



HAL
open science

Creating a virtual reality serious game using a domain specific language for interactive 3D environments

Florent Alain Sauveur Robert, Marco Winckler, Hui-Yin Wu, Lucile Sassatelli, Barthélemy Passin-Cauneau, Brice Graulier, Théo Fafet

► To cite this version:

Florent Alain Sauveur Robert, Marco Winckler, Hui-Yin Wu, Lucile Sassatelli, Barthélemy Passin-Cauneau, et al.. Creating a virtual reality serious game using a domain specific language for interactive 3D environments. IMX 2021 - XR in Games, Jun 2021, New York, United States. hal-03464417

HAL Id: hal-03464417

<https://inria.hal.science/hal-03464417>

Submitted on 1 Apr 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Creating a virtual reality serious game using a domain specific language for interactive 3D environments

Florent Robert, Marco Winckler, Hui-Yin Wu, Lucile Sassatelli,
Barthélemy Passin-Cauneau, Brice Graulier, Théo Fafet





Summary

- Context and related works
- Challenges
- A domain specific language approach
- Perspectives



Context and related work

Serious game in immersive environment

Virtual reality

Place players in immersive environment

- Enjoy 360 ° video & film
- Interact with objects in an environment

Allows players to experience lifelike scenarios in interactive environments, useful in different cases

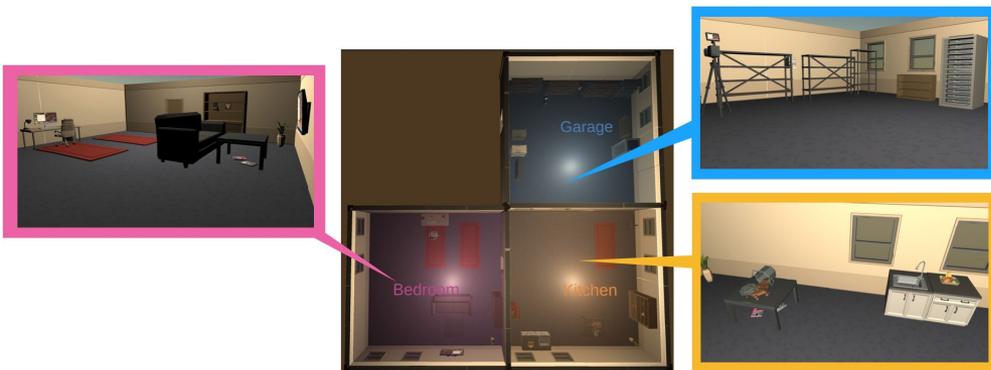
- Game
- Training
- Education
- ...



Serious game

A serious game for training and rehabilitation of users with low vision, using two different environments

- Complex environment (house interior)
- Dangerous environment (city exterior)



State of art

Some solutions already exist

X3D (Daly & Brutzman 2007), DSL for 3D content :

- XML based language usable for VR
- Describe 3D environnement (texture, position, rotation, ...)

Low level language, doesn't describe :

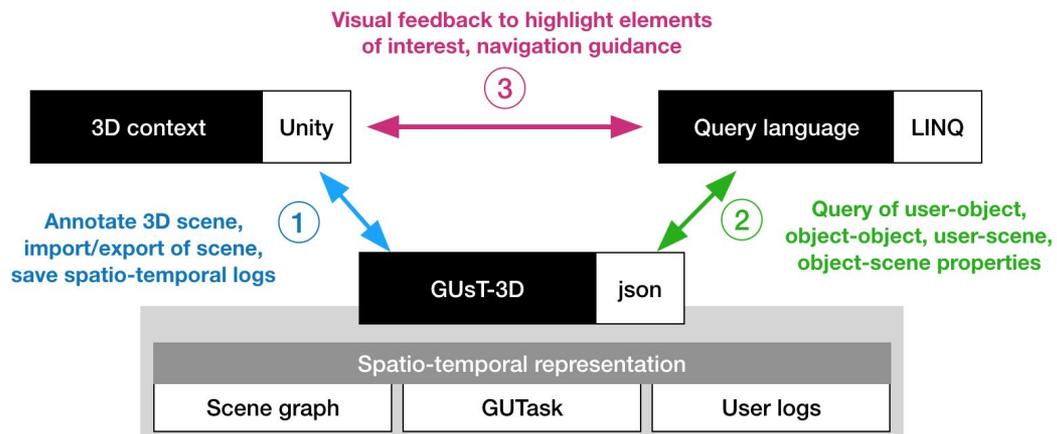
- Object relations and interactive properties
- How the user perceives, interacts



