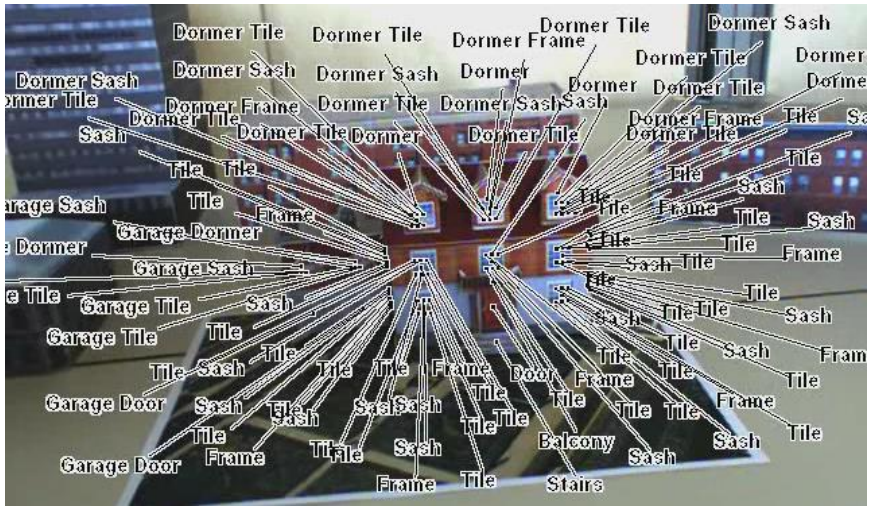
- There can be trade-offs between Maximizing Visibilities among the three

Assumption: Spatially Registered AR

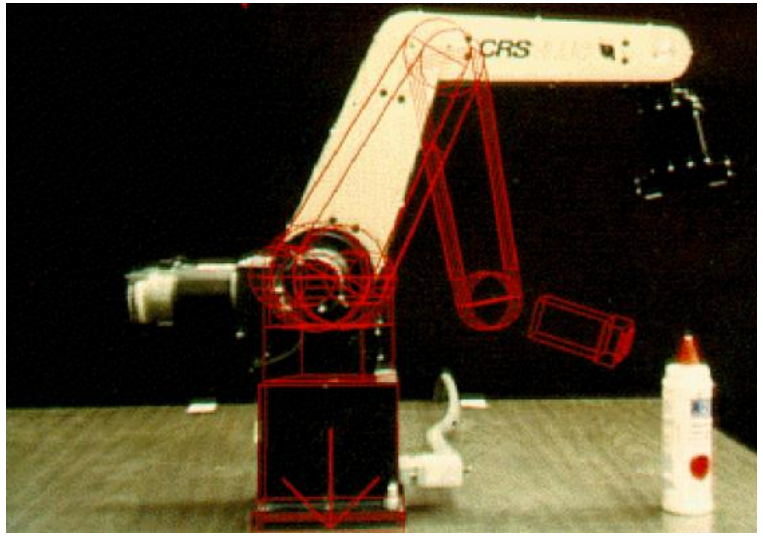
Target Object (Enhancement)



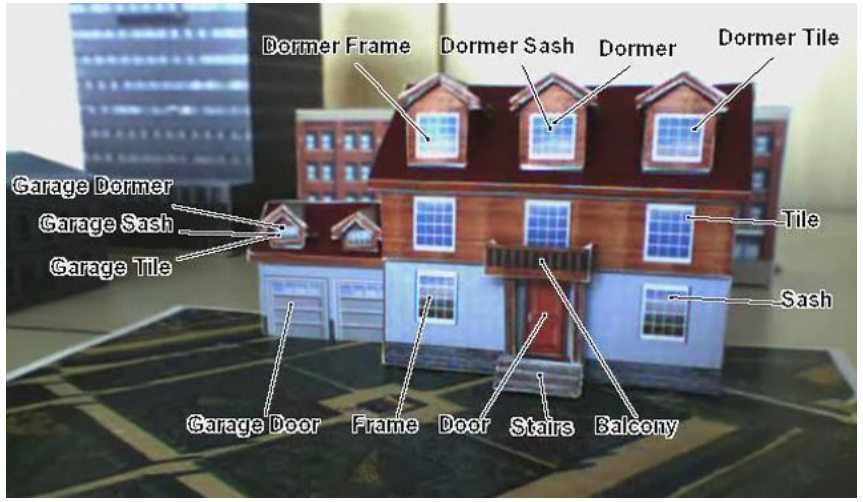
Emphasis with edges
[Avery et al.]



