

How Useful are Virtual Reality Simulations to the Field of Crime Prevention Through Environmental Design? Case study

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Outline of the research

Why :

Can we utilizing the VR simulation beyond the representation tool in CPTED?

What :

To test-out the VR simulation as a part of the design process

Analyze user experiences in the site and the VR simulation

How:

Build 3D model thru 3D MAX

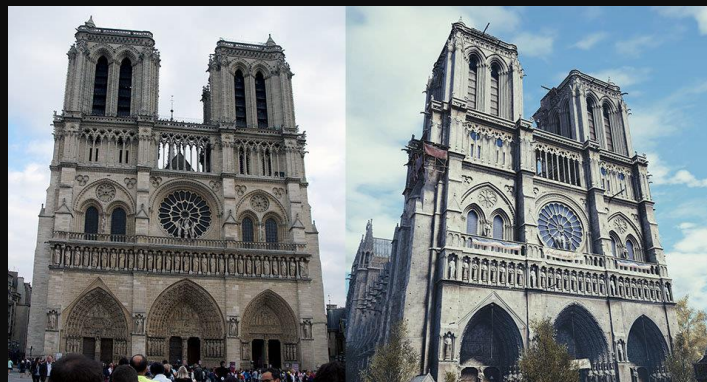
VR simulation by Unreal Engine 4

Evaluate the simulation.by Surveys & Interviews



Gravity Sketch

<https://www.youtube.com/watch?v=tbzE9z4HE2k>



Assassin's Creed Unity

<https://www.dexerto.fr/general/assassins-creed-unity>



Lumion VR

<https://www.youtube.com/watch?v=ACGgYwVc3zU>



VR Sketch Extension

<https://extensions.sketchup.com/en/content/lightscape-vr-designer>



360 Panoramic Park VR

<https://www.360vrs.com/360-panorama/welland-park-rose-garden-4/>



Twinmotion VR

<http://www.masonrydesignmagazine.com/virtual-reality-twinmotion-2018-real-time-vr-software-architects-designers/>

VR Design

Representation

Visual Simulation

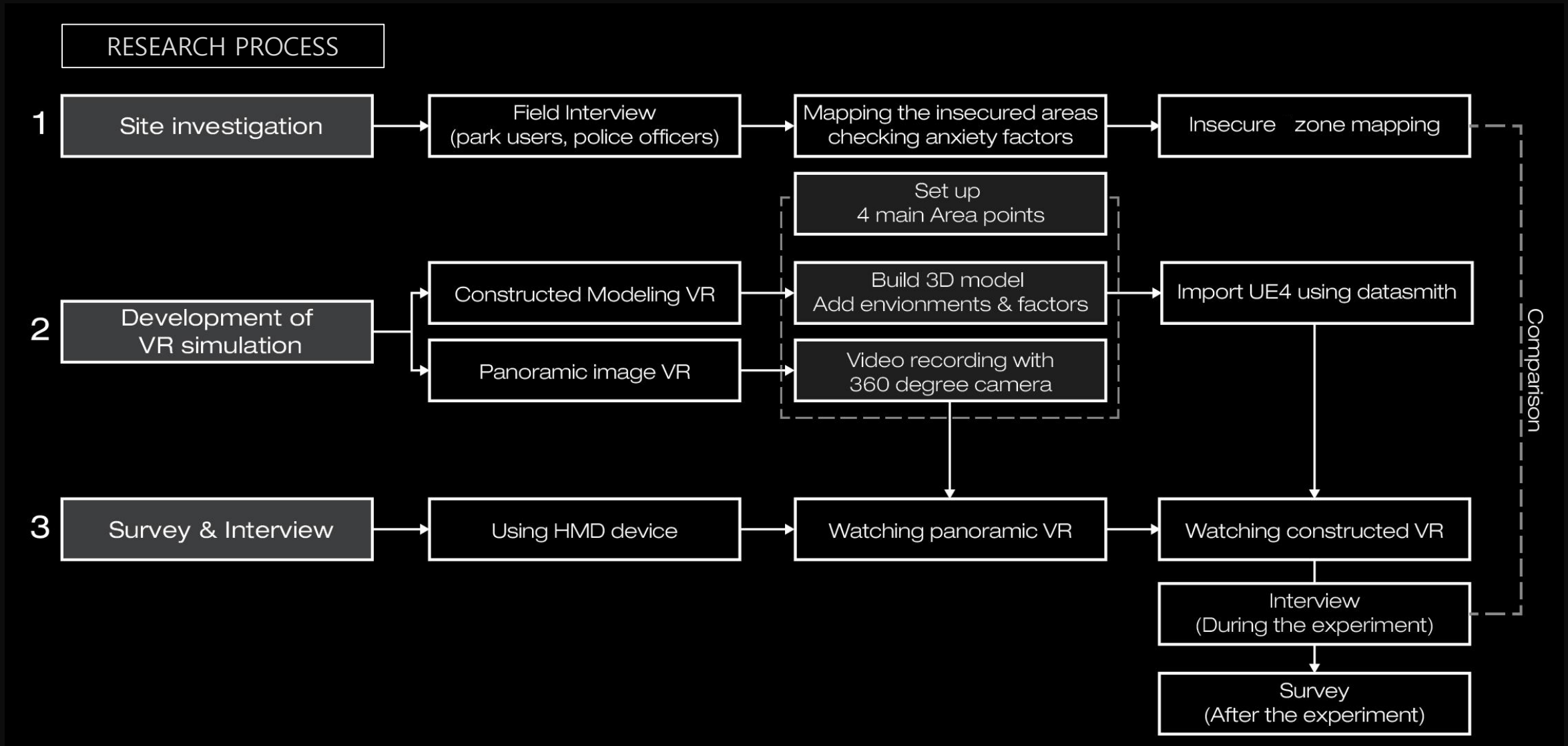
CPTED: Crime Prevention Through Environmental Design

