engineering laboratory

Leveraging Standard Geospatial Representations for Industrial Augmented Reality

Teodor Vernica (NIST, United States) – teodor.vernica@nist.gov
Aaron Hanke (TU Dresden, Germany) - aaron.hanke@gmx.de
William Bernstein (NIST, United States) - william.bernstein@nist.gov

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Industrial Augmented Reality

Maintenance

Remote assistance

Assembly guidance

Other data overlay scenarios

Motivation – Project Goals

- Enable overview of the manufacturing floor
- Display real-time contextual information
- Transfer technology

Motivation – Project Goals

Start moving the camera up with speed 1

http://192.151.1.108/cgi-bin/ptz.cgi?action=start&channel=0&code=Up&arg1=0&arg2=1&arg3=0

Device: GFAgie01; UUID: mtc_adapter001

Device : GFAgie01

Events

Timestamp	Type	Sub Type	Name	Id	Sequence	Value
2020-02-27T17:34:36.343947	Availability		avail	GFAgie01-dtop_1	295795840	UNAVAILABLE
2020-02-27T17:34:36.343157	EmergencyStop		estop	GFAgie01-dtop_2	295795830	UNAVAILABLE
2020-02-27T17:34:36.343804	AssetChanged			GFAgie01_asset_chg	295795838	UNAVAILABLE
2020-02-27T17:34:36.343874	AssetRemoved			GFAgie01_asset_rem	295795839	UNAVAILABLE

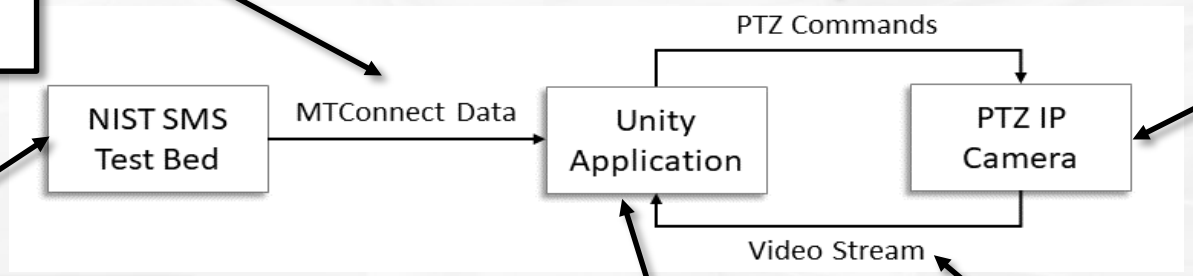
Condition

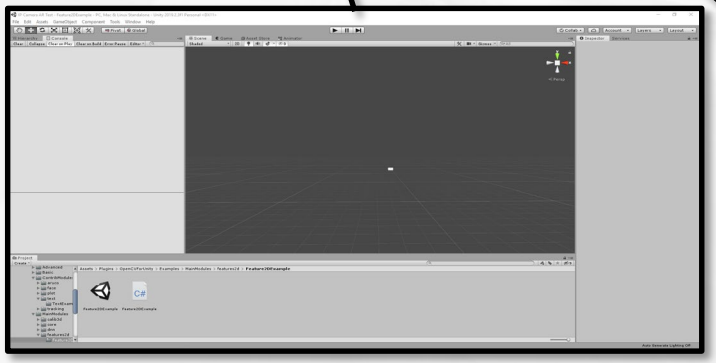
Timestamp	Type	Sub Type	Name	Id	Sequence	Value
2020-02-27T17:34:36.343227	Unavailable		system	GFAgie01-dtop_3	295795831	

Rotary : A

Samples

Timestamp	Type	Sub Type	Name	Id	Sequence	Value
2020-02-27T17:34:36.342090	Angle	ACTUAL	Aposition	GFAgie01-A_2	295795815	UNAVAILABLE

