Initial Design on
VR-based Data Acquisition Environments for Human-Robot Interaction:
Scenarios and Functional Requirements

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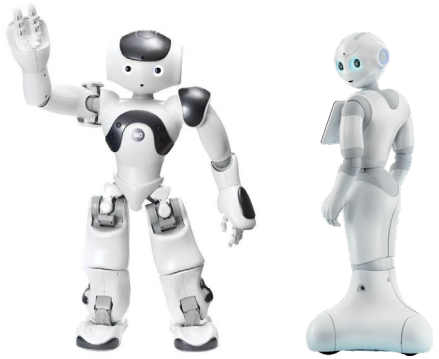
Agenda

- Motivation: VR-based Data Acquisition Environments
- Trend: Possession, HRI, Synthetic Dataset
- Proposed Solution
- Scenario-Centric and System Overview
- Progress Video
- Implement Details: Plan A, B, C
- Future Work

Motivation
:VR-based Data Acquisition Environments

Elderly people

Various Environments



Real Robots

Many difficulties are expected to acquire quality data in quantity for HRI research.

For example,

- **Financial and technical challenges** to prepare realistic environments, people, and robots considering various interaction scenarios
- Even with the huge amount of pre -recorded dataset, **new types of interaction scenarios** are always demanded in reality.

Key Trends of VR for HRI

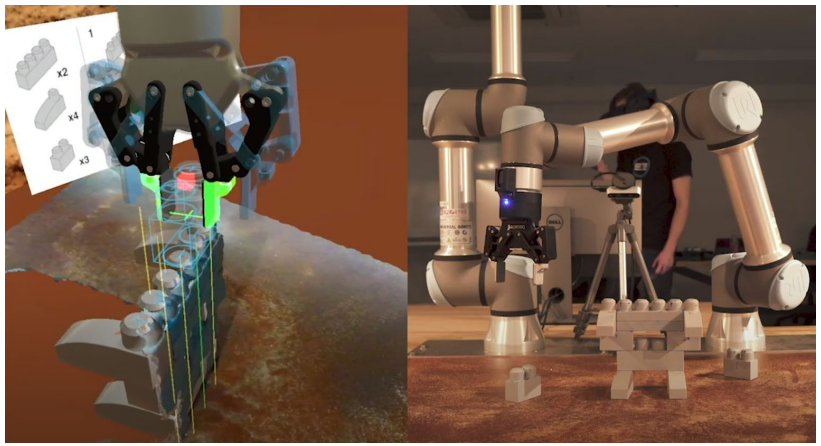
: Possession, HRI, Synthetic Dataset

Possession

[2019, IEEE SeGAH]
Analysis of Inverse Kinematics Solutions for Full-Body Reconstruction in Virtual Reality

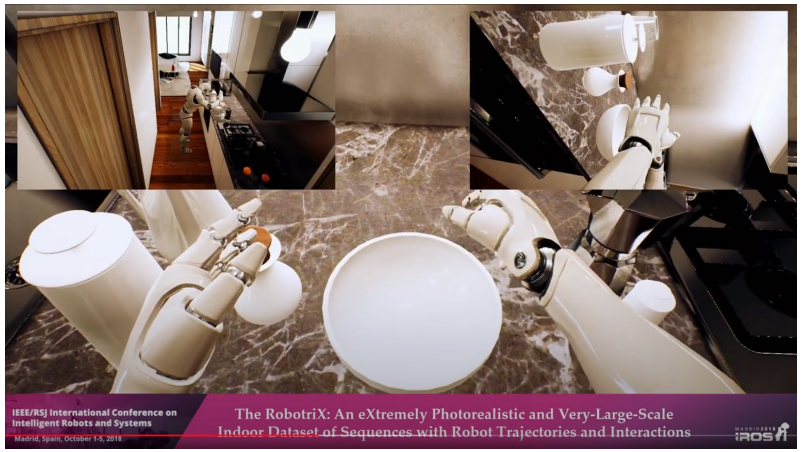
Human-Robot Interaction

[2019, ACM SIGGRAPH]
Spooky Action at a Distance, Real-Time VR Interaction for Non-Real-Time Remote Robotics



Synthetic Dataset

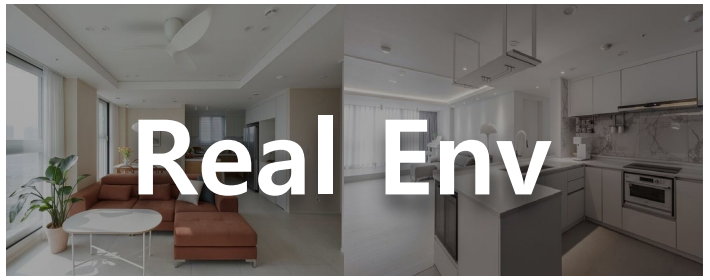
[2018, IEEE IROS]
The RobotriX: An Extremely Photorealistic and Very-Large-Scale Indoor Dataset of Sequences with Robot Trajectories and Interactions

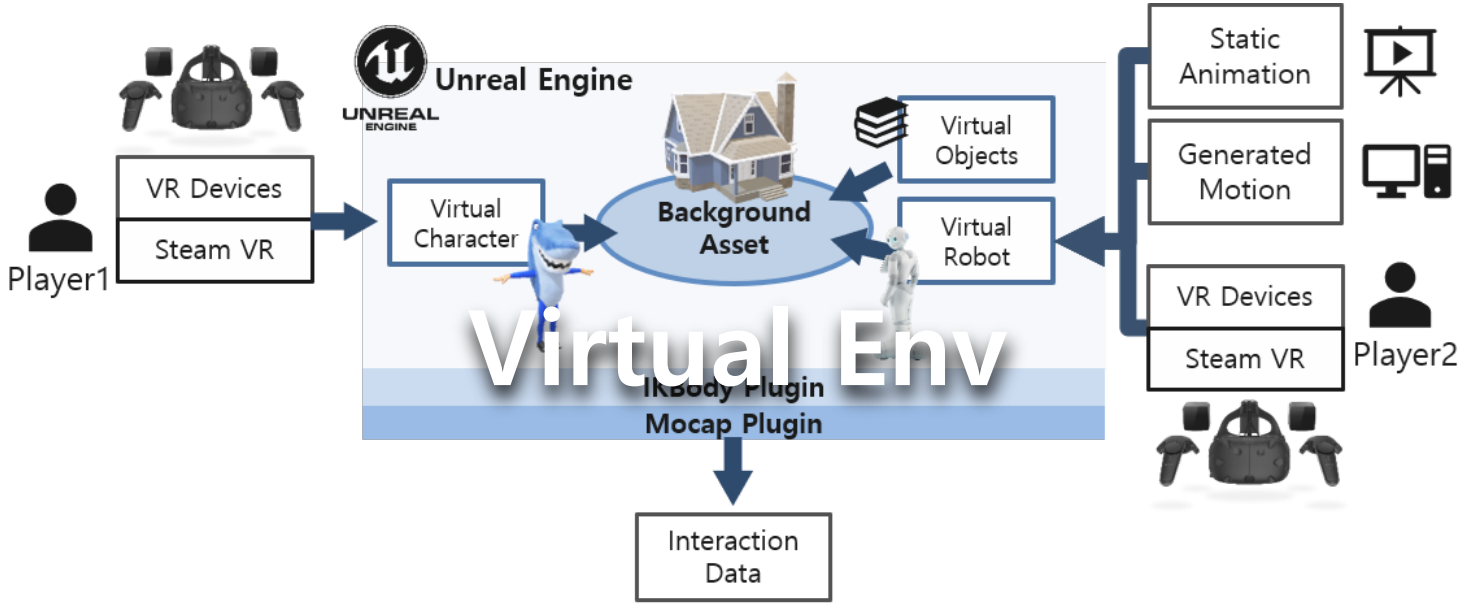


Proposed Solution

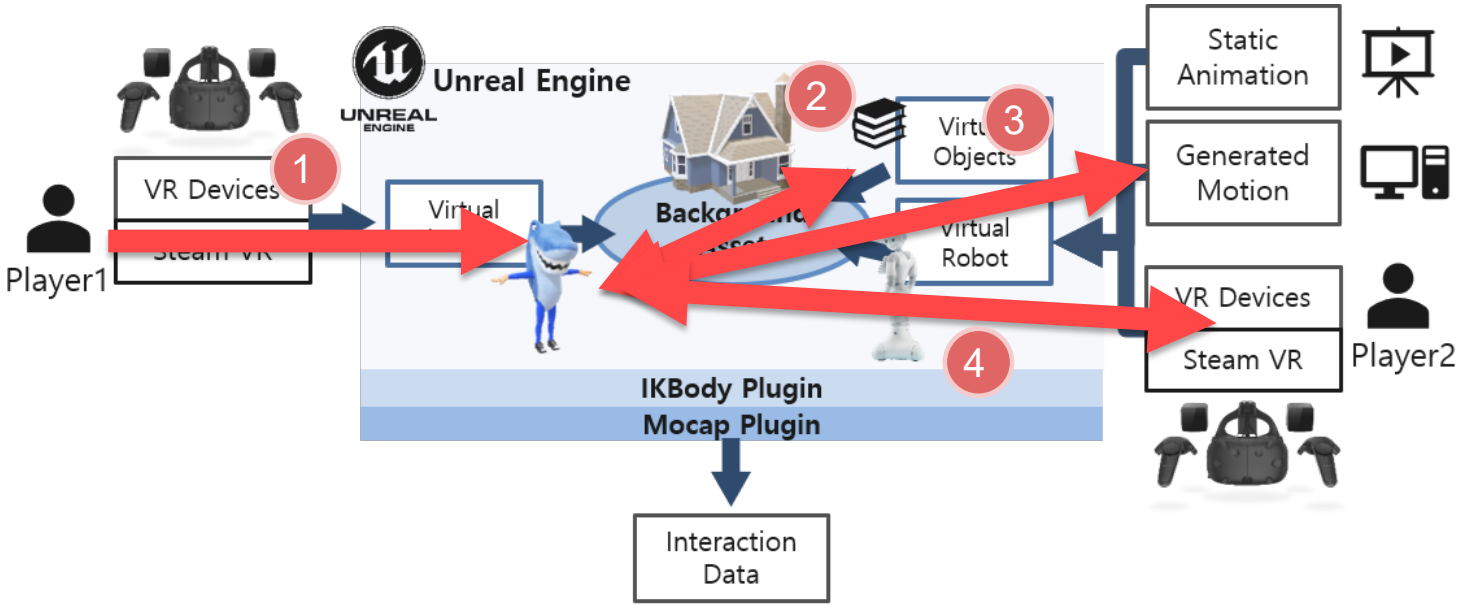
:VR-based Data Acquisition Environments

We propose a VR-based data acquisition environment to interactively generate quality HRI data while overcoming the various physical and financial constraints.



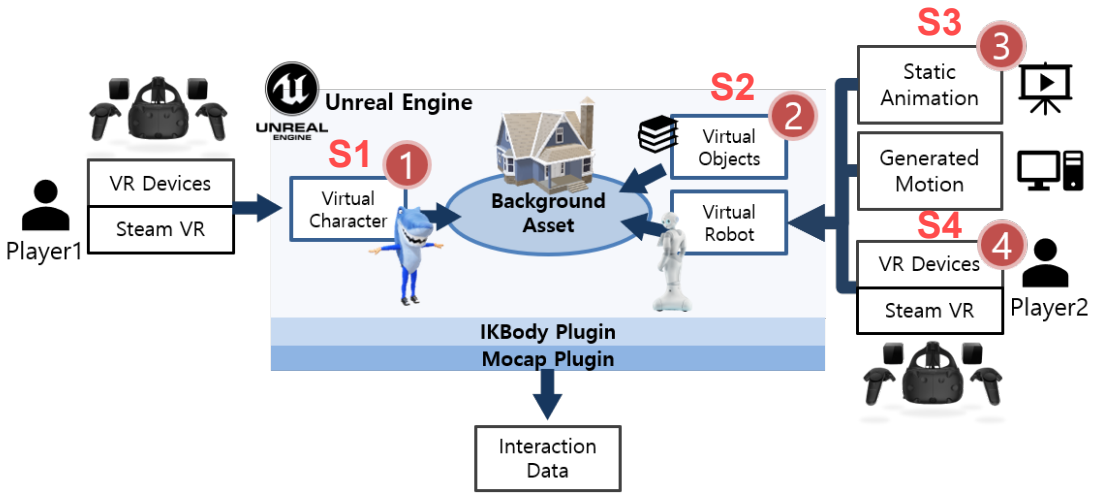


Scenario-Centric Views



1. Human Behavior
2. Human-Object interaction
3. Human-Robot interaction
4. Human-Human interaction

System Overview



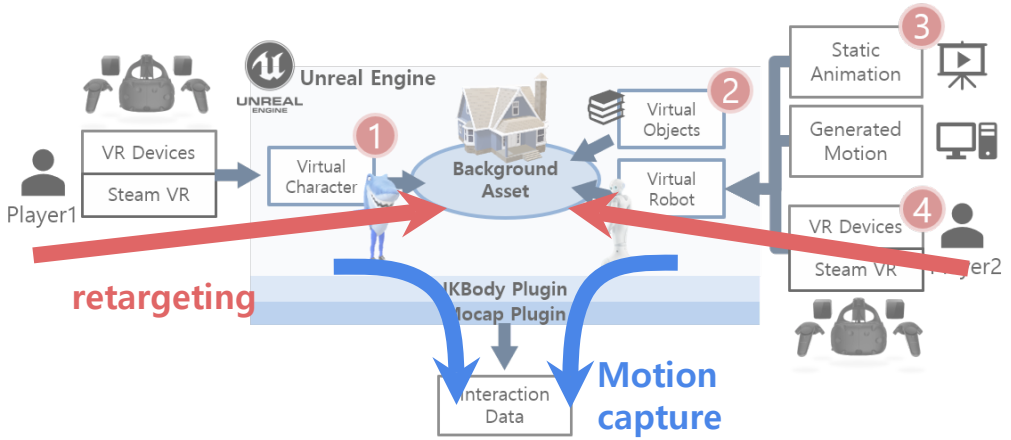
Items	Env.
OS	Windows 10
Game engine	Unreal Engine 4.25
Hardware	HTC Vive HMD, 2 Hand Controllers, 3 Vive Trackers
Languages	UE4 Blueprint
API	UE4 Blueprint API, Mocap Custom Plugin
Third party	UnrealCV
Data format	PNG, FBX, BVH

- ## Functional Requirements
  1. **S1.FR = [Possession, GUI, data saving]**
  2. S2.FR Interacting with object + S1.FR
  3. S3.FR Robot motion simulation, human reaction + S1.FR
  4. S4.FR Dual VR approach + S1.FR

- ## Organization of Dataset
  1. **S1.Data = [RGBD, Mask, Motion Data]**
  2. S2.Data Human-Object interaction pair Data + S1.Data
  3. S2.Data Human-Robot interaction pair Data + S1.Data
  4. S2.Data Human-Human interaction pair Data + S1.Data

Implementation Details - Low-level Functions

- Retargeting - from sensor to skeleton
- Motion Capture - from skeleton to data file



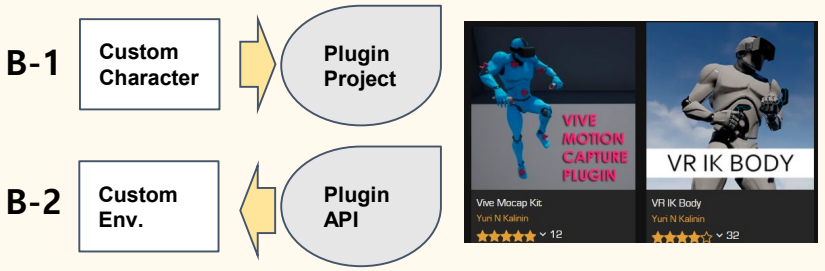
Plan A

- IKinema Orion
  - Complete functions
  - Acquired by Apple in 2019

ORION by IKinema

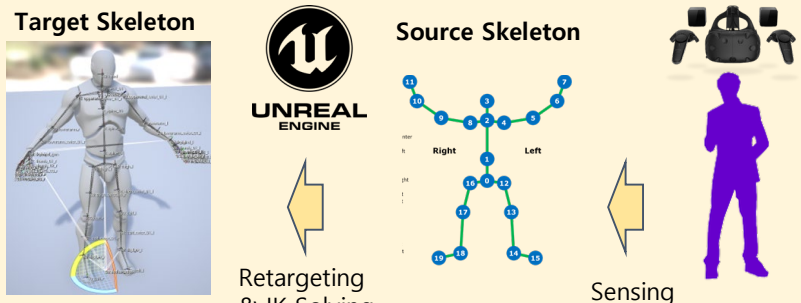
Plan B

- Other UE4 Plugins
  - (ex) VRMocap,IKBody
  - limitations in functions



Plan C

- Our own Plugin using UE4 API
- R&D Resources!



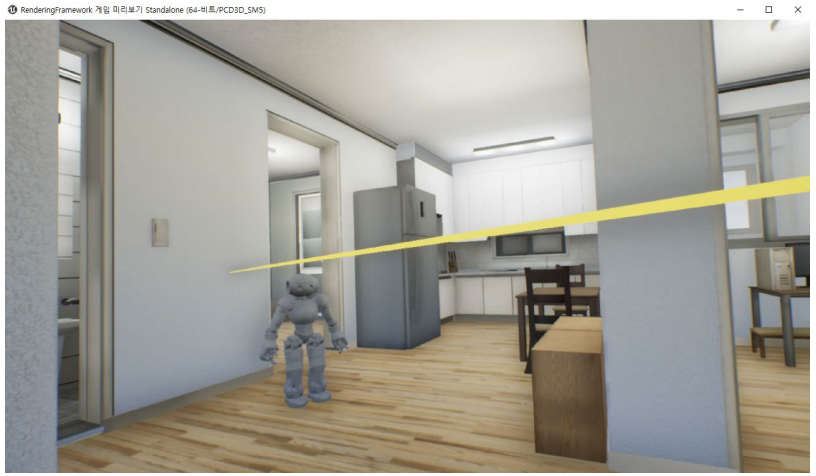
Progress - Videos

Static Virtual Environment

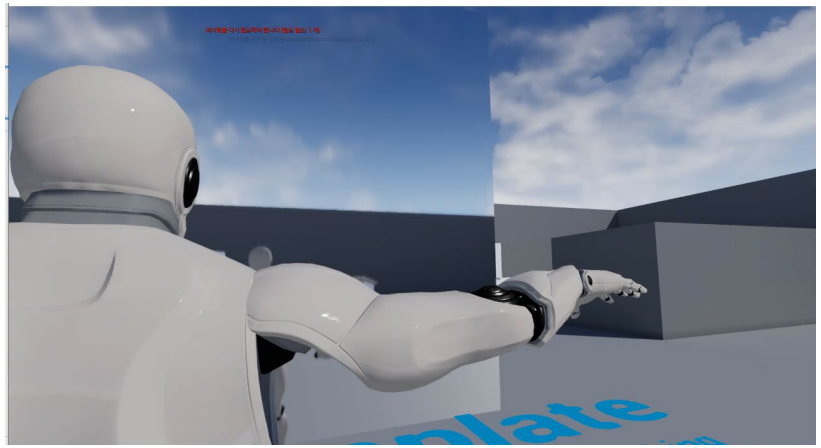
Project AIR/KIST, 2019

VR Based Environment

- Possession



- Retargeting



- Motion capture

- Deep learning

Future Works

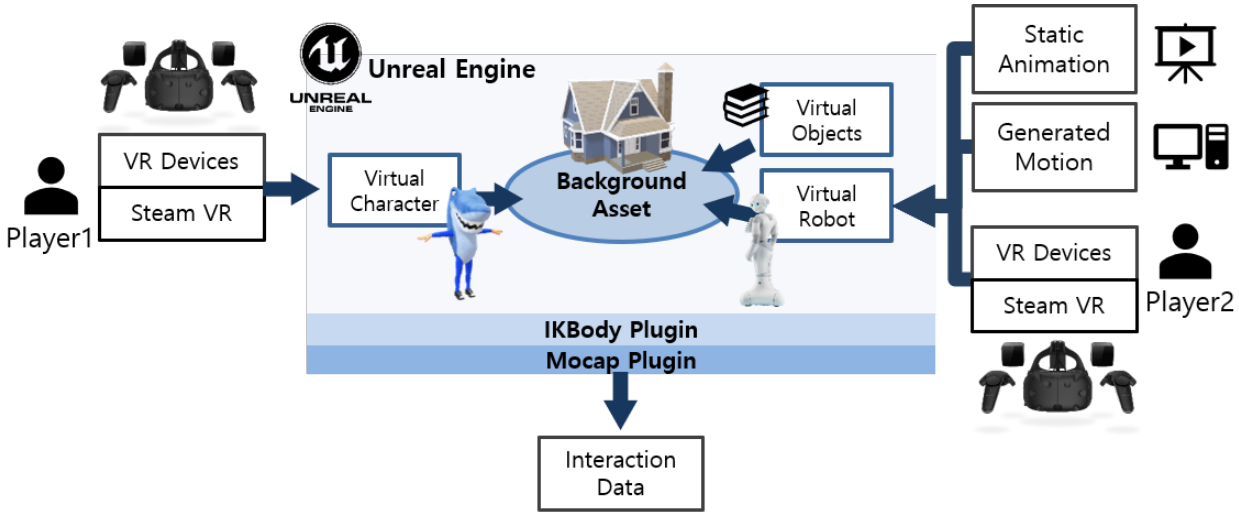
1. Overcoming **implementation** bottleneck

   (ex) custom plug-ins for retargeting/motion capture

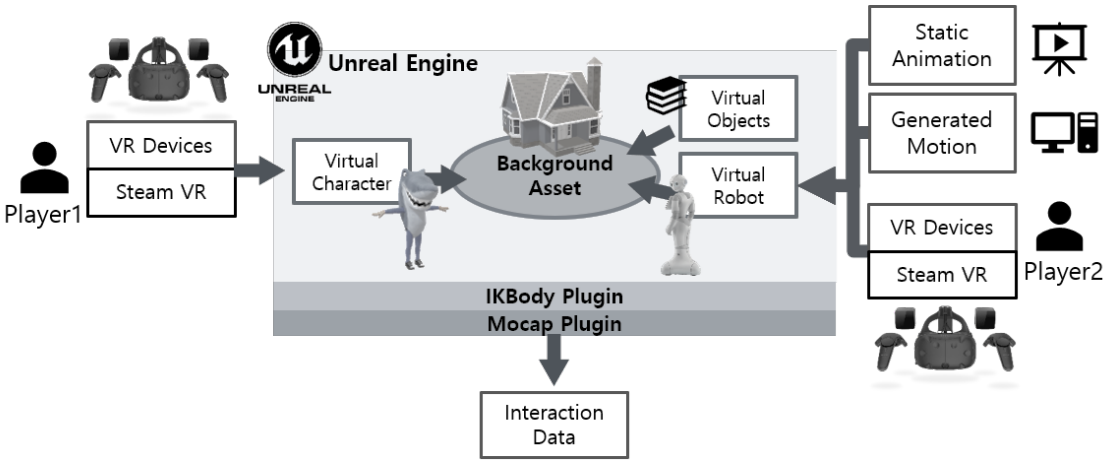
2. **Generation** of dataset from our VR-based HRI data acquisition environment

3. **Application** in deep learning for various HRI tasks

   (ex) Project AIR



Q&A


Unreal Engine
UNREAL ENGINE
VR Devices
Steam VR
Player1
Virtual Character
Background Asset
Virtual Objects
Virtual Robot
IKBody Plugin
Mocap Plugin
Interaction Data
Static Animation
Generated Motion
VR Devices
Steam VR
Player2

ACKNOWLEDGMENT

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