Natural surveillance

- Natural surveillance is the arrangement of trees, buildings and facilities to maximize **visibility**.
- Create landscape designs that provide surveillance, especially in proximity to designated points of entry and opportunistic points of entry.
- When creating **lighting design**, avoid poorly placed lights that create **blind-spots** for potential observers and miss critical areas.

Why Virtual Reality is needed in CPTED?

- Represent non-physical elements(Lights, shadows, blind spots) and situations that can be threatened .
- Need the tool for testing non-physical factors such as lights, shadows, blind spots.
- Can represent of replication of homeless people, stranger's appearance like some unexpected situations can threat the people.
- Can be used as a part of the design process, not just in simple visual simulation.



RESEARCH PROCESS

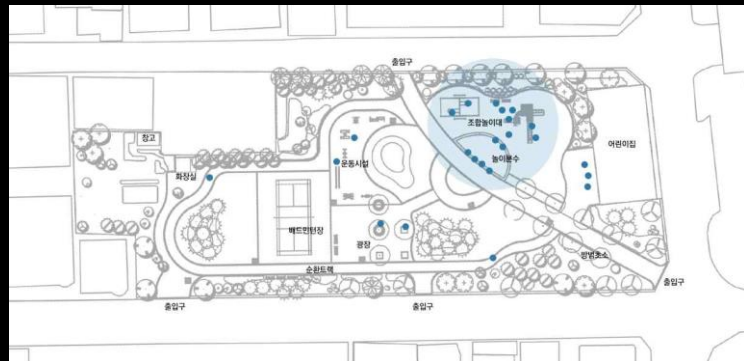
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Site investigation

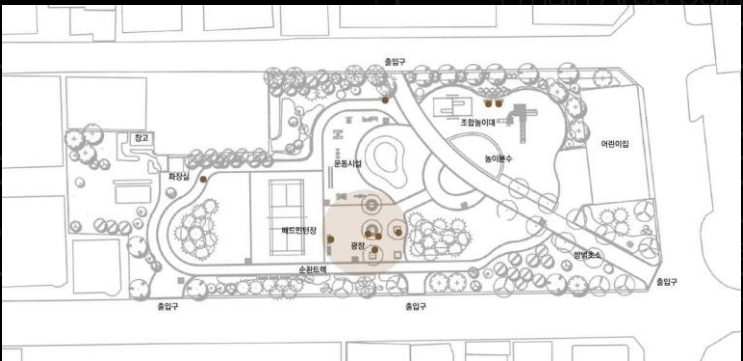
Field Interview
(park users, police officers)