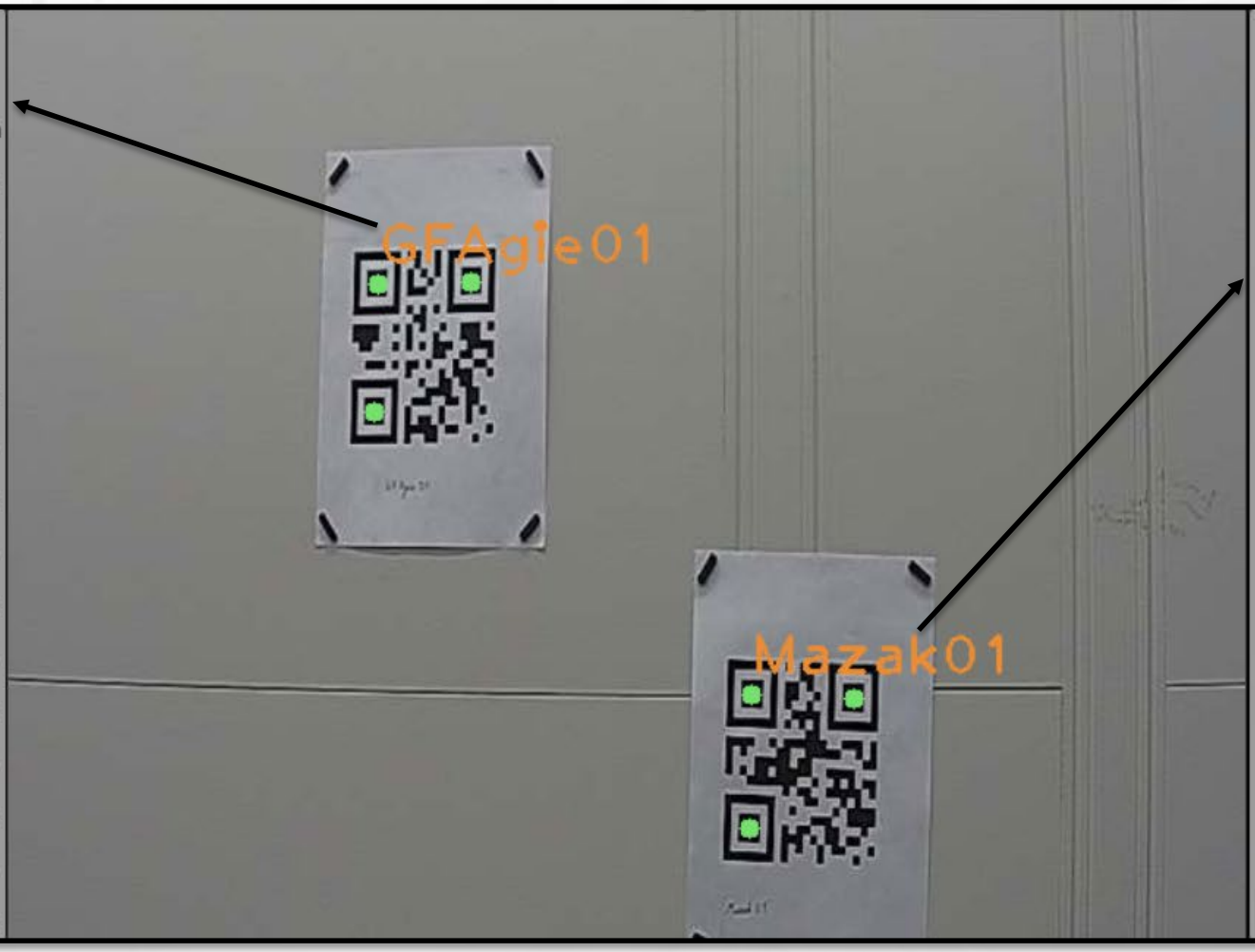




Initial Prototype

Machine:GFAgie01
Uuid: mtc_adapter001
(Samples)