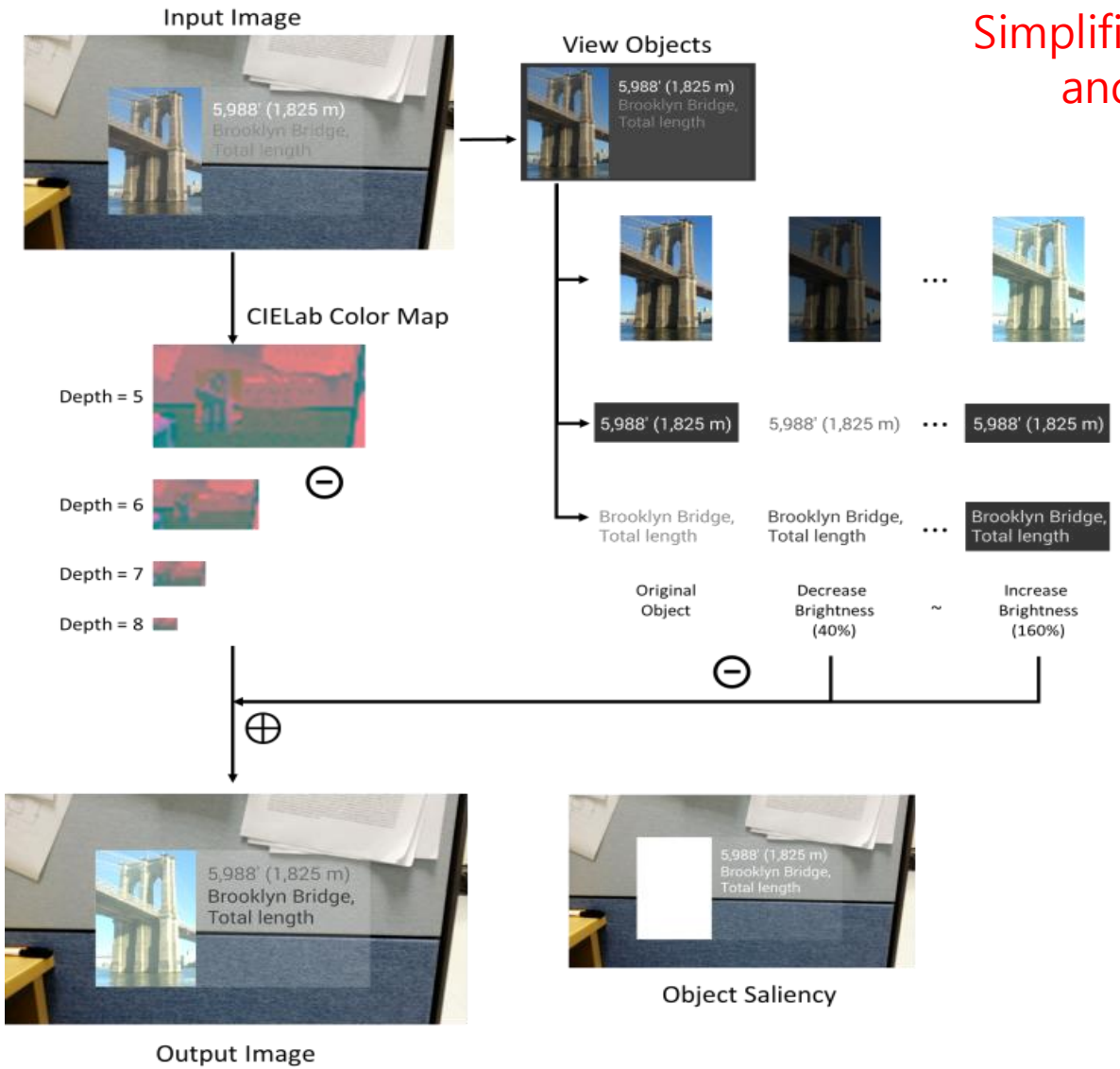
Filtering
[Tanzgem et al.]



Motion profile
[Milgram et al.]