Mapping the insecure areas
checking anxiety factors

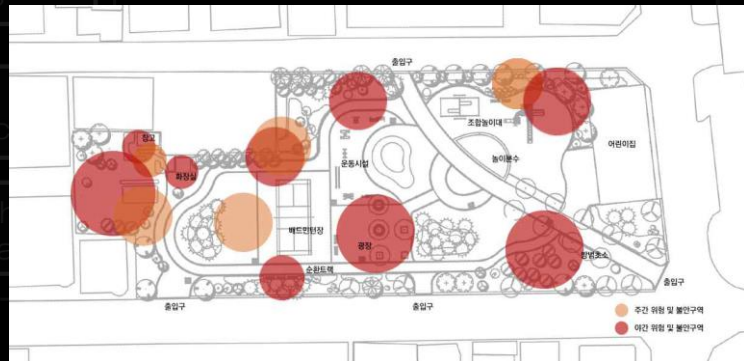
Insecured zone mapping



Daytime use mapping



Nighttime use mapping



Insecure zone mapping

3

Survey & Interview

Using HMD device

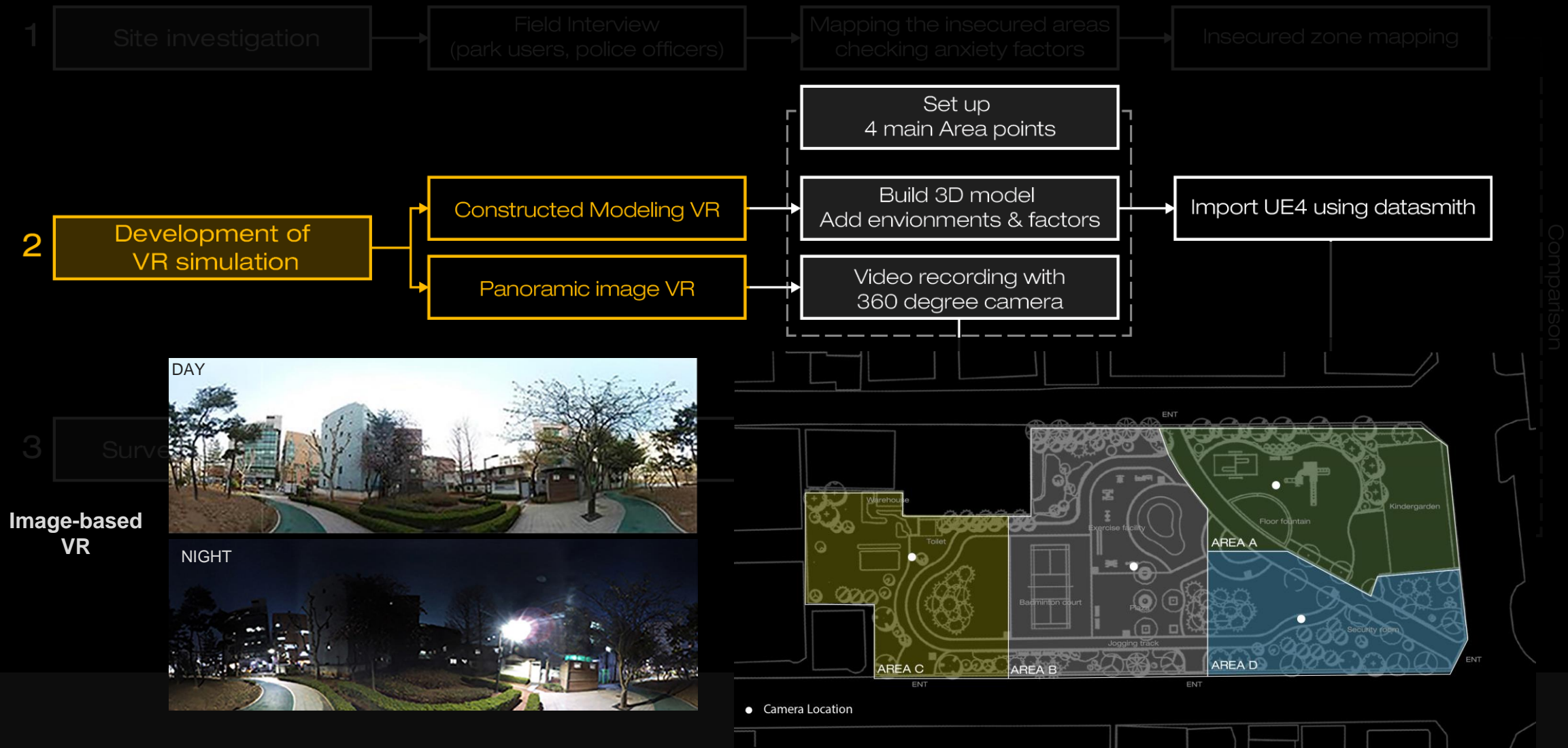
Watching panoramic VR

Watching constructed VR

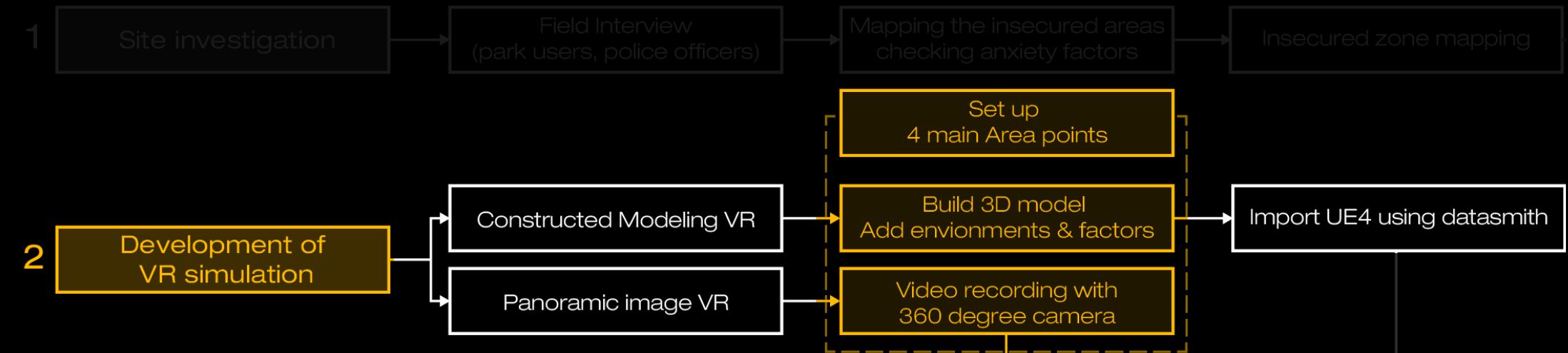
Interview
(During the experiment)

Survey
(After the experiment)