72019-11-21T06:56:05.112934 Xposition 107672492 18.97709
2019-11-21T06:56:05.257469 Xposition 107672504 18.97715
2019-11-21T06:56:05.406710 Xposition 107672508 18.97705
2019-11-21T06:56:05.551160 Xposition 107672511 18.97706
2019-11-21T06:56:05.696677 Xposition 107672514 18.97715
2019-11-21T06:56:05.841122 Xposition 107672517 18.97707
2019-11-21T06:56:05.985671 Xposition 107672520 18.97706
2019-11-21T06:56:06.131761 Xposition 107672524 18.97708
2019-11-21T06:56:06.275169 Xposition 107672531 18.97707
2019-11-21T06:56:06.435235 Xposition 107672535 18.97708
2019-11-21T06:56:06.579767 Xposition 107672539 18.97709
2019-11-21T06:56:06.725451 Xposition 107672543 18.97714
2019-11-21T06:56:06.869977 Xposition 107672547 18.97694
2019-11-21T06:56:07.013646 Xposition 107672551 18.97724
2019-11-21T06:56:07.161878 Xposition 107672555 18.97702
2019-11-21T06:56:07.305387 Xposition



Machine:Mazak01
Uuid: mtc_adapter002
(Samples)

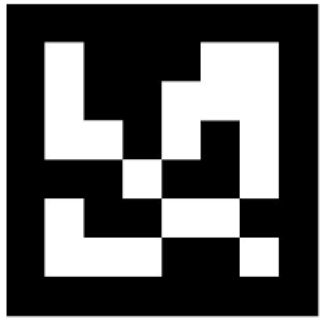
72019-11-21T06:56:05.138437 Xload 107672496 36
2019-11-21T06:56:05.138229 Xfrt 107672495 0
2019-11-21T06:56:05.138549 Zabs 107672497 -19.445986
2019-11-21T06:56:06.221252 Zabs 107672526 -15.893542
2019-11-21T06:56:07.307932 Zabs 107672562 -12.432157
2019-11-21T06:56:05.138661 Zfrt 107672498 3.2004
2019-11-21T06:56:05.138879 auto_time 107672500 10571121
2019-11-21T06:56:06.221578 auto_time 107672527 10571122
2019-11-21T06:56:07.308102 auto_time 107672563 10571124
2019-11-21T06:56:05.139083 total_time 107672502 49509581
2019-11-21T06:56:06.226464 total_time 107672529 49509582
2019-11-21T06:56:07.308303 total_time 107672565 49509583
2019-11-21T06:56:05.138981 cut_time 107672501 5755996
2019-11-21T06:56:06.222416 cut_time 107672528 5755997
2019-11-21T06:56:07.308210 cut_time 107672564 5755998
2019-11-21T06:56:05.138766 Fact

Limitations

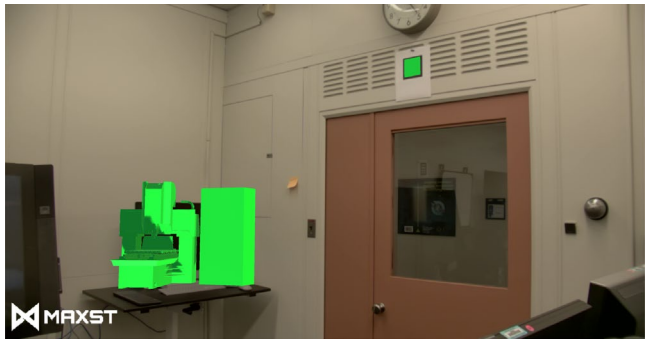
- QR Cod
- Marker
- Occlusi
- Informa

Addressing the Limitations

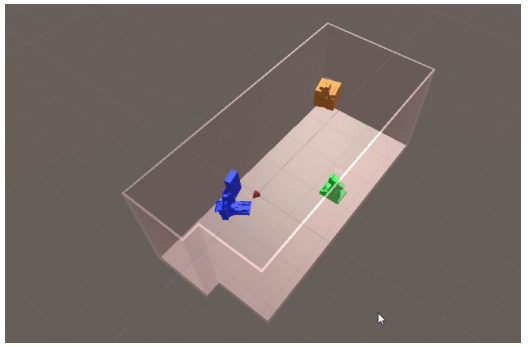
Improved detection using AR fiducial markers (but still limited)