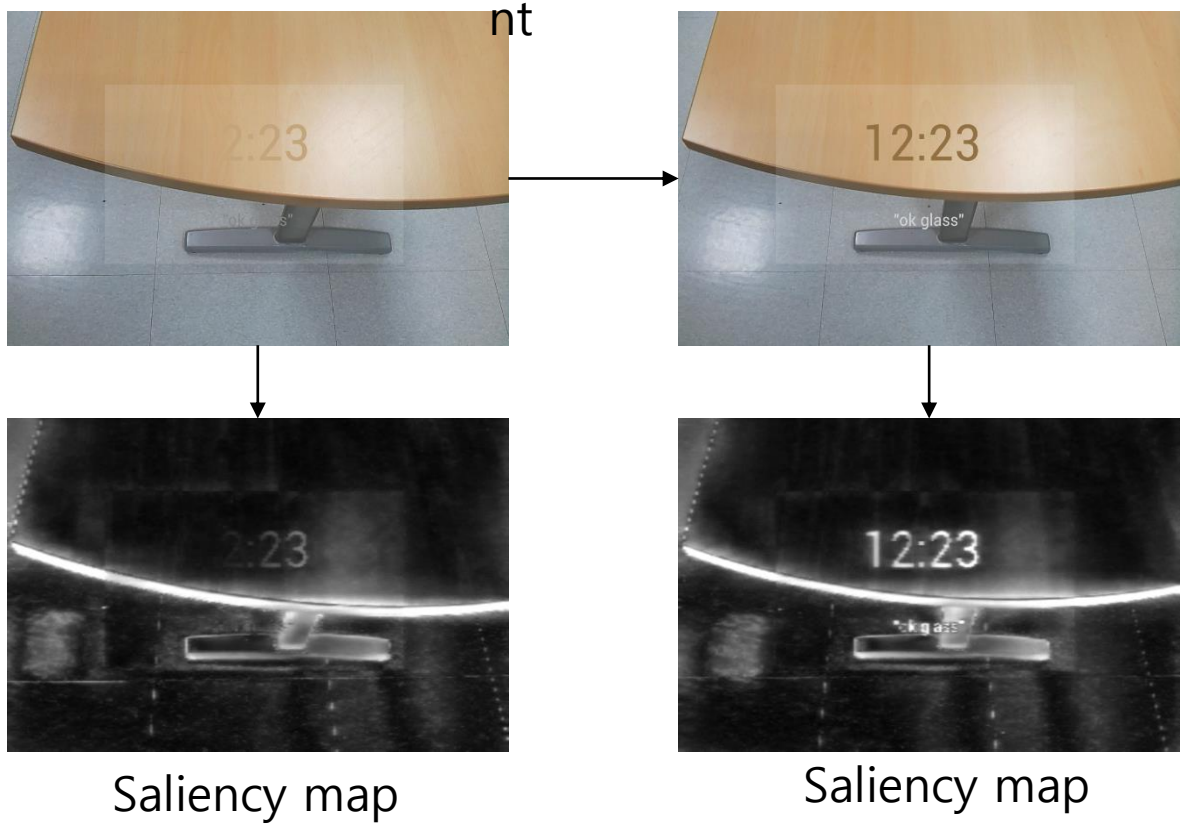


Clear Augmentation
Saliency based Method [Ahn and Kim]



Simplified/Real time and Mobile

Adjustment



Augmentation and Target Object

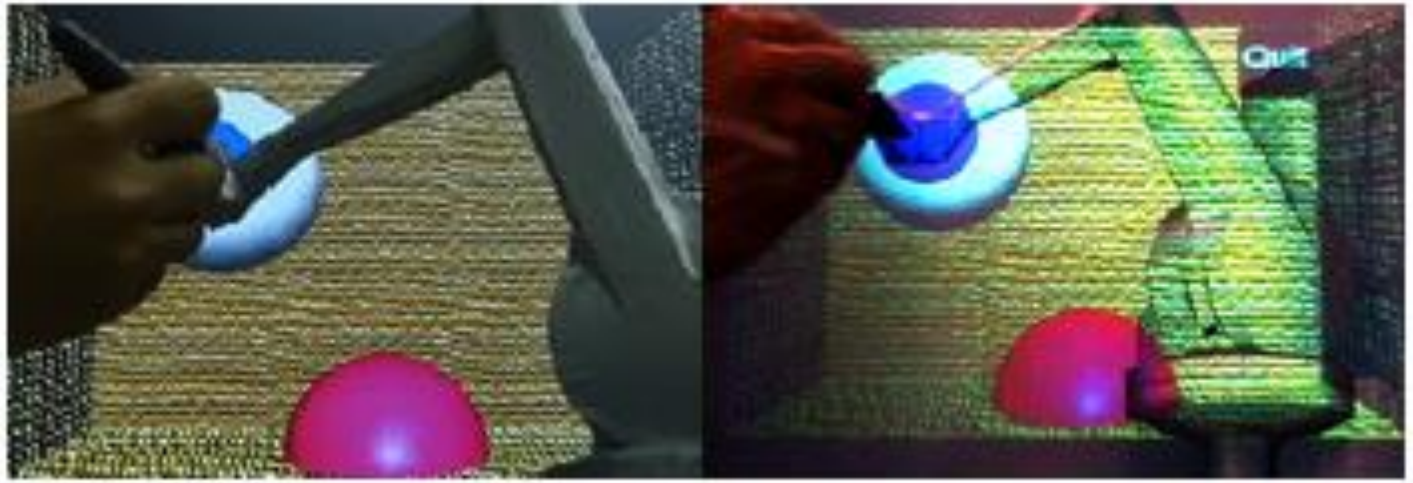
Saliency of occlude and occludee [Sandor et al.]

Transparency adjusted by saliency [Zollman et al.]

Is it possible to make both target and augmentation clearly visible at the same time?

Context / Neighborhood

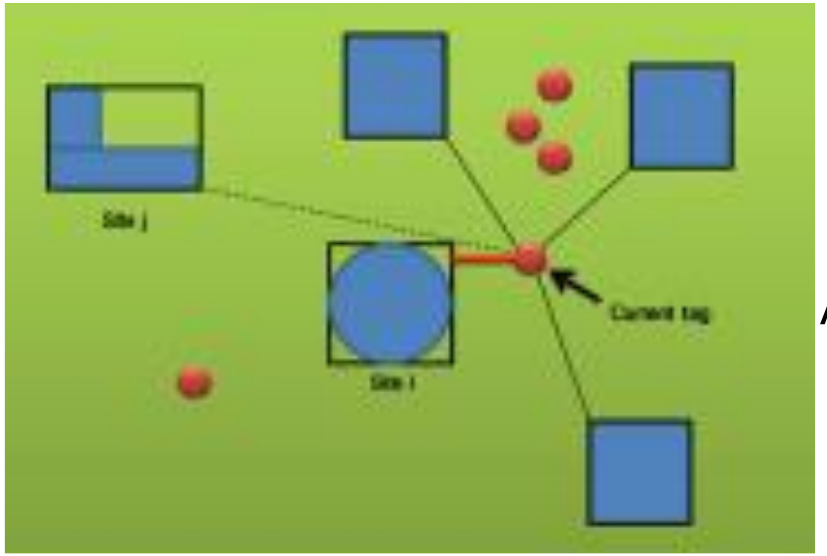
Warp to show more
Sandor et al.