System for serious game creation

Tool to create serious game DSL
oriented on describing interactions

- Creation of interactive environment
- Creation of game scenario
- Guidance of user during scenario
- Analysis of user experience





Challenges

Creation of scenario in interactive environment

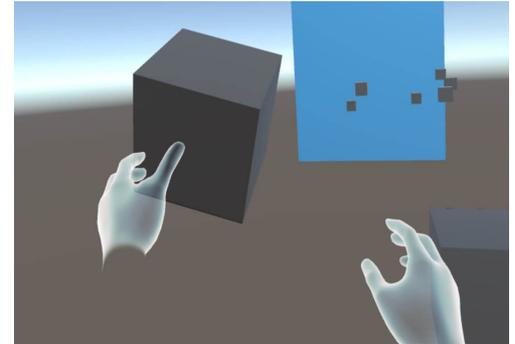
Building a serious game in virtual reality

Creation present two main complex points:

- Interactive environment
- Game scenario

Analyse the experience to give feedback

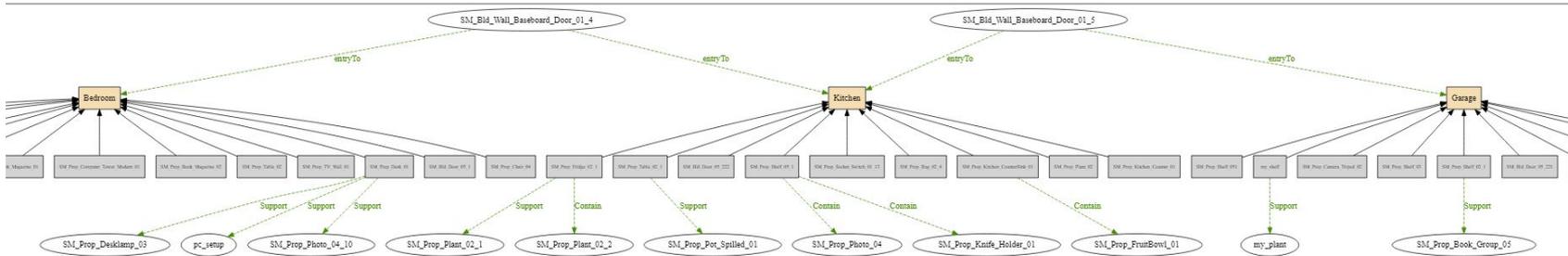
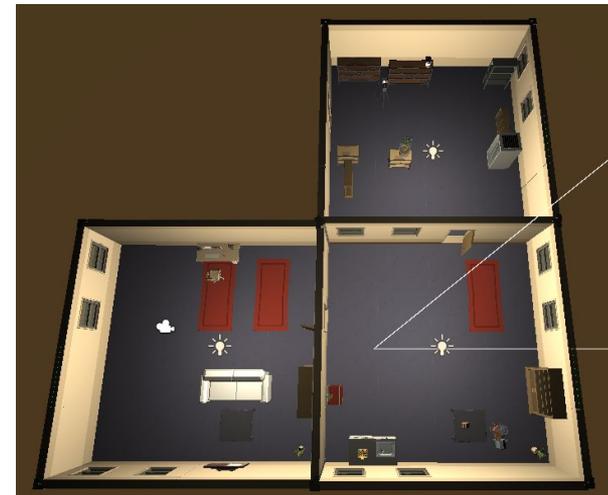
- Record the experience
- Analyse the record