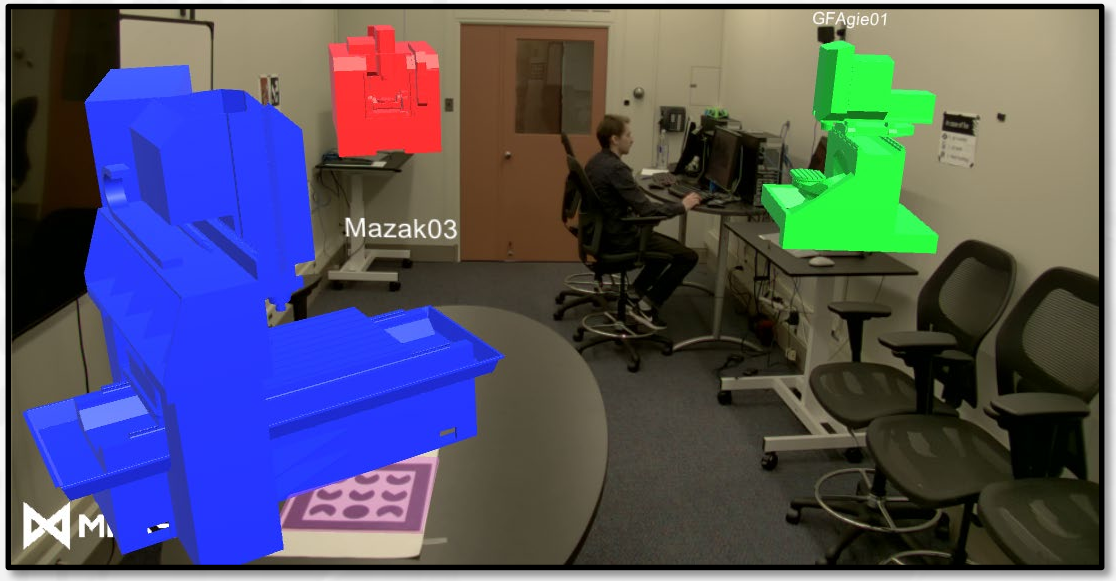
Display 3D data in addition to the MTConnect data