Remove to show more
Inami et al.

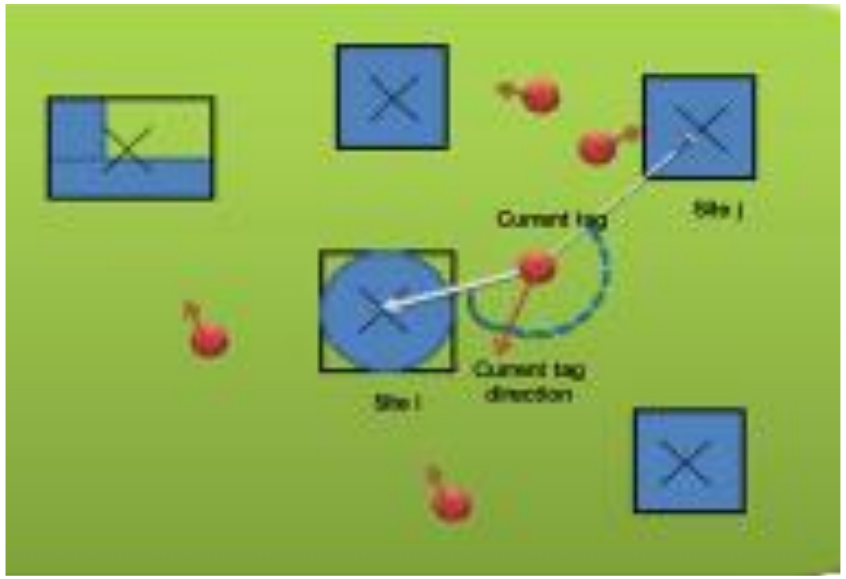
Context / Neighborhood

Crowded tag problem



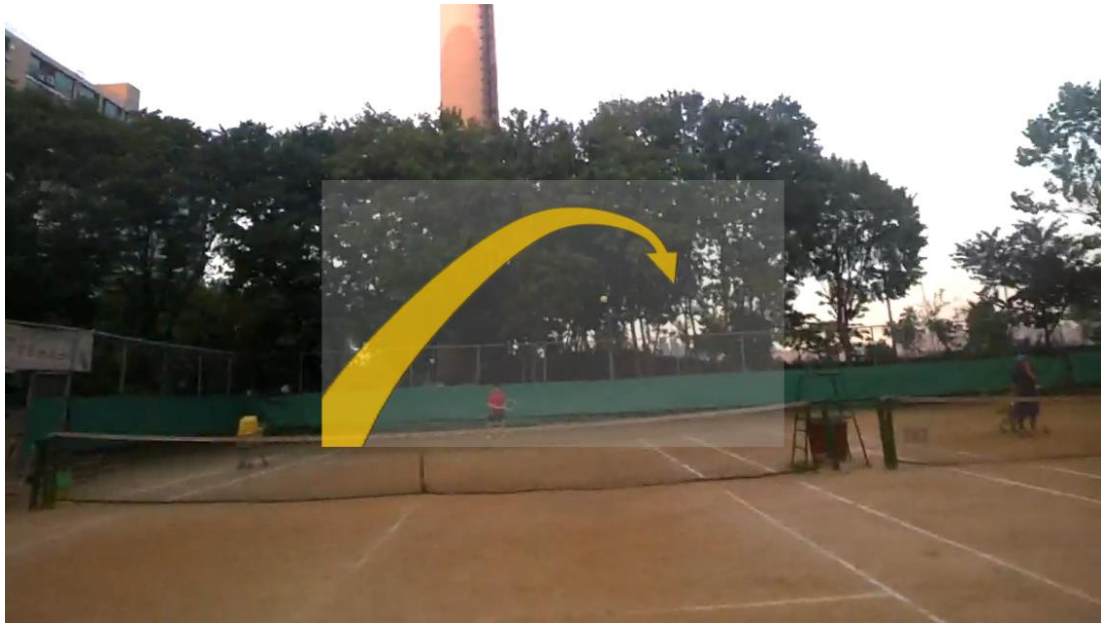
Organize to show more
[Choi and Kim]

Associate Geo-tags to a group
By location/direction similarity



MULTIMODALITY [KIM AND KIM]

Fast paced guidance



Visual, Aural, Visual + Aural ?