Interactive environment

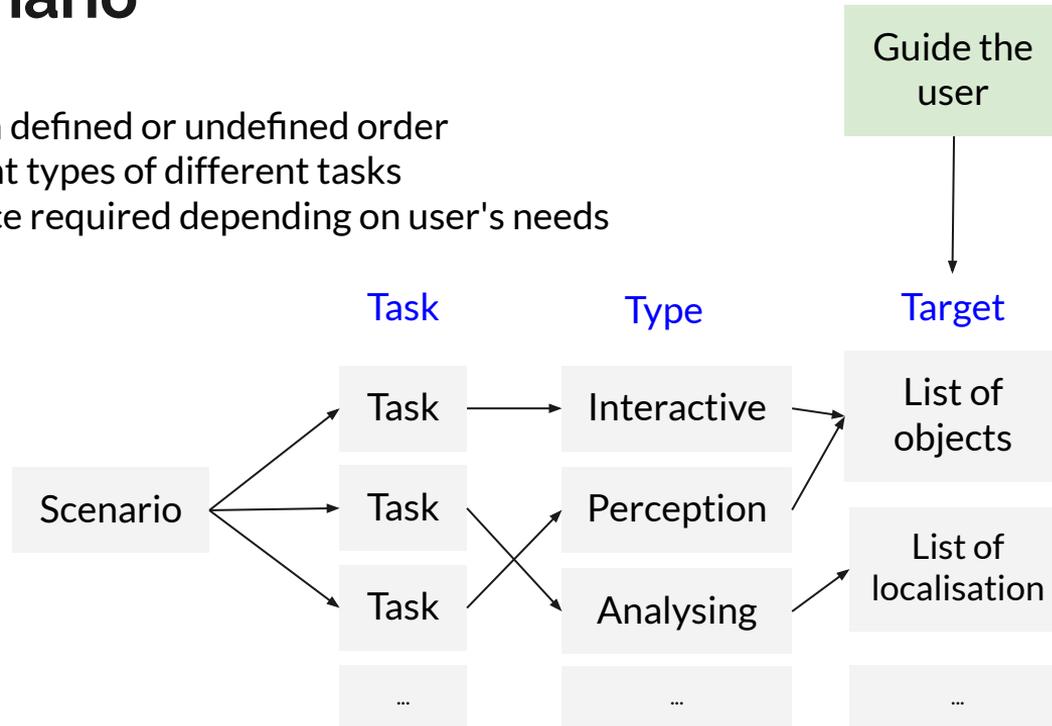
- Complexities:
 - Large number of objects
 - All unique properties and interactions
 - Walls / Objects obstruct player's view

The development team will have to work on each object



Game scenario

- Complexities :
 - Task in a defined or undefined order
 - Different types of different tasks
 - Guidance required depending on user's needs





A domain specific language approach



Proposed solution

Tool using a DSL to describe the environment and its properties, focusing on interactions

- Annotate objects in the scene
- Creating tasks using DSL
- Record user actions and interaction

Gain of time for the development team on the creation of interactives environments and scenarios

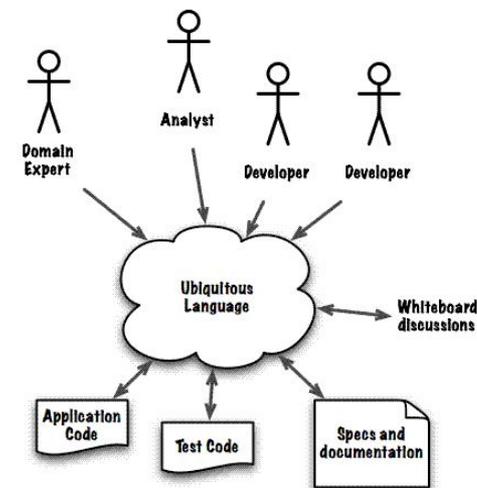


A domain specific language ?

Programming language with specifications designed to meet the constraints of a specific application area

DSL oriented on describing interactions between objects composing a 3D scene and the player