RESEARCH PROCESS

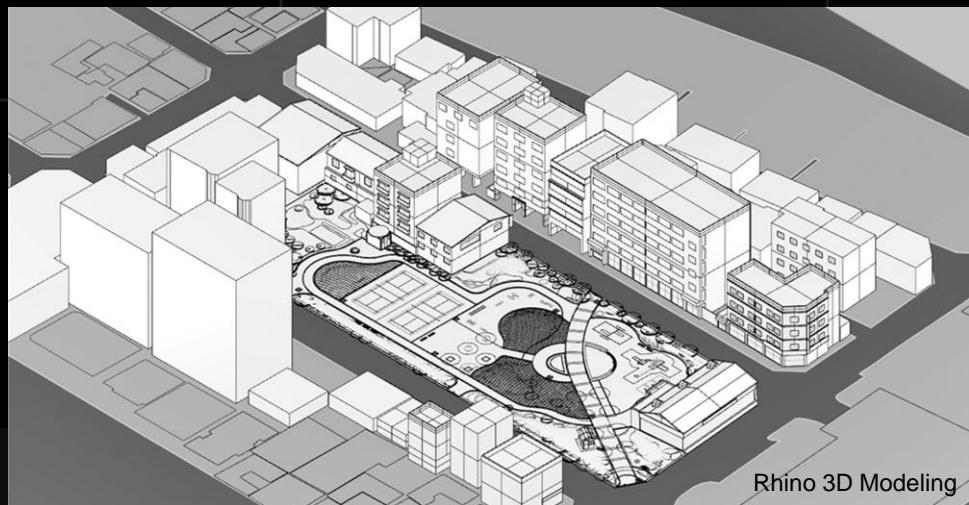


RESEARCH PROCESS



3 Survey

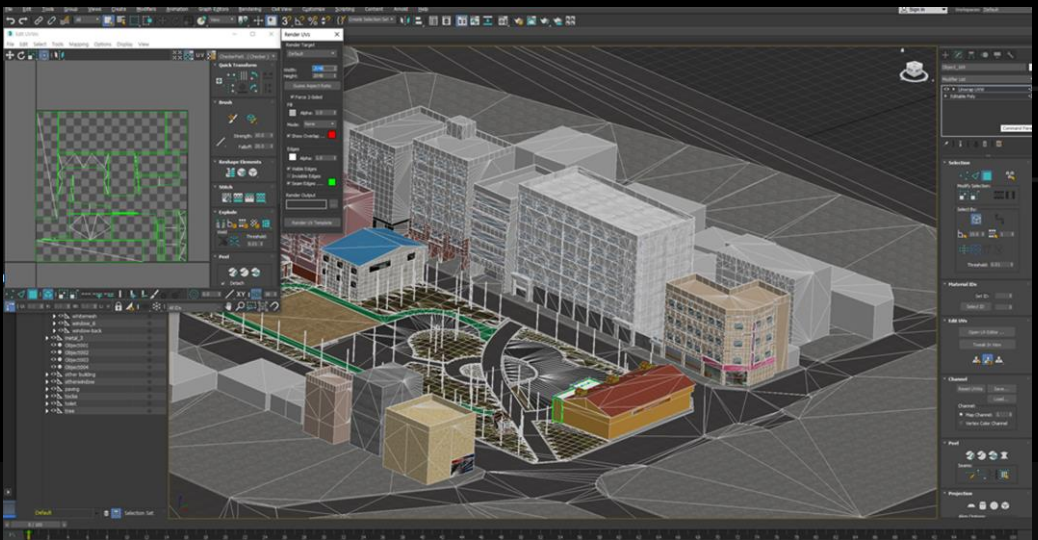
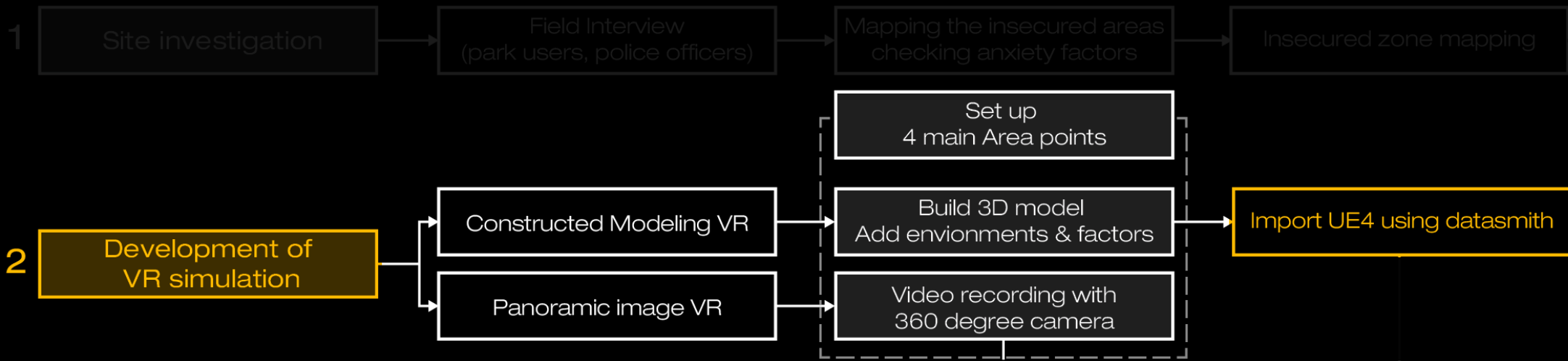
Model-based VR



Rhino 3D Modeling

Comparison

RESEARCH PROCESS



3DS MAX



UNREAL ENGINE 4

RESEARCH PROCESS



3

Survey & Interview

Using HMD device

Watching panoramic VR

Watching constructed VR

Interview
(During the experiment)

Survey
(After the experiment)