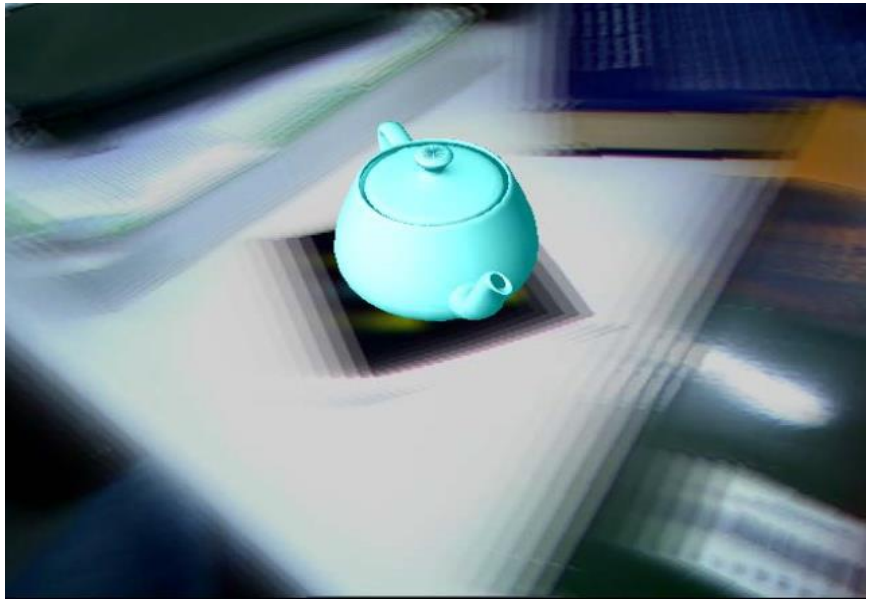
movie

MAR Viz. Requirement 3: Stability and Persistence

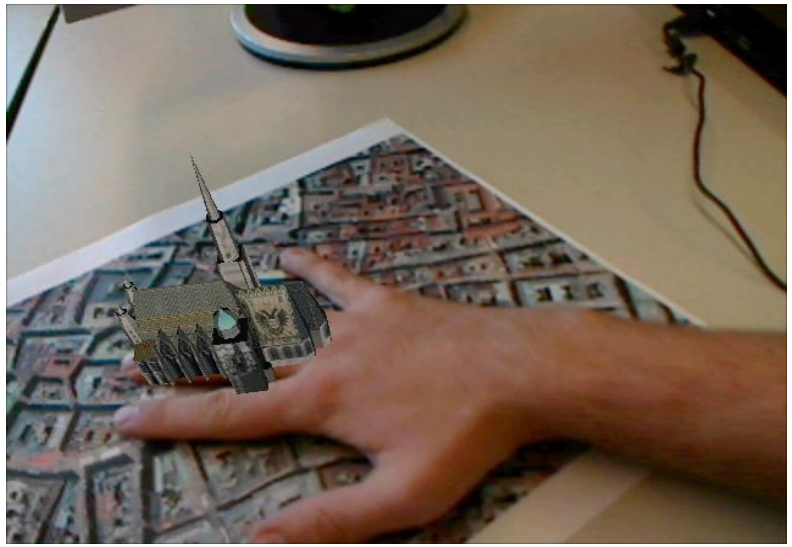
- Augmentation should be stable and comfortable to View/interact
- Once augmented in certain form, it should not disappear nor change without any meaningful reason

This is more of a system issue (vs. content)

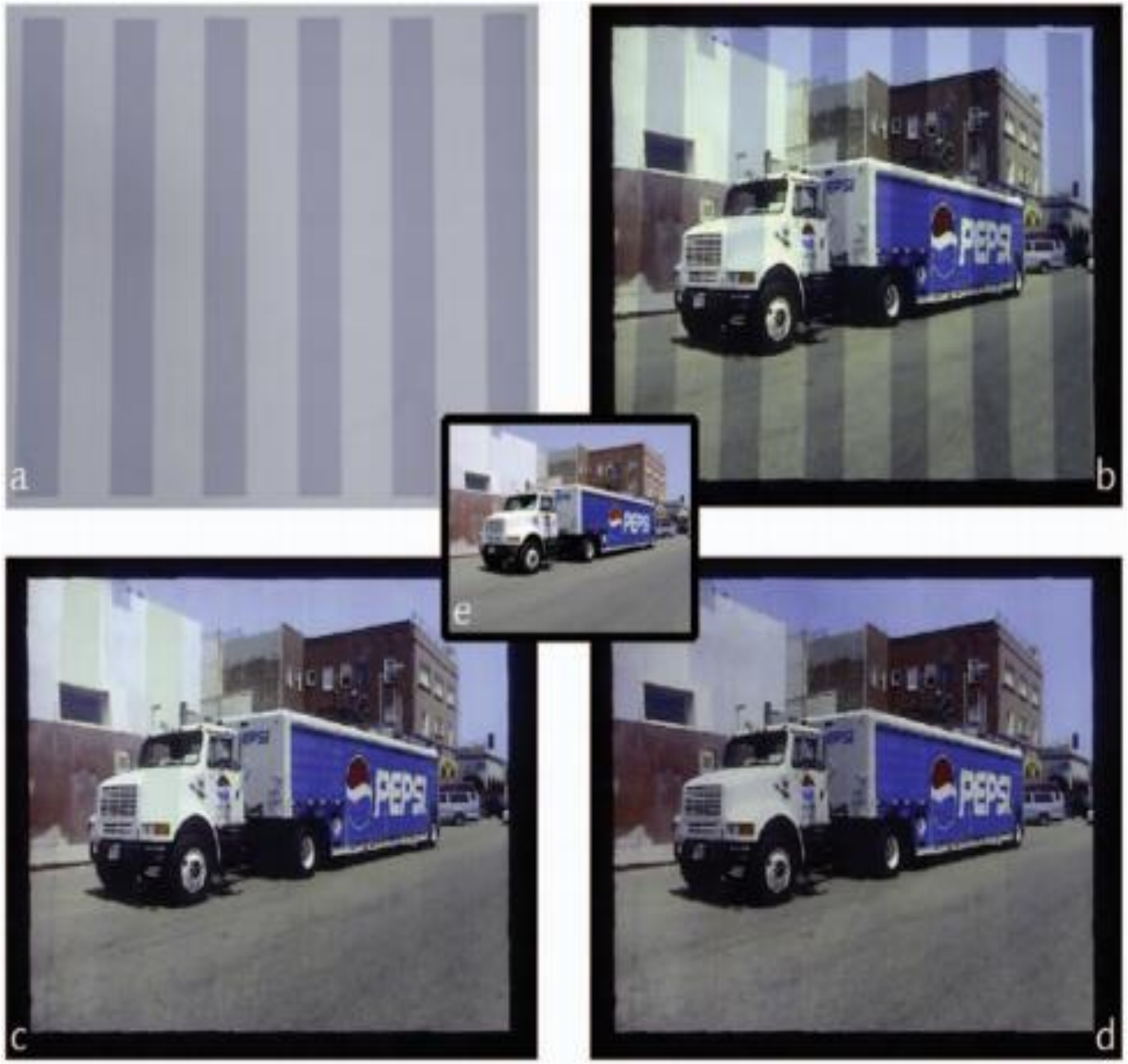
Motion stabilization
[Azuma et al.]