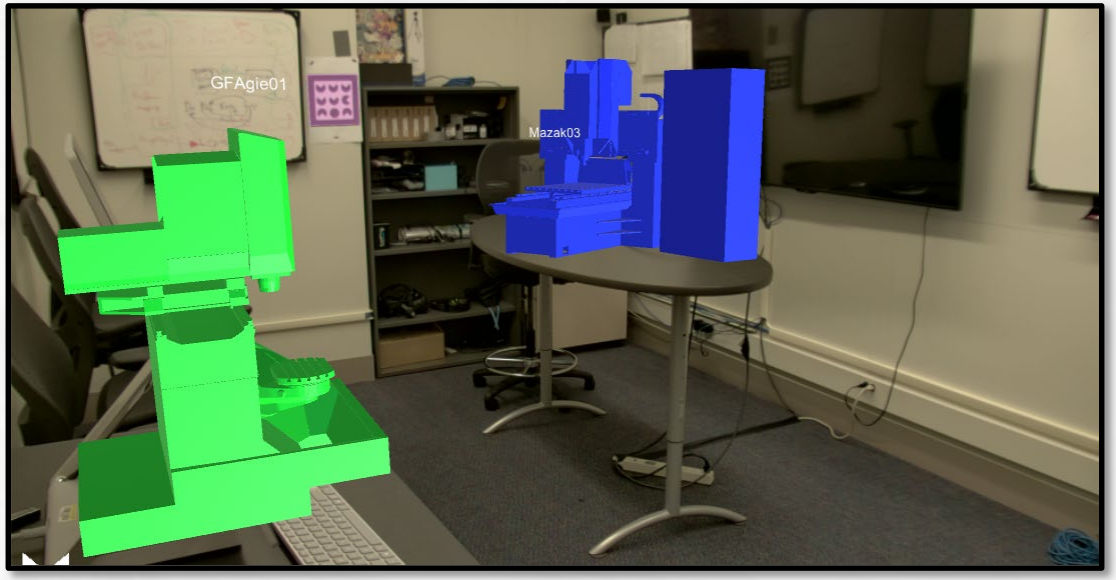


Track the room rather than individual objects

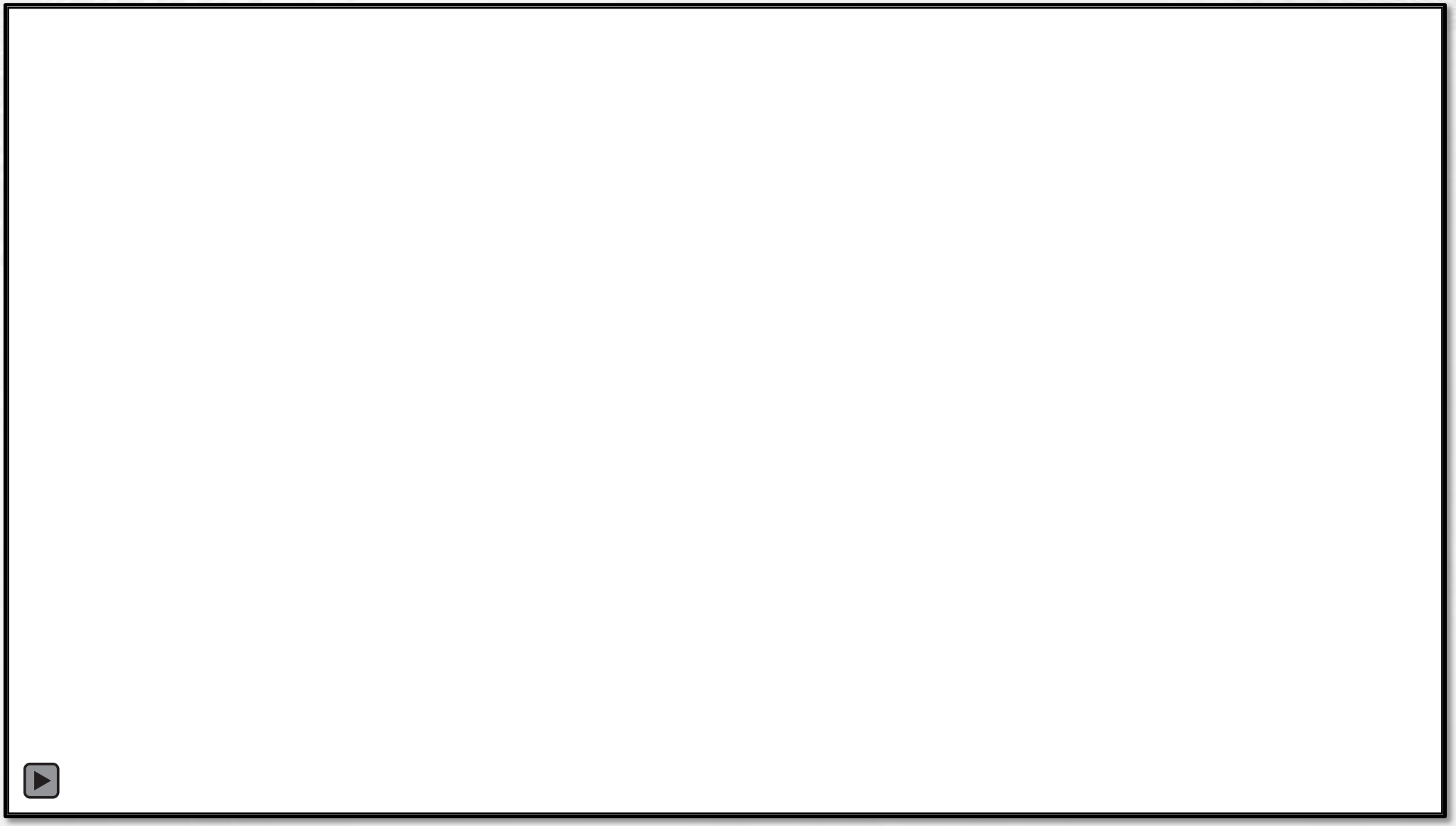


Second Iteration





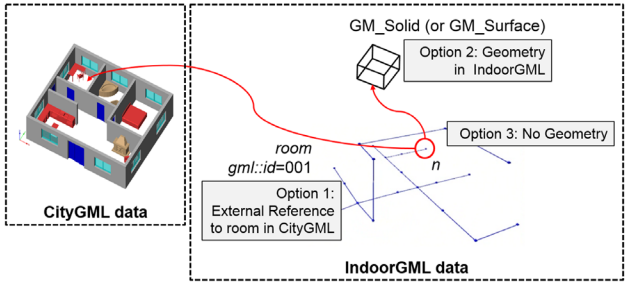
Second Iteration



Opportunities

Incorporating Standard Geospatial Representations

OGC®
Making location count.