HMD Device: HTC VIVE

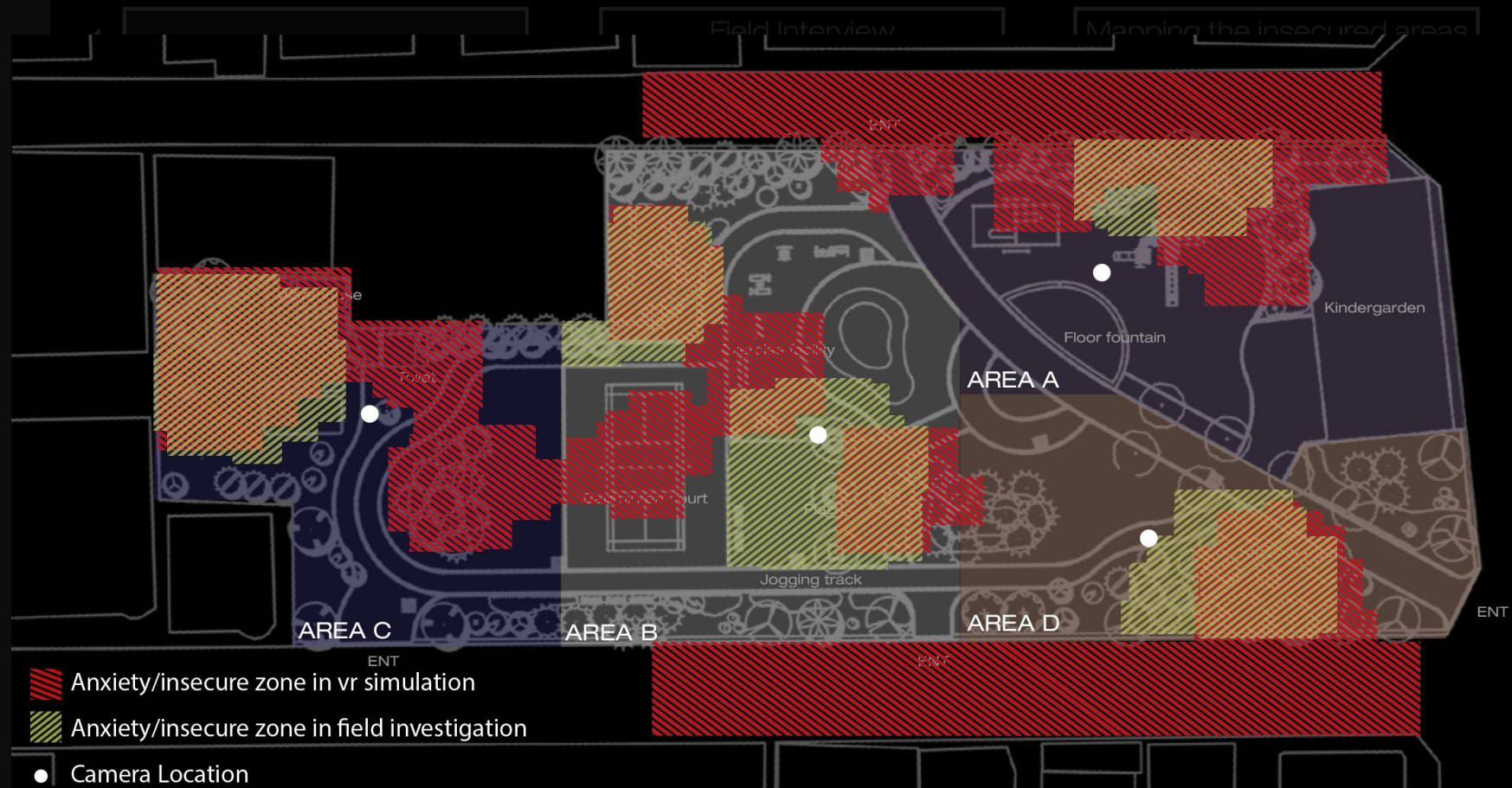




Level: VR_NIGHT_vrmode (Persistent)
UNREAL ENGINE 4
VR Simulation Video- Nighttime

TESTING RESULT

Comparison of anxiety locations in real space and virtual space



Insecure zone mapping

Import UE4 using datasmith

Watching constructed VR

Interview
(During the experiment)

Survey
(After the experiment)