Handle blur
[Tyoura et al.]



Handle occlusion
[Percheim et al.]



Handle surface variations
[Bimber et al.]

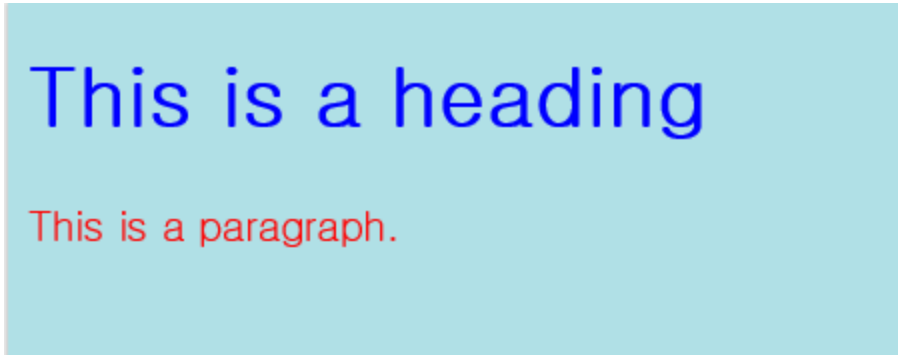
Other factors

- Color
- Contrast and Brightness
- Display type (Video see through, Glass, Mobile, …)
- Stereoscopy
- Field of view
- Avatar form (Character-like, Reconstructed, Half and half, …)
- Exaggeration

c.f. HTML and CSS

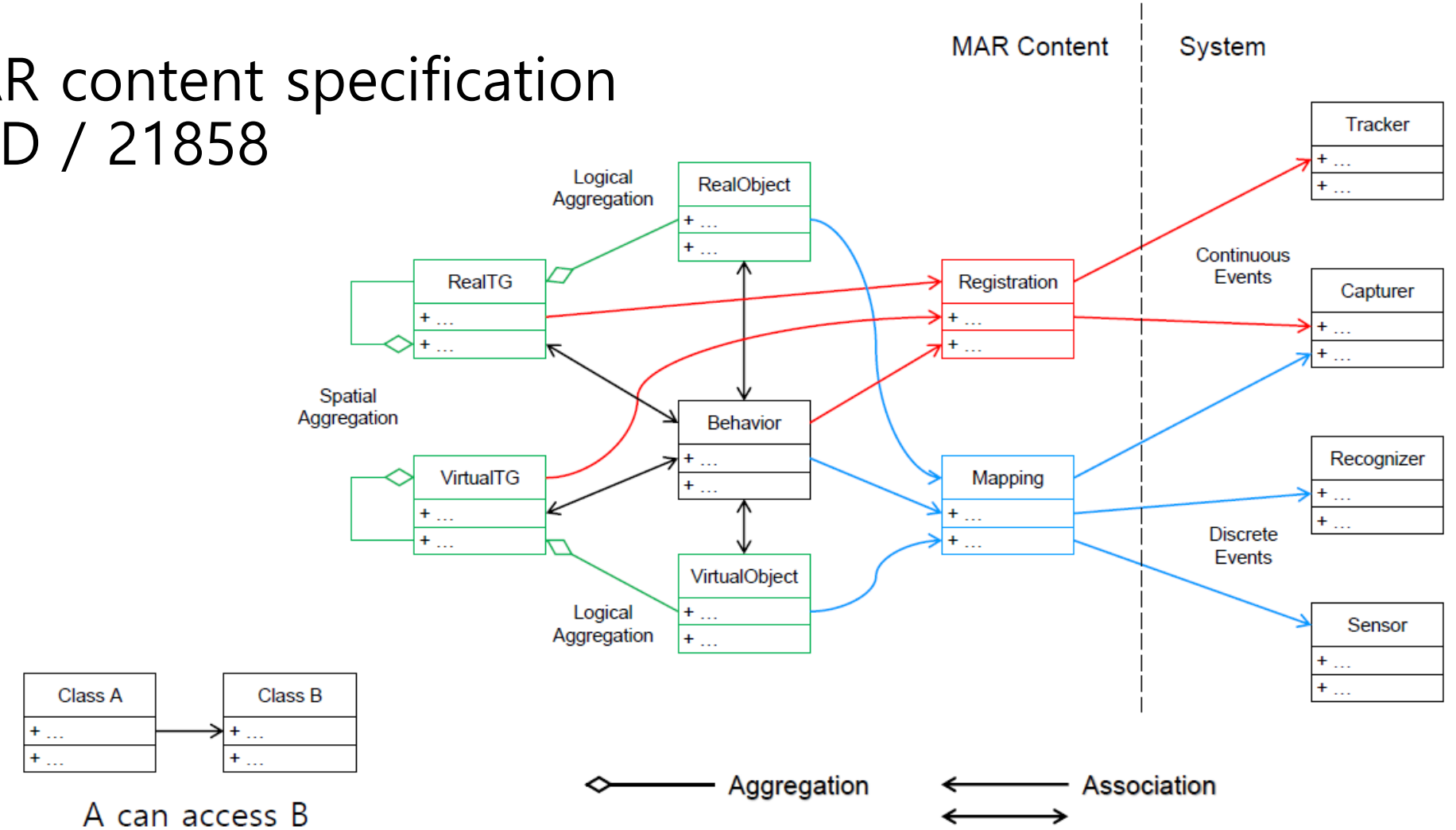
- CSS stands for Cascading Style Sheets
- CSS describes how HTML elements are to be displayed on screen, paper, or in other media.
- CSS saves a lot of work.
  - Separation of content and style → Flexible
- It can control the layout of multiple web pages all at once.

```
<!DOCTYPE html>
<html>
<head>
<style>
body {background-color: powderblue;}
h1   {color: blue;}
p    {color: red;}
</style>
</head>
<body>

<h1>This is a heading</h1>
<p>This is a paragraph.</p>

</body>
</html>
```