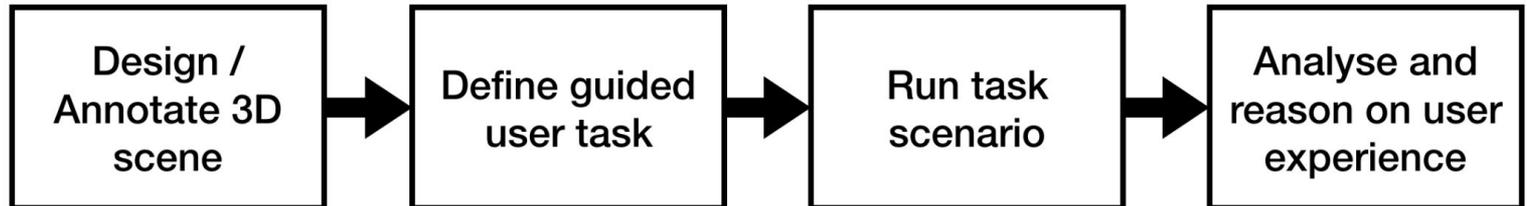
- +
 - Syntax represent any concept to use with the domain
 - Experts modify without programming knowledge
- -
 - Cost linked to the production and its maintenance
 - Performance, use processor time less efficiently





Solution

- Define the layers
- Annotate the scene
- Create a scenario
- Play the scenario
- Analyse the user experience





Defining the layers

The different types of objects understood by the language

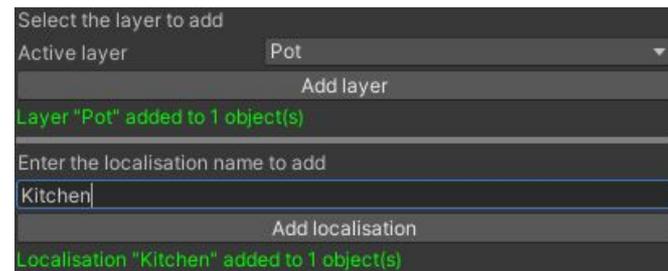
- Explain the domain
- Can be extended as needed

```
Layers  
Camera  
User [Camera]  
Support  
Ground [Support]  
Container  
Obstacle  
Wall [Obstacle]  
Movable  
Entryway  
Prop [Movable]  
Door [Entryway]  
Bookshelf [Support,Container]  
Plant [Prop]
```