Comparison

RESEARCH RESULT

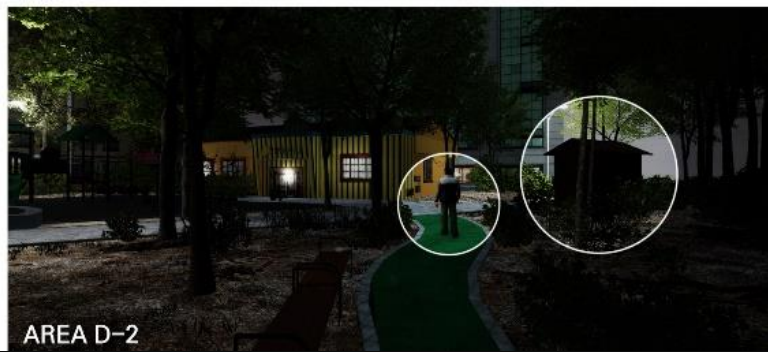
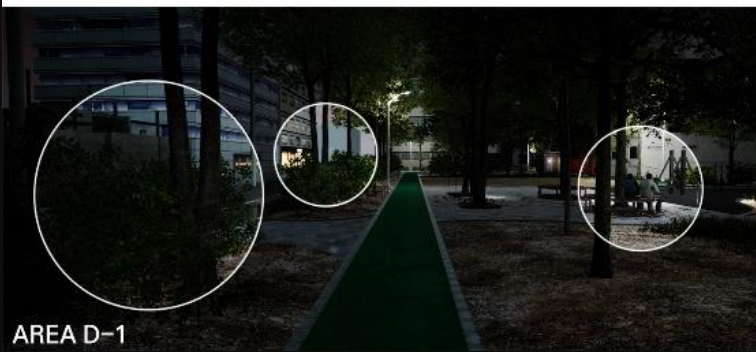
Insecure factors in Areas A to D in screen-captured views



Area	Anxiety Factors	Participants responded (%)
A	1. Darkness caused by the absence of streetlight	96.7
	2. Shielding/boundary planting of trees	86.7
	3. Presence or absence of building light	80.0
	4. Presence or absence of park users	73.3
	5. The form and materials of the building	60.0
	6. Shielding/boundary planting of shrubs	40.0
	7. Floor paving materials	26.7
	8. Parked vehicle	13.3
B	1. Homeless / drunken people	100
	2. Garbage (bottles, cigarette butts, newspaper)	80.0
	3. Presence or absence of park users	70.0
	4. Tree (blocking the street lights)	46.7
	5. Shielding/boundary planting of shrubs	36.7
	6. Location of CCTV	30.0
	7. Empty security house	26.7
	8. The form and materials of the building	13.3

RESEARCH RESULT

Insecure factors in Areas A to D in screen-captured views



Area	Anxiety Factors	Participants Responded (%)
C	1. Darkness caused by the absence of streetlight	96.7
	2. Shielding/boundary planting of shrubs	96.7
	3. Empty temporary buildings	96.7
	4. A blind spot between buildings	90.0
	5. Presence or absence of building light	86.7
	6. Toilet	83.4
	7. Shielding/boundary planting of trees	73.3
	8. Distant homeless / drunken people	60.0
	9. The form and materials of the building	60.0
	10. Presence or absence of park users	26.7
D	1. Darkness caused by the absence of streetlight	96.7
	2. Empty security house	83.3
	3. Presence or absence of building light	70.0
	4. Shielding/boundary planting of trees	60.0
	5. The form and materials of the building	60.0
	6. Presence or absence of park users	40.0
	7. Shielding/boundary planting of shrubs	40.0
	8. Parked vehicle	40.0

RESEARCH RESULT

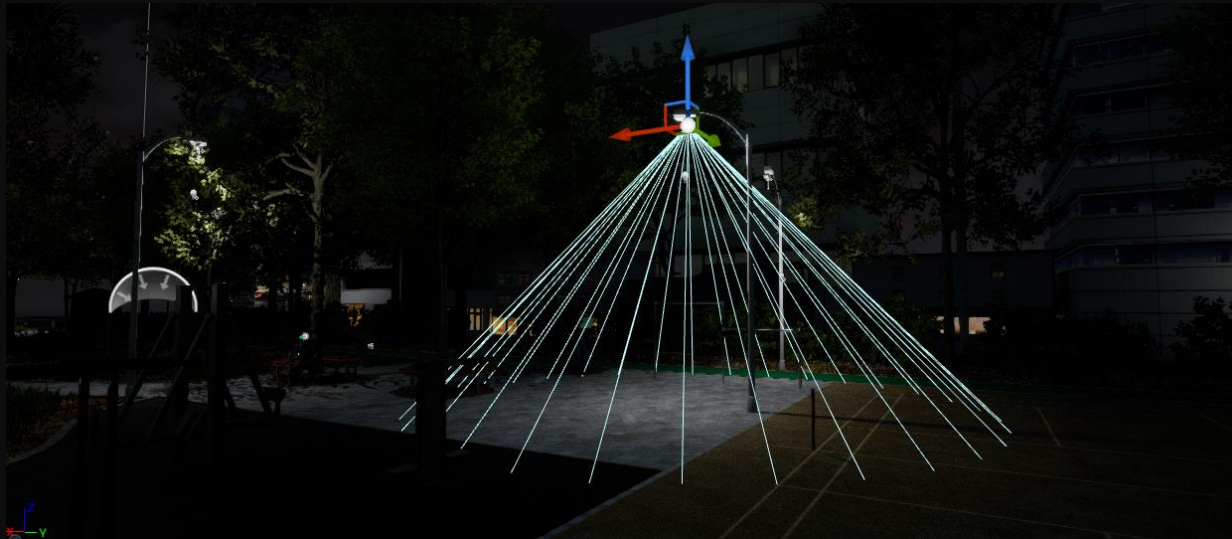
Survey results by categories

Category	Question	Average	SD
Materiality	1. Things look natural.	4.00	0.59
	2. The VR space looks like the real world.	3.47	0.82
Degree of actual environment	3. Daytime in panoramic video coincides with the VR simulation.	3.20	0.91
	4. Night-time in panoramic video coincides with the VR simulation.	3.87	0.78
Realistic Immersion	5. While experiencing the VR simulation, this place felt real.	4.23	0.73
	6. Upon experiencing the VR simulation, the park seemed to be real.	3.70	0.79
Unnaturalness	7. In the VR simulation, things, people, and trees felt artificial.	2.63	0.85
Fatigue	8. I felt dizzy while experiencing VR.	2.83	1.42
	9. Eye fatigue increased while wearing HMD	3.00	1.31
	10. I can focus on the VR simulation through HMD.	3.17	0.75
Screen quality	11. I can watch the view clearly while wearing HMD.	3.23	1.25
	12. The resolution of the HMD screen is high.	2.83	1.05

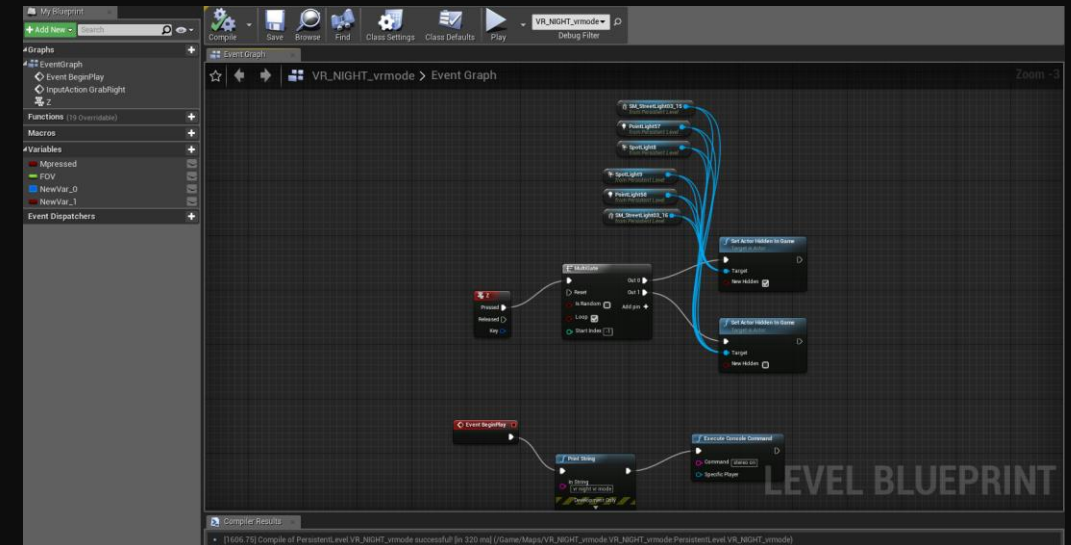
Likert Scale (1: strong negative, 5: strong positive)

Limitation

- Lacking of technical expertise such as 3D model's quality, lighting, animation, and Interaction.
- Need more detail questionnaire survey and statistics.



UNREAL ENGINE 4 – spotlight option



UNREAL ENGINE 4 – Blueprint script