Likewise then: MAR Content and its Style

- MAR content specification
  – CD / 21858

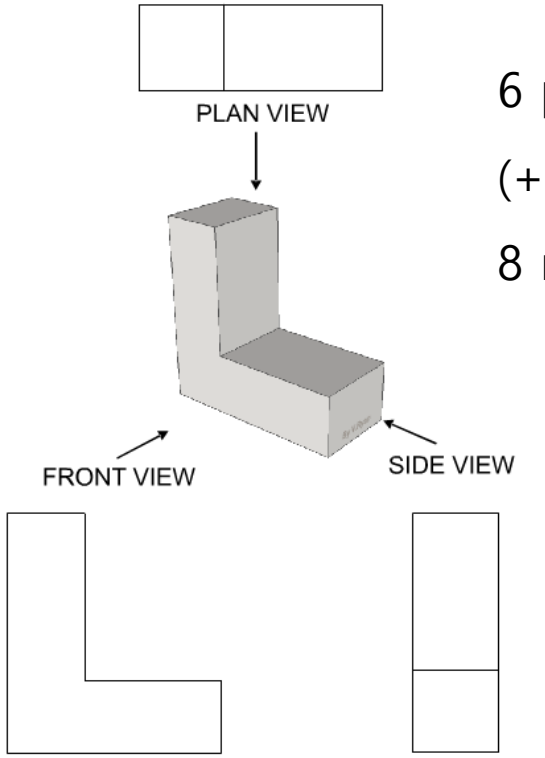


Proposal for MAR standard – Occlusion issue

- Basic display requirement
  - ISO 9241 Series / Part 3 (Visual display requirements) addresses it
    - There may be some differences among various MAR displays (VST, OST (Glass), Mobile, Open Lens) but they might be similar to those between e.g. different desktop monitors, projectors and displays …
  - Likewise for performance specifications (clarity, legibility, stability, fatigue) under dynamic working conditions
    - Dynamic conditions once measured can be addressed by programmable and variable adjustments
- MAR specific visualization specification? → Occlusion

Specify occlusion behavior – as part of *MAR content behavior*

- Augmentation occludes the target object
  - Eccentricity (where relative to the object)
  - Maximum coverage
  - Opacity
  - …
  - View angle dependent



6 principal directions

(+x –x +y –y+z –z) and

8 more diagonal directions

- Behavior::MARSGNode

Behavior objects specify the dynamics of the objects in the scene, e.g. time based or event based behaviour. Therefore, such behaviors can be expressed simply by relying on the usual script nodes. Behavior nodes, in addition to housing such flexible scripts, serve to abstract some typically used MAR “augmentation” behaviors (i.e. how virtual augmentation objects associated and spatially registered to a real physical object behave reacting to input and external events). The main purpose of such an abstraction is the ease of use, simplicity and thereby quick authoring. Behavior nodes are driven by external events/data produced from the MAR system components (such as the Sensor, Capturer, Tracker and Recognizer, see Clause 6.3) and accessible indirectly through the Mapping node (see Clause 7.4), and simulated by the MAR simulation engine (another important part of MAR system). The behaviour node will have associations with the content objects which are needed to drive and simulate the behaviour and those that are affected by the simulation as well.

Examples of often used augmentation behaviour are simple activating/deactivating of the augmentation to be visible, simple animation of them, highlighting effects, changing of transparency and color.