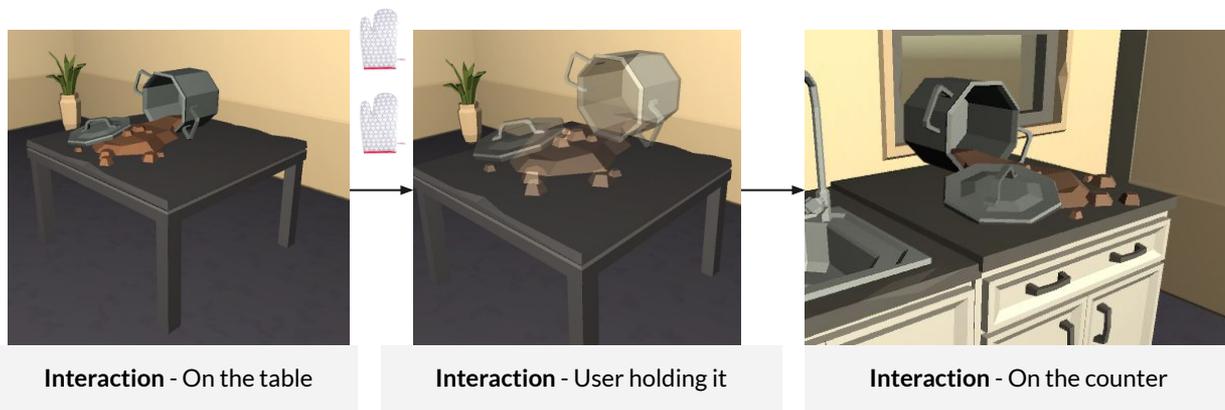
Annotation of objects

- Describes the scene by annotating objects
- Language that can be extended

Allows actions without being predefined



Pot
 Layers - Movable, Hot

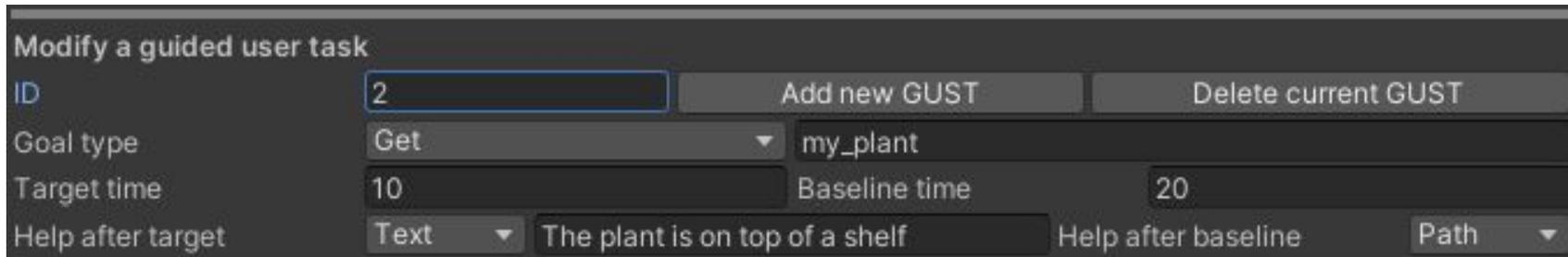




Creation of scenario tasks

Creation of tasks for a scenario

- Type of goal
- Time limits
- Help provided

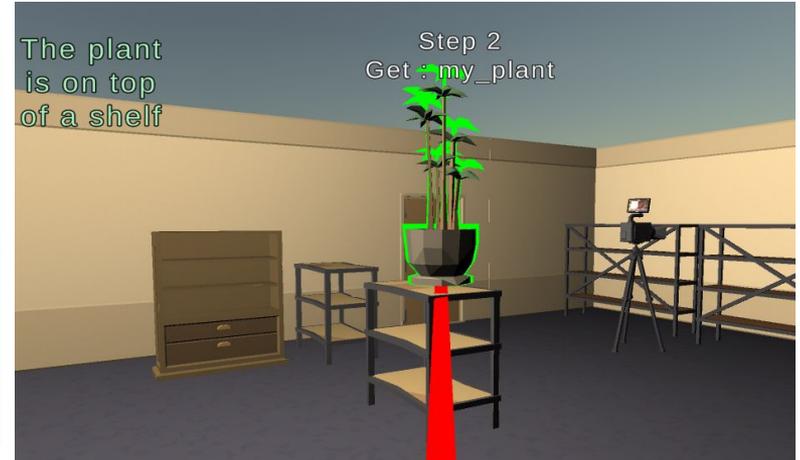


Modify a guided user task

ID	<input type="text" value="2"/>	<input type="button" value="Add new GUST"/>	<input type="button" value="Delete current GUST"/>
Goal type	<input type="text" value="Get"/>	<input type="text" value="my_plant"/>	
Target time	<input type="text" value="10"/>	Baseline time	<input type="text" value="20"/>
Help after target	<input type="text" value="Text"/>	<input type="text" value="The plant is on top of a shelf"/>	Help after baseline <input type="text" value="Path"/>

Creation of scenario tasks

- 1/ Go to the garage
- 2/ Get my_plant
- 3/ Go to the bedroom
- 4/ Place my_plant on my_desk



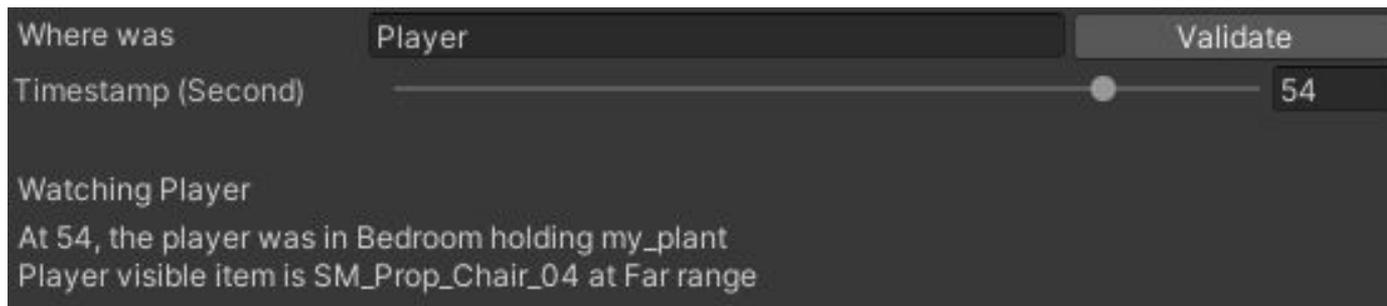


Logs

Analyzing logs to check over time :

- Player action and interaction with the environment
- Player localisation in the environment
- Player visible items and range distance

Allow development team to analyse user experience



Jeff Sauro. 2010. MeasuringU: 5-second usability tests.