Addressing Technology Transfer Challenges

vuforia™

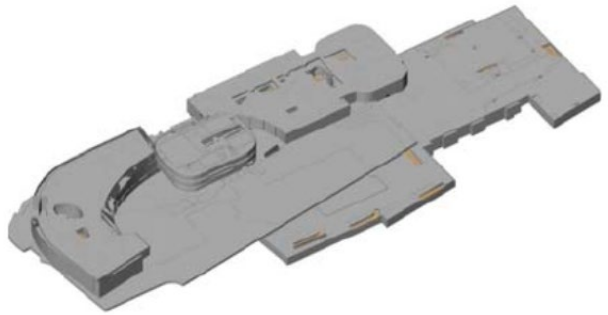
ARCore

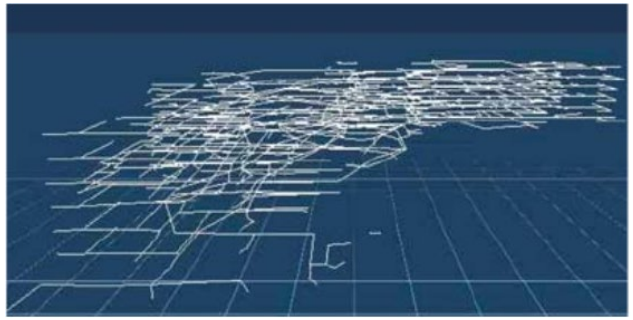
ARKit

Microsoft

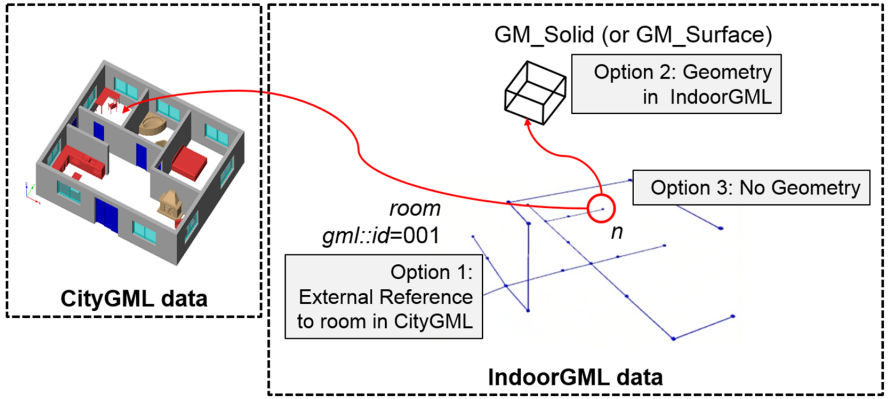
Standard Geospatial Representations

CityGML vs IndoorGML





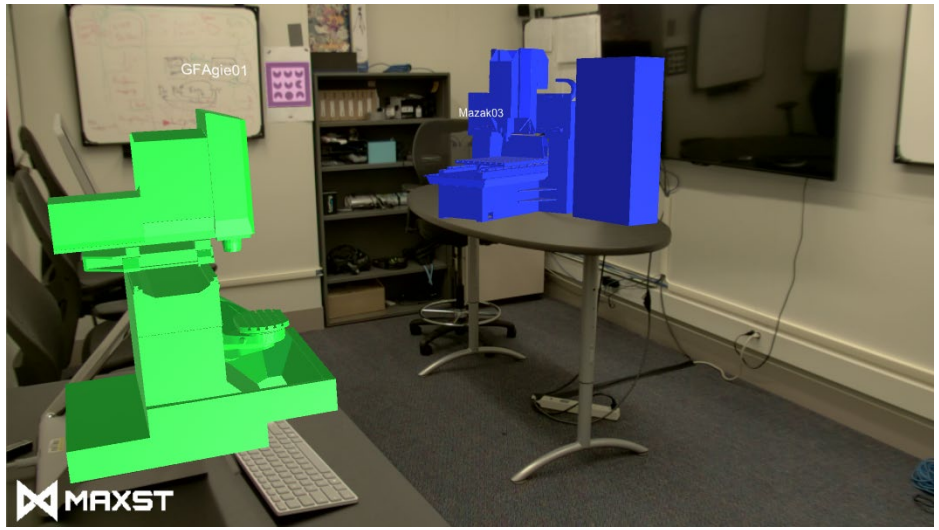
Integration of the Two Standards



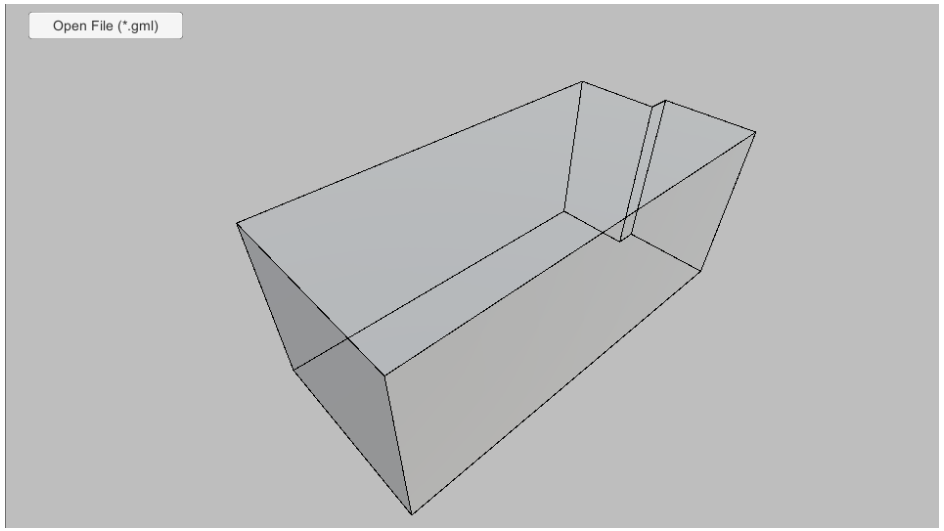
Ryoo et al. 2015 Comparison between two OGC standards for indoor space - CityGML and IndoorGML

Standard Geospatial Representations – DIVE Lab

Digital Information Visualization and Exploration (DIVE) Lab



IndoorGML representation of the DIVE Lab



Standard Geospatial Representations – Example

Interoperability and Scalability

Devices and Sensors

Frameworks

vuforia™

ARCore

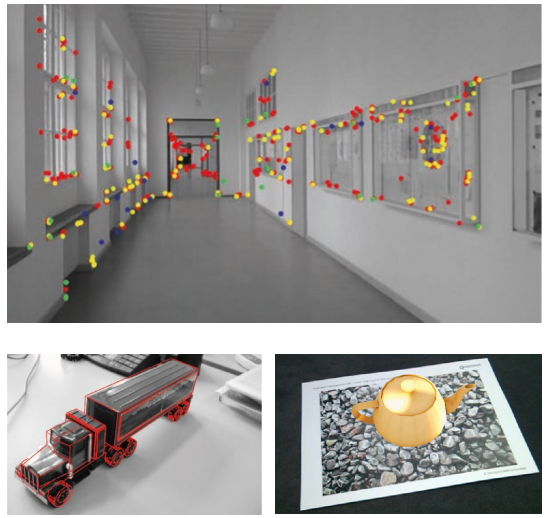
ARKit

wikitude
See more.

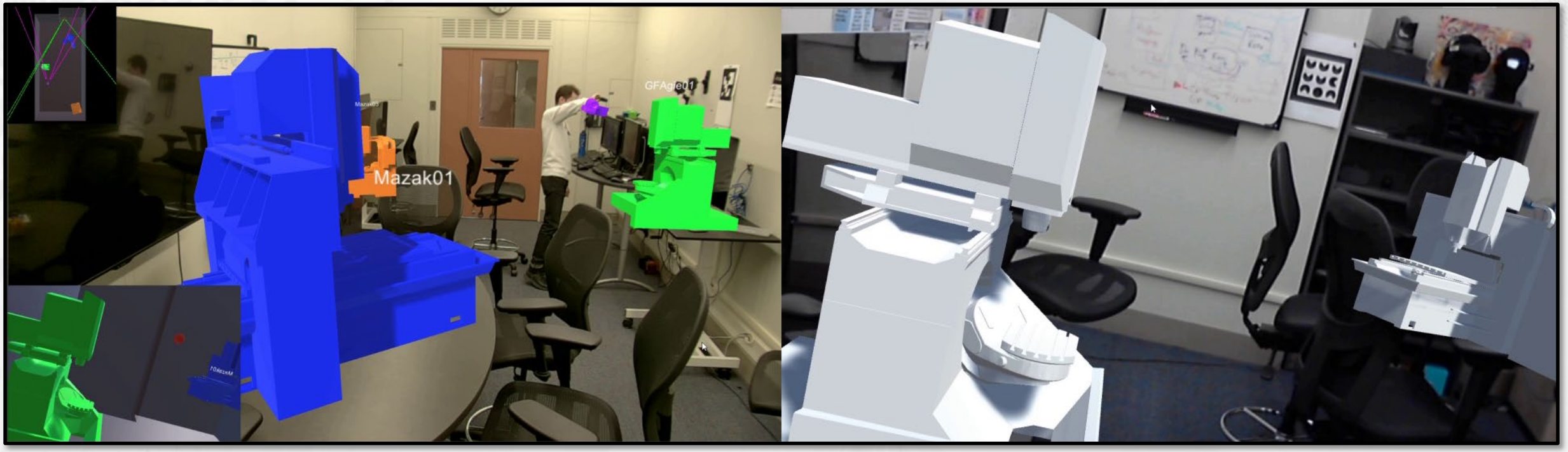
Windows Mixed Reality

MAXST

Algorithms



Interoperability and Scalability



wikitude
See more.

Marker-less “Instant” Tracking

vuforia™

Marker Tracking

Interoperability and Scalability – Demo

Marker-less “Instant” Tracking

Marker Tracking

Takeaways

- Situational awareness can be guided by geospatial representations
- Interoperability related challenges need to be addressed
- Future work is needed in testing scalability and maintainability