Scenario (Marker or Image patch based, Video see-through)

Assumed R/V Root TGs are initialized by system automatically

We consider only MAR content side and do not consider anything about system side

Assumed R. Root

Assumed V. Root

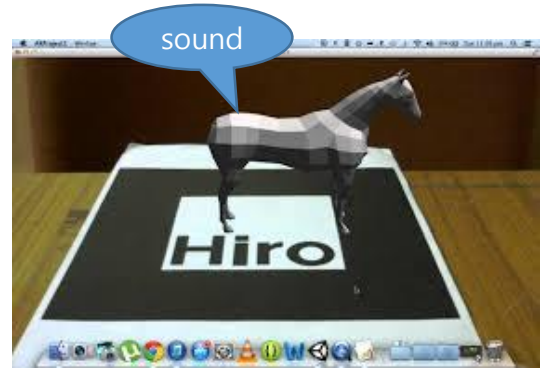
Marker RO

RTG

R

VTG

Viewpoint VO



R

Marker Tracker

Live BG VO

VTG

M

Front
- Location: Center
- Max coverage: 30%
- Opacity: 75%

Left side
- Location: Top left
- Max coverage: 40%
- Opacity: 10%

...

Horse VO

Sound VO

Live Video Capturer

System side doesn't know anything about MAR content

Behavior Visibility/ Sound

M

Touch Sensor

Touch Event

Camera Sensor

Sensor just senses some real world data

TextStyle

MAR언어(예시)	기능
<TextStyle… />	TextStyle를 추가합니다.
id = “textStyle1”	TextStyle의 ID를 설정합니다.
font = “arial”	텍스트 폰트를 설정합니다.
color = “1.0, 0.0, 0.0, 1.0”	텍스트의 RGBA를 설정합니다.
scale = “1.0”	텍스트의 크기를 설정합니다.
letterSpace = “0”	문자간의 간격을 설정합니다.
wordSpace = “1”	단어간의 간격을 설정합니다.
lineHeight = “1.0”	줄간의 간격을 설정합니다.
decoration = “bold”	문자의 특징을 설정합니다. (DEFAULT, BOLD, ITALIC, STRIKEOUT, UNDERLINE)
direction = “LTR”	글자가 써지는 방향을 설정합니다. (LTR, RTL)

TrackingStyle (Object Style)

MAR언어(예시)	기능
<TrackingStyle… />	TrackingStyle를 추가합니다.
id = “trackingStyle1”	TrackingStyle의 ID를 설정합니다.
type = “spin”	TrackingStyle의 Type을 지정합니다. Spin, Blink, Pump 3가지 타입이 있습니다.
angle = "0.0, 50.0, 0.0"	Spin Type일 때만 적용되는 속성으로써, 매 프레임 마다 몇 도씩 회전 할지 설정합니다.
scale = "0.5"	Pump Type일 때만 적용되는 속성으로써, 객체의 크기가 커지고 작아지는 정도를 설정합니다.
speed ="2.0"	Pump, Blink Type일 때만 적용되는 속성으로써, 객체의 크기가 바뀌는 속도를 설정하거나, 몇 초를 기준으로 깜빡이는지 설정하는데 쓰입니다.

TrackingStyleRegister

MAR언어(예시)	기능
<TrackingStyleRegister… />	TrackingStyleRegister 컴퍼넌트를 추가합니다.
trackingStyle = “trackingStyle1”	어떤 TrackingStyle을 TrackingStyleRegister에 지정할지 설정합니다.

```
<MarApp id = "TestApp">
  <Scene id = "scene1">
    <TrackingStyle id ="trackingStyle1" type ="spin" angle="0.0,50.0,0.0" scale = "0.5" speed ="2.0"/>

    <TextStyle id = "textStyle1" decoration = "strikeout" font = "arial" scale = "1.0" letterSpace = "1"
               wordSpace = "1" lineHeight = "2.0" direction = "LTR" color ="1.0, 1.0, 0.0, 1.0"/>

    <RealObject id = "realObject1"/>
    <RgbCamera id = "capture1" videoPath = "01_Asset/Video/sample.avi">
      <ImageRecognizer realObject = "realObject1" targetImagePath = "01_Asset/Image/marker.jpg"/>
    </RgbCamera>

    <Object id = "object1">
      <Transform parent = "realObject1"/>
      <TrackingStyleRegister trackingStyle ="trackingStyle1"/>
      <DummyRenderer/>
    </Object>

    <Object id = "object2">
      <Transform parent = "realObject1" localPosition = "3.0, -3.0, 0.0" localRotation = "0.0, 90.0, 0.0"/>
      <DummyRenderer/>
    </Object>

    <Object id = "object3">
      <Transform parent = "realObject1"/>
      <TextRenderer text = "HelloWorld¥Hello MAR" textStyle = "textStyle1"/>
      <Speaker audioName = "backgroundSong" audioPath = "01_Asset/Audio/lenaPark.mp3" loopType = "LOOP" playWhenCreate = "true"  volume = "1.0" />
    </Object>

    <Object id = "object4">
      <ArRenderer sensor = "capture1"/>
    </Object>

    <Event condiFuncName = "GetMouseButtonDown" condiFuncParam = "0" actFuncCallObject = "object1" actFuncName = "MarObject::SetActive" actFuncParam = "false"/>
  </Scene>
</MarApp>
```

동영상

Plan

- NWIP: Part 2 to 21858 (this fall)
- Demonstration implementation (in progress)