Results

KLM-GOMS preliminaries results

- Type of task
- Time estimate

Simulates scenario time

Description	Operator	Duration (s)
Mentally prepare (by heuristic rule 0)	M	1.35
Move cursor to <i>departure</i>	P	1.10
Click mouse button	K	0.20
Mentally prepare (by heuristic rule 0)	M	1.35
Move cursor to <i>origin</i>	P	1.10
Click mouse button	K	0.20
Move hands to keyboard	H	0.40
Press <i>p</i> key	K	0.20
Press <i>a</i> key	K	0.20
Press <i>r</i> key	K	0.20
Press <i>down arrow</i> key	K	0.20
Press <i>enter</i> key	K	0.20
Press <i>enter</i> key	K	0.20
Total time predicted		6.90

Results

Preliminaries results with 10 objects :

- Annotate objects
- Create scene graph
- Record experience
- Analyse experience

With GUsT-3D DSL			Without GUsT-3D DSL		
Type	Description	time	Type	Description	time
K	Open the Unity scene	0.2	K	Open the Unity scene	0.2
P	Move mouse cursor to the PFE menu option	1.1	-	Create and complete scripts to store all layer and localisation options	S
K	Select PFE menu	0.2	-	-	-
P	Move to the "Layer assign" window	1.1	-	-	-
M	Identify objects to annotate	1.35	M	Identify objects to annotate	1.35
P*n	Move cursor to objects to annotate	1.1*n	P*n	Move cursor to objects to annotate	1.1*n
K*n	Select objects to annotate	0.2*n	K*n	Select objects to annotate	0.2*n
P	Move the cursor to the layer field	1.1	P*n	Attach a layer script to each object	1.1*n
H	Select a layer	0.4	K*n	Type in the layer name	2*n
P	Move cursor to "Add Layer" button	1.1	-	-	-
K	Click "Add Layer" button	0.2	-	-	-
P	Move the cursor to the localisation field	1.1	P*n	Attach a localisation script to each object	1.1*n
K	Enter a localisation	2	K*n	Type in the layer name	2*n
P	Move cursor to "Add Localisation" button	1.1	-	-	-
K	Click "Add Localisation" button	0.2	-	-	-
Total time: 11.15 + 1.3*n (24.15 for n = 10)			Total time: 1.55 + 7.5*n + S (76.55 + S for n = 10)		



Perspectives

Perspective

Provide help for

- Creation of interactive environment
- Creation of game scenario
- Analyzing user experience

Useful in various domains

- Education
- Rehabilitation
- Training
- ...





Perspectives

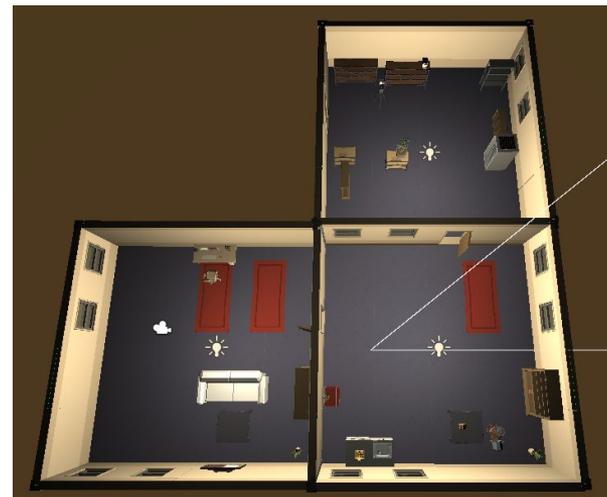
We are planning to do 2 case studies

- Complex environment (house interior)
- Dangerous environment (city exterior)

Applicable in any domain to

- Generate content dynamically
- Understand user experience
- Describe 3D environment with a vocabulary

Interested by using it in a specific domain





Thanks you for